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Agricultural and Food Industry

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Preface

Rajamangala University of Technology Suvarnabhumi, in associating with National Research Council of Thailand, Upper Northern Research Network, Office of the Higher Education Commission, Office of the Minister-Ministry of Science and Technology, and Other eight Rajamangala Universities of Technology, organized the 6th Rajamangala University National Conference with the title of "Technology and Innovation toward ASEAN" during 23 – 25 July 2014. The purposes of this conference are to provide an opportunity to present researches, technologies and innovations to society, bring together researchers and scholar for learning sharing, discussing, and forming research network. This could direct the development and creation of research which ultimately lead to the economic and social development of the country.

This conference proceeding has collected full research reports from both oral and poster presentations that

presented at the 6th Rajamangala University National Conference. All articles were double-blind peer reviewed by professional committees in each field before accepting. We hope that this proceeding will be useful for learning and referencing in academic purpose.

On behalf of the conference organizer committee, I would like to express gratitude to researchers and scholars whom sent articles for presenting. I thank all participants for their sharing experience and opinion which helpful for research development. In addition, I feel gratitude the assistance of reviewer committees for their qualified article evaluation. The commitment and dedication from conference organizer committee is also my appreciation. Finally, I thank all firms and sponsors for co-hosting this conference.

Associate Professor Dr. Kitti Boonlertnirun

Editor

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Is Amodel Sculpture Crucial When Crieating a Sculpture?

Chaichan Jantasri[1*]

Abstract

The objective of this research project is to study whether a model sculpture is crucial when creating a sculpture. The finding will enhance the improvement of the course syllabus in sculpturing field at POH-CHANG Academy of Arts, Rajamangala University of Technology Rattanakosin. The tools used in collecting the data was two questionnaires each containing two parts. Part one asked about the autobiography of the selected sculpture experts; the other part described comments of the freelance sculptors and experts who have expertise in sculpturing and who teach sculpturing art.

The research results show that the comments received from the academics, teachers and freelance sculptors are all relevant; that is a model sculpture is crucial when creating a sculpture, scoring 91.67%, and a small-scale model sculpture is also needed before making a sculpture, scoring 95%. The reason is a model sculpture helps define the targeted piece of art for the sculptor. It interprets and illustrates the sculptor's imagination. It also facilitates the alteration, if any, for any mistakes can be seen and corrected in the model sculpture before the start of the sculpture. This is helpful for both the sculptor and the hirer. The model sculpture not only represents the planned sculpture but also assists the sculptor to achieve the work better. This is relevant to Mr.Komsun Kumsingha's interview which stated that model sculptures helped him calculate labor and equipment costs involved as well as make a more precise time frame for his hirer, which is considered as valued added and means for sculptors' reputation.

Keywords : sculpture, model sculpture, mold

Introduction

The evolution of the works of sculpture in Thailand is happened constantly.The research on archaeological discovery have been widely conducted such as many valuable sculptures of ancient archaeological sites including Dvaravati, Srivijaya, Lopburi Chiang Saen, UThong, Sukothai and Ayutthaya. It is considered that those sculpture works are seen as the cultural heritage which ancestors have created consecutive succession down from generation to generation. Works of sculpture in the past which were seen as valuable to the history, archeology, philosophy, culture and way of thinking made the people aware of the environment, way of living, religion, economic society and politics, etc.

Her *Royal* Highness *Princess* MahaChakri *Sirindhorn*has strongly paid attention to cultural heritage with the perseverance and intelligence in performing royal duties in disseminating and promoting the conservation of cultural heritage in all aspects of continuous effort. Her royal grace appears to be apparent at any time. All artists and inhabitants nationwide can well realize this point. Work of sculpture is an art in key branch of the fine arts and visual arts that has been used to inspire and encourage human society for so long from the prehistoric time to the present. The sculpture is the work that requires skills

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and imagination with the combination of art and then it has been converted into a 3D shape which is the complex process and difficult step to learn. At present various sculptures are also acceptable from society and market but lack of good creative craftsmen. Sculpture works of sculptor nowadays are facing the problems with the decline of aesthetic quality, ignoring the importance of learning about the techniques and processes that have been used by the teachers and then passed them down generation to generation. Especially, in the field of sculpture works, operation must go through processes such as data collection, designing and sketching, modeling, making sculpture actual size, printing, and casting, assembling parts and decorating and painting works respectively. Sculpting model based on draft which was designed as the line is considered very significant step of creating sculptures. Particularly, in the process to complete the sculpturing of the scale model before making the large size is considered extremely important to create sculptures. However, students graduated the sculpture courses did not pay attention to the process and system of sculpture work as in earlier. As a result, creative works of sculpture is not beautiful and has not the correct proportions and visual aesthetics or quality as in the past. This may be the reason of the sculptors that tends to reduce costs and shorten the operation or it may be because the courses are taught nowadays. Besides, this reason also includes teachers and art institutions do not pay attention to the process to complete sculpting miniatures before being enlarge the size of the actual sculpting. Because of the above mentioned issues, students or graduates from sculpture field did not create good quality of sculpture work for the social service. If there is no solution, this may affect the quality of the creative arts for society and in the long time, it will affect the aesthetic value of art and the art market and economy in the future. From above mentioned issues, this research needs to be conducted to improve the curriculum and learning methodology in order to make sculpture work to be keep up with the progress and need of society. This is the source of the problems in this research.

Objectives

2.1 To study whether a model sculpture is crucial when creating a sculpture.

2.2 The finding will enhance the improvement of the course syllabus in sculpturing field at POH-CHANG Academy of Arts, Rajamangala University of Technology Rattanakosin.

2.3 The results of the research will be publicized at a conference or journal.

Methodology

1. Population and Sample

The respondents are the population who have knowledge with expertise in sculpture field and have to graduate at least bachelor degree majoring in sculpture. They have to be on duty or employed in the field of sculpture at least 15 consecutive years. They need to be recognized or known as the artists in

the field of sculpture in the country such as national artist, freelance artist, sculptors, academics, teachers and retired government officials.

The sample of 60 respondents is divided into two groups and each group comprises of 30 respondents as follows:

Group 1 comprises of 30 academics and teachers who do sculpture activities along with teaching art in schools, colleges, universities around the country which are well-known art in the sculpture at least 15 years.

Group 2 comprise of 30 freelance sculptors and free lance artists employed in the field of art sculpture, with the qualification of bachelor degree in art from various institutions together with the consecutive experiences in sculpture work not less than 15 years.

2. Research Instrument

The tools used in collecting the data was two questionnaires each containing two parts. Part one asked about the autobiography of the selected sculpture experts; the other part described comments of the freelance sculptors and experts who have expertise in sculpturing and who teach sculpturing art.

3. Data Collecting

In this study, researcher has collected data from a sample of the experts, academics, teachers, sculptors, artist, and freelance sculptors. The sample of 60 respondents is divided into two groups and each group comprises of 30 respondents: a group of academics and teachers who do sculpture activities along with teaching art in schools, colleges, universities around the country which are well-known art in the sculpture field at least 15 years, and a group of freelance sculptors and free lance artists employed in the field of art sculpture, with the qualification of bachelor degree in art from various institutions together with the consecutive experiences in sculpture work not less than 15 years. The data have been collected as follows:

3.3.1 Contact the 60 experts or experienced people who have knowledge of the sculpture as it is defined such as academics, teachers, freelance sculptors and freelance artists nationwide.

3.3.2 Ask for the official correspondences from Rajamangala University of Technology Rattanakosin, Poh Chang Academy of Arts and deliver them to experts, scholars, teachers, artists and freelance sculptors who are the main targets for collecting data to ask for permission and assistance in data collection process.

3.3.3 In case the respondents are doing duties in organizations, researcher has to submit official correspondences to the administrators to ask permission for filling questionnaires or conducting interviews. (Only for a sample group of experts, academics, teachers who are in organization).

3.3.4 The researcher has collected data by hiring, sending questionnaires to the respondents by mail or by hiring the legal person by mean of commutation. Some of questionnaires have been collected by the researcher himself.

3.3.5 In the data collection process, the researcher collected data from 60 questionnaires. Then the data were all classified into information in each item and then written in a narrative summary.

3.3.6 Summarize and write the research report

4. Data Analysis

The researcher analyzed data from questionnaires step by step, starting with writing the narrative report, describing an each item and writing a summary overview of each respondent.

Conclusions

From the 60 respondents of experts, academics, teachers, artists and freelance sculptors, it is found that the respondents provide similar and relevant information. The researcher as summarized and written report on the following topics.

4.1 In the sculpturing process, do you agree whether it is necessary to sculpt the small- model before making a sculpture? The comments received from the academics, teachers and freelance sculptors are all relevant; that is a model sculpture is crucial when creating a sculpture, scoring 91.67%.A model sculpture helps define the targeted piece of art for the sculptor. It interprets and illustrates the sculptor's imagination. It also facilitates the alteration, if any, for any mistakes can be seen and corrected in the model sculpture before the start of the sculpture. This is helpful for both the sculptor and the hirer. The model sculpture not only represents the planned sculpture but also assists the sculptor to achieve the work better. A model sculpture is a way to solve the problem of composition of art, providing the sculptures with beautiful and perfect sculpture works which are consistent with three-dimensional shape as desired. It is also a way of finding a shaped structure to assist in the calculation and expansion of the sculpture work in order not to make the mistakes. The model sculpture can be compared with the compass used for indicating all work processes before creating sculpture work. It can also reduce mistakes in the process of sculpture work. The model sculptures can help the sculptor calculate labor and equipment costs involved as well as make a more precise time frame for his hirer. This is considered as the value added for sculptors' reputation.

4.2 The advantages of sculpting the model sculpture before making the real sculpture are as follow. With the model sculpture it is easy to expand the size defined in the model and helps in extending of the large structure with the right ratio without any mistakes. When enlarging the model into the real one, the sculptors will not be concerned about the ratio, because they have corrected the model, making the sculptors to complete their work faster. Assistant or apprentice sculptor team will have a better understanding about sculptures, having confidence, no reluctance and wasting no time in forming as well

as working without mistakes. Model sculpture reduces the problems that will arise in the composition of art such as shape, mass, volume, line, space and surface etc., including views on a piece of sculpture. This is a way of studying the structure of piece of work to find out the weaknesses and it can be used as a prototype in order to create the sculpturing quickly and easily. Making model sculpture enables the sculptors to analyze and calculate wages, material and equipment, duration of the operation, at the same time, save time, material and equipment cost, and various budgets. The model sculpture is considered as an operational simulator before the actual work is done. This is to determine the problems and find solutions.

4.3 The disadvantage of a small model sculpture before molding a works of sculpture are as follows. If the sculpture creators do not make the model sculpture, it will adversely affect the operation and make the process delay. The sculptors may encounter obstacle, have to repeat work for solutions, waste their time and cause mistakes and damages over time. If there is only a sculptor who knows the model sculpture, it will result in lacking of assistance from the apprentice sculptor team in case the problems arise. The sculpture team will not believe in a sculptor because the lack of a model used to guide the measurement, making procedures and patterns unclear. When making real sculpture, there may be high mistakes, wasting times to make correction. There may also be bad job elements, resulting to the incomplete works of sculpture based on the beauty and artistic value, including the lack of reliability from inspectors, hirers and general persons who may see those sculpture work sunder standard with the carelessness and ignorance the step and theory, making the overview of the work operation complicated. Calculating the cost of material and equipment, labor and other expenses as well as the duration of work without model will result to the mistakes in calculating the structure on mass, volume, shape and story including the composition of arts. This also makes impact on the expansion of sculpture into the actual size. The desired shape of sculpture may be distorted, causing the problems during the operational process and making impact on the emotional state. It may cause some changes in the purpose of the sculpture as set, affecting the management of sculpturing process.

4.4 Why did not the young generation sculptors create the model sculpture before creating the sculpture work? This is because of lacking of time, making it fast, being incumbent and careless, overlooking the importance of the model sculpture, lacking of experiences, skills and carefulness. Besides, it is because they need to reduce the steps of work, the cost of materials and equipment and the duration of work as well as the lack of ideology of the sculptors. The concept of a new generation combined with the lifestyle of people nowadays is highly competitive and urgent. The high cost of living also makes them selfish, resulting to the lack of well training and discipline. The entrepreneurs and hirers of work of art have high competition to produce goods for export. Therefore, they want to reduce the cost and duration of the operation. These causes the sculptors have to run their work quickly, resulting to the reduction of model sculpture process. The government education institutions and the instructors do not

focus on the lesson plan because of lacking of sufficient time or not paying attention to model sculpture before making it into the actual size. Therefore, it can be considered that it depends on the institutions has provided knowledge based on the theory or not. The young generation sculptors are confident with new technology, computer-aided design and photo retouching software. As a result, the new generation does not want to run the model.

4.5 From the experiences of experts, scholars, teachers, artists, freelance sculptors who are the respondents, it is considered that the model sculpture is the most important, scoring 95 % as summarized below.

4.5.1 The model sculpture is considered to have been created from the imagination conveying ideas and making meanings into three-dimensional art. Several times of revisions have been done until the work is complete. It can do well in calculating of various costs, labor, materials and equipment as well as duration of work.

4.5.2 The model sculpture process is a way of operation plan using the model for visualizing the structure of work, understanding the size of the sculpture portion in order that it will not be distorted and reducing mistakes. Those mistakes can be corrected in time before allowing us to study and analyze before molding it. With the process mentioned, the sculptors can effectively complete their works and produce the perfect prototype of sculpture.

4.5.3 The model sculpture is like a simulation which is a way of creating work from the actual, enabling the sculptors aware of the problems of the created works, analyzing the problems as well as finding way to solve the problem beforehand. The model sculpture can be seen as a compass for the operation process which can help sculpturing teams to visualize work clearly and complete work on time, not waiting for the chief to monitor the operation process over time. Using the model sculpture can help the sculptors to present their works to the clients easily because they can visualize the real model beforehand before making decision. It also helps build up confidence to the sculpturing team. No great artist or sculptor created the model sculpture without creating sculpture.

4.6 The experiences of experts, scholars, teachers, artists and freelance sculptors towards the small model sculpture can summarized as follows. The model sculpture is the process of bringing imaginative ideas and principles of visual elements into the perfect composition in order to make the work to meet the perfect beauty at all aspects. It also shows the aesthetic value of the visual arts to fulfill imaginative ideas and can be corrected and modified before operation. The model sculpture model will be used as the prototype to correctly expand the model into a large piece of work. The sculptors can understand every part of components such as structure and anatomy of work. The model sculpture is like a compass, directing the plan, direction and duration of work precisely. It can also be as an instrument to evaluate the internal structure of shapes and estimated various costs such as labor cost, materials and equipments, location and duration of the operation.The model sculpture can make the hirers or customers

can see the initial image of work before extending it into the actual size. It helps the sculptor team or assistants understand the work process easily. As a result, it can support the sculpture in operate the work effectively and easily and divide work to the others.The model sculpture has small size which can be easily moved to show in a limited area.

Discussions

Results of this study have been discussed as follows:

5.1 Is a model sculpture crucial when creating a sculpture? The research results show that the comments received from the academics, teachers and freelance sculptors are all relevant; that is a model sculpture is crucial when creating a sculpture, scoring 91.67%.Everyone has given the same answers and reasons, that is to say, the aim needs to be clearly defined for the creative prototype whichrelevant to the interview of Nikorn Chotchapong, Chamrueng Wichiankhet and Wichai Sitthirat. A model sculpture helps define the targeted piece of art for the sculptor. It interprets and illustrates the sculptor's imagination. It also facilitates the alteration, if any, for any mistakes can be seen and corrected in the model sculpture before the start of the sculpture. This is helpful for both the sculptor and the hirer. The model sculpture not only represents the planned sculpture but also assists the sculptor to achieve the work better. This is relevant to Kran Kunchasin, Ariya Kitticharoernwiwat and Prasopsuk Ratmai's interview. The model sculpture not only represents the planned sculpture but also assists the sculptor to achieve the work better. A model sculpture is a way to solve the problem of art compositions, providing the sculptures with beautiful and perfect sculpture works which are consistent with three-dimensional shape as desired. This is relevant to Sopit Phuttarak, Chalerm Wiset ,Kittikorkn Bamroongboon and Sompop Kongchainamsakul's interview. It is also a way of finding a shaped structure to assist in the calculation and expansion of the sculpture work in order not to make the mistakes. This is relevant to the interview of Prasopsuk Ratmai, Kran Kunchasin and Somkuan Imtakul.The model sculpture can be seen as a compass for the operation process which can help sculpturing teams to visualize work clearly and complete work on time and reduce mistakes in the work process.This is relevant to the interview of KomsanKamsingha.Making model sculpture enables the sculptors to analyze and calculate wages, material and equipment, duration of the operation, at the same time, save time, material and equipment cost, and various budgets.It also used as a tool to present work to the hirers and create a positive image or value added. This help make a significant step in the operation of work of the creators or sculptors. This is relevant to the interview of Prasert Wannarat and Pitak Chalermlao.

5.2 From studying the advantages of model sculpture before making the real sculpture, it is found that making the model sculpture makes it easy to expand the size defined in the model and helps in extending of the large structure with the right ratio without any errors. When enlarging the model into the real one, the sculptors will not be concerned about the ratio, because they have corrected the model, making the sculptors to complete their work faster. Assistant or apprentice sculptor team will have a

better understanding about sculptures, having confidence and no reluctance and wasting no time in forming together with working without mistakes. This is relevant to the interview of Prsopsuk Ratmai, Riharn Opas, Peerapong Duangkeaw and Ben Sadonram. Model sculpture reduces the problems that will arise in the art compositions such as shape, mass, volume, line, space and surface etc., including views on a piece of sculpture. This is the way of studying the structure of this piece to find out weaknesses and can be used as a prototype in the sculpturing quickly and easily. Making model sculpture enables the sculptors to analyze and calculate wages, material and equipment, duration of the operation, at the same time, save time, material and equipment cost, and various budgets.The model sculpture is considered as an operational simulator before the actual work in order to determine the problem and find solutions. This is relevant to the interview of Pradap Temdee, Komsan Kamsingha, Prasert Wannarat and Suwitchai Uttha. The disadvantage of a small model sculpture before molding a works of sculpture are as follows. If the sculpture creators do not make the model sculpture, it will adversely affect the operation and make the process delay. The sculptors may encounter obstacle, have to repeat work for solutions and waste their times together with causing a mistake and damage over time. If there is only a sculptor who knows the model sculpture, it will result in lacking of assistance from the apprentice sculptor team in case the problems arise. The sculpture team will not be confident to a sculptor because the lack of a model used to guide the measurement, making procedures and patterns unclear. When making real sculpture, there may be high error, wasting times to make correction. There may also be bad job elements, resulting to the incomplete works of sculpture based on the beauty and artistic value, including the lack of reliability from inspectors, hirers and general persons who may see those sculpture works under standard with the carelessness and ignorance the step and theory, making the overview of the operation complicated. This is relevant to the interview of Somchai Thaothong, Prasert Wannarat, Komsan Kamsingha, Somyos Youngtaland Wichai Sitthirat. Calculating the cost of material and equipment, labor and other expenses as well as the duration of work without model will result to the mistakes in calculating the structure on mass, volume, shape and story including the composition of arts.This also makes impact on the expansion of sculpture into the actual size. The desired shape of sculpture may be distorted, causing the problems during the operational process and making impact on the emotional state. It may cause some changes in the purpose of the sculpture as desired, affecting the management of sculpturing process. This is relevant to the interview of Riharn Opas, Ariya Kitticharеonwiwat, Prasert Wannarat and Nopadol Suwannasombat.

5.3 From the experiences of experts, scholars, teachers, artists, freelance sculptors who are the respondents, it is considered that the model sculpture is the most important, scoring 95 %. The model sculpture is considered to have been created from the imagination conveying idea and making meanings into three-dimensional art. Several times of revisions have been done until the work is complete. It can do well in calculating of various costs, labor, materials and equipment as well as duration of work. This is

relevant to the interview of Sopit Phutharak, Prasert Wannarat and Komsan Kamsingha.The model sculpture process is a way of operation plan using the model for visualizing the structure of work, understanding the size of the sculpture portion in order that it will not be distorted and reducing mistakes. Those mistakes can be corrected in time before allow us to study and analyze before molding it. With the process mentioned, the sculptors can effectively complete their works and produce the perfect prototype of sculpture. This is relevant to the interview of Ariya Kittichareonwiwat and Suwitcha Uttha.The model sculpture is like a simulation which is a way of creating work from the actual, enabling the sculptors aware of the problems of the created works, analyzing the problems as well as finding way to solve the problem beforehand. This is relevant to the interview of Prasop Sukratmai and Kanet Samudhaya.The model sculpture can be seen as a compass for the operation process which can help sculpturing teams to visualize work clearly and complete work on time, not waiting for the chief to monitor the operation process over time. This is relevant to the interview of Komsan Kamsingha, Prasert Wannarat and Sompop Kongchainamsakul. Using the model sculpture can help the sculptors to present their works to the clients easily because they can visualize the real model beforehand before making decision. It also helps in building up confidence to the sculpturing team. No great artist or sculptor created the model sculpture without creating sculpture. This is relevant to the interview of NonthiwanChantanaphalin and PrasertWannarat.

Suggestions

3.1 Suggestions received from the findings.

3.1.1 In terms of teaching and learning process, educational institutions should focus on improving the curriculum, encouraging the teaching a model sculpture continuously in order to provide the knowledge and ability for the learners to create the value of sculptures. The art teachers of all educational institutions for academy of art should ask the learners to understand the importance of creating a model sculpture coupled with practicality, not skipping this step. The learners have to be informed of the benefits of this step. If there are any mistakes, it can also be immediately solved and corrected. It is essential that teachers must help create sculptural attitude towards this profession even more.

3.1.2 In term of essentiality and importance, the model sculpture does not only display the value of beauty inside itself but also help create and achieve the sculptural works precisely and clearly. All the problems and mistakes can be seen and corrected in this step. Before making the sculpture, it is crucial to make a model sculptures in order to get the most perfect works. In the process of making a model sculpture, we should pay attention to finding information, devoting time and setting goal to the works as well as practicing the small instruments.

3.1.3 In term of the characteristics, the model sculpture is the way to convey imaginative ideas into three-dimensional shapes, expressing the shape of the structure by using the principle of

visual elements to help set the composition. It is seen crucial because it is served as a model for expansion ratios in large pieces. Without the model sculpture, the sculptors may take a lot of time to create the work with confusion, reluctance and unclearness.

3.1.4 In term of heirs and enterprises, some of the enterprises or employers nowadays want to reduce costs and time to produce pieces of works to the market faster, preferring the sculptors to skip the step of making model sculpture.

As a result, the unqualified sculptural works are produced to market, making the art circles full of unvalued arts.

3.1.5 In term of computer, today's technology and online communication computers have playeda key role on almost every branch of art. Computer help make art with precision and fastness. Anyway, the beauty of the sculptures made by human looks charming rather than by computer

3.2 Suggestions on the next research.

3.2.1 The research should be undertaken further by using the results of this research.The next research should be the in-depth study in the course and classes up to the curriculum and teaching process.

3.2.2 The techniques, patterns and process of making the good quality of sculptural works should bestudied and discovered in order to help sculptors produce the works to meet the standard as set within the time period.

3.2.3 There should be the research on the enterprises and employers about the steps of making a model sculpture before making the sculptural works. This is to help them find out the fact whether a model sculpture is crucial to the process of making the sculptural work or not.

3.2.4 It is difficult to discover information on this field of study. This is because there is no related research, journals, and art books used as the reference. However, those problems can be solved by interviewing experts.

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This research is important to a model sculpture. It wouldn't be successfully achieved without the sacrifices of time and kindness of people from both government agencies and private sectors, includingsenior experts, specialist academics, teachers, sculptors, 60 independent artists that respondent questionnaires, the 5 experts reviewing the interview form and question, Hall of Sculpture, The 10th Regional Office of Fine Arts, Fine Arts Department, KhunSiripornJantasri as a research assistant, KhunSombatKongkamud as a typist of this research, Mrs. NathapornJantasri, a specialist teacher from Rachborpit School , Bangkok as the proof reader of Thai.

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Study the Sculpture Work of National Artist in Visual Art (Sculpture) to Apply in Creating the Work of Sculpture in Individuality Style

Chaichan Jantasri[1*]

Abstract

The research aims to study the works of sculpture of national artists in visual art (sculpture) in order to apply them for creating the sculptural works in individual style from the past to the present (2011)in term of creative applications, subtractive shapes as well as process, content, structure and form, line, texture, volume, mass, space, rhythm and direction. The results of the research can be beneficial to an application of designing and creating the new work of sculpture in individuality style, can help in producing academic documents conveying the new body of knowledge, can apply them to the creative application of works of sculpture in individuality style and also help in creating 7 pieces of work of sculpture in individuality style in order to display and publicize those works in the conferences and use them for decorating the areas at Rajamangala University of Technology Rattanakosin. Tool used to collect data is the satisfaction questionnaire about the sculptures of the 50 national artists in visual art (Sculpture). The samples used in this research are the 50 specialists in the field of sculptures as the respondents of the questionnaires. The results show that the works of sculpture of national artists in visual art (sculpture) from the past to the present (B.E.2554) are created intermofcreativeapplications, deductive or subtractive as well as process, content, structure and form, line, texture, volume, mass, space, rhythm and direction and have the prominent visual elements. The composition of art has been set up with the same range of consistency, sorting from descending order. The sculptural works are delicate, firm, smooth and shiny together with the distinctive mass and volume. The curve line has been used to create the creative works more perfectly. The nature and direction of the rhythm have been applied to the creative works of sculpture causing the expression of prominent rhythm and direction. The external shape of an oval form has been applied to the creative works of sculpture to make them more gorgeous and perfect. The space has also been applied to this sculptural works. The results of the research can be applied in creating 7 pieces of sculptural works in individuality style, and can be used in producing academic document for the creative application of sculptural work in individuality style and used for decorating the campus.

Keywords : Sculpture, National Artist, visual art, Individuality Style, creative

Introduction

The cabinet passed a resolution on 26 February 1985to declare the 24 February of each year as National Artist Day to commemorate King Loetla Nabhalai's birthday. Therefore, to promote the artists to follow in the footsteps of *His Majesty the King* and to honor and confer those individuals who create works of art to be appeared to the public's, Office of the *National Culture Commission* has selected the artists' master piece of art based on criteria of the national artist and then declare and confer those artists as national artists. This type of selecting process has been performed annually. National artist is the one

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who creates good quality of works and publicizes them continuously. Those work sare of good quality up to national level and have been declared and conferred as a national artist by the National Commission for Culture. The national artist award has been conferred by the National Commission for Culture for 26 years since 1985 to the present (2011). There are more than 200 artists who has been conferred this award and declared as the national artists by the National Commission for Culture. The researcher knows that a lot of artists in the field of visual art (Sculpture) are among those national artists. Everyone has created the distinctive, creative and unique work depending on their knowledge, skills, experiences and inspiration.Such works are very interesting and should be studied and conducted research. The researcher would like to study the content, structure of form,mass and volume, line, surface,space, rhythm and direction in order to apply body of knowledge from this research to create sculptural work in individual style. In addition to the honor of publishing history and works of national artists, the research also hopes that this research is a way of studying concepts and the process forms of art with the unique of each artist and can be beneficial to those studying the culture. Itis also seen as one of the inspirationof those interested in creating creative works of art in the future. According to the evidences, this type of research has never been done before. The researcher hopes that, by doing research, there will be the academic papers full of the application of new body of knowledge which is helpful to create unique sculptures. The results of this research can be applied in designing the sketch for creating the 7 creative sculptures in individual style. Those

Objectives

2.1To study the works of sculpture of national artists in visual art (sculpture) in order to apply them for creating the sculptural works in individual style from the past to the present (2011)in term of creative applications, subtractive shapes as well as process , content, structure and form, line, texture, volume, mass, space, rhythm and direction.

2.2 To design and create the new work of sculpture in individuality style.

2.3 To produce academic documents conveying the new body of knowledge and apply them to the creative application of works of sculpture in individuality style.

2.4 To create 7 pieces of work of sculpture in individuality style in order to display and publicize those works in the conferences and use them for decorating the areas at Rajamangala University of Technology Rattanakosin.

Methods

1. Population and Sample

The population in this research is the literate people in the field of sculpture and the teachers who teach the art of sculpture in universities around the country with a minimum qualification of bachelor degree insculpture and have experiences in teaching sculpture or sculptural subjects continuously.The

samples used in this research are the 50 specialists in the field of sculptures and teachers teaching the art of sculpture in universities around the country with a minimum qualification of bachelor degree insculpture and have5 years of experiences in teaching sculpture continuously.The artists whose works are participated in this research have to be declared as a national artist in visual arts (Sculpture) from the year 1985 to the present (2011) in the field of creative application of abstract or semi-abstract art only.Works of national artists in this research require various specificationsin term of creative applications and deductive or subtractiveshapeof the realistic arts to make the abstract and semi-abstract sculpture.5-10 photos of works of sculpture of each national artist have been selected and used as questionnaires. The specialists then select 5-10 of photos of sculptural works to serve this research.The selection processes are based on the various aspects, for examples, well known in artistic circles, award winning, used as reference, publishedinpapers, books, academic papers, articles and researches. The works of sculpture of 50national artists, as the specialists, are summarized and weighted for the highest score. Then one of highest score work of each national artist is analyzed based on the criteria set. Researcher thenstudies the content, form, structure, shape, line, surface, area, volume, mass, space, rhythm and direction only. The work of sculpture in individuality style refers to the new creation created by the researcher based on results from this study combined with the identity to design and create new 7 pieces of sculptural work. Those works are sculptures in the round or round relief with the size 50-80 cm, made of fiber glass which is seen as the durable material for casting.

2. Instruments

Tools used for data collection are the questionnairesconcerning satisfaction towards the sculptures of national artistsin visual arts (Sculpture).

3. Data Collecting

1. Study and search information from the related theories.

2. Collect the photos of sculptural work of national artists in visual arts (Sculpture) in the creative application in term of both abstract and semi-abstract art.

3. Determine and design the way of conducting research, distribute and collect questionnaires of the photos of sculptural work of national artists, teachers, academics and specialists in the field of sculpture across the country.

4. Summarize and analyze the questionnaires about the photos of sculptural work and then select one of the best work of each national artist (1 piece) created in term of creative application both abstract and semi- abstract art.

5. Analyze the photo sculptures of national artists based on the criteria set and summarize it and write the report.

6. Design work of sculptures in individual style by relying on results of writing report about the sculptural works of national artist.

7. Select sketch and model.

8. Enlarge the sketch and create sculptures in individual style.

9. Make painting sculpturesin individual style.

10. Mold the sculptures in individual style.

11. Assemble and join each sculpture part and decorate the sculptural work in individual style.

12. Paint and glaze the sculptural work in individual style.

13. Write academic paper in individual style of sculptures and summarize it.

4. Data analysis

The results of this can be summarized as follows:

1. Find the frequency and percentage of the questionnaires.

2. Summarize the frequency and percentage in order to find the one of the photo of sculptural work of the national artist that has the highest score of frequency and percentage.

3. Analyze the photos of sculptural work based on the criteria and write the report.

4. Use the results of writing report about the sculptural works of national artist to design work of sculptures in individual style.

Conclusions

From the study, the highest score of the frequency and the percentage of sculpture work of national artists can be summarized as follows:

Sculpture work of Mr. PaitoonMeungsomboon named KayakamNo.4(Acrobatic No.4) is 20 %.Sculpture work of Mr.ChitRianpracha named Rammana (Tambourine) is 46%.Sculpture work ofMr.PimanMoonpramook named Sansan (Creative) is 56 %.Sculpture work of Mr. ChamreungWichiankhet named Klum (Group) is 34 %. Sculpture work of Mr. ChaloodNimsamer named Ongsam(PodDuang money) is 30 %.Sculpture work ofMr. InsonWongsam named Prisana (Puzzle) is 32%. Sculpture work of Mr. NonthawatJantanaphalin named Samathi (Meditation) is 36 %. The researcher has summarized results of the analysis of the overall sculpture works of the 7 national artists and has put them in order based on the importance, concept and duplication of their works in descending order. The visual elements have been used for creating their sculpture works and making their works more distinctive and beautiful as follows:

1. The sculpture works of 7 national artists are distinctive and unique and texture of the sculptures is, taut, glossy, smooth, firm and glazed.

2. 6 of 7 of national artists- Mr.Paitoon Meungsomboon, Mr.Chit Rianpracha, Mr.Pimarn Moonpramook, Mr.Chamreung Wichiankhet, Mr.Chalood Nimsamer and Mr. NonthawatJantanapalin -

have applied mass and volume increating the works of sculptures in order to make their works more beautiful. Therefore, their works of sculptures are featured on the mass and volume.

3. 6 of 7 of national artists - Mr.Paitoon Meungsomboon, Mr.Chit Rianpracha, Mr. Pimarn Moonpramook, Mr.Chamreung Wichiankhet, Mr.Chalood Nimsamer and Mr. Nonthawat Jantanapalin- have applied curve lines in creating the works of sculptures in order to make their works more beautiful. Therefore, their works of sculptures are featured on curve line.

4. 6 of 7 of national artists - Mr.Paitoon Meungsomboon, Mr.Chit Rianpracha, Mr.Pimarn Moonpramook, Mr.Chamreung Wichiankhet, Mr.Chalood Nimsamer and Mr. Nonthawat Jantanapalin- have applied rhythm and direction increating the works of sculptures in order to make their works more beautiful. Therefore, their works of sculptures are featured on rhythm and direction.

5. 5of 7 of national artists- Mr.PaitoonMeungsomboon, Mr.ChitRianpracha, Mr.PimarnMoonpramook, Mr.ChamreungWichiankhet and Mr.ChaloodNimsamer – have applied the oval and circular shapes increatingthe works of sculptures in order to make their works more beautiful.

6. 4of 7 of national artists - Mr.PaitoonMeungsomboon, Mr.ChitRianpracha ,Mr.ChaloodNimsamer and Mr. InsonWongsam - have applied space in creating the works of sculptures in order to make their works more beautiful. Therefore, their works of sculptures are featured on space.

Discussions

The results show that the works of sculpture of national artists in visual art (sculpture) from the past to the present (2011) are created intermofcreativeapplications, subtractive shapes as well as process, content, structure and form, line, texture, volume, mass, space, rhythm and direction and have the prominent visual elements.The sculptural works of national artists can be discussed as follows:

1. **Mr.PaitoonMeungsomboon**

The contents of story are conveyed through the sculptural work called "KayakamNo.4" (Acrobatic No. 4), focusing on anatomy of human body while doing acrobatic or gymnastics *in* a back bendin order to get the oval shape, bending hands and feet touching one another at the back. Artist also takes into account of the real acrobatic, using the principles visual elements to apply in creating the composition of art. The external shape of this sculpture work is horizontal oval and most of lines in this sculpture are curved lines. The external texture of the form is smooth, firm, round and neat with no differences of mass and volume. The external texture is also firm, neat and has harmonic scale. The space is applied in creating this sculpture in order to make it softer, airy, and relaxing and also help in reducing the discomfort of the audiences. This work is featured in expressing rhythm and direction, making audiences feel the movement in direction of sculpture.

2. Mr.Chit Rianpracha

The contents of story are conveyed through the sculptural work called “Rammana” (Tambourine). The contents represent the rhythmic form of the human body that coordinates and related to the characteristics of Thai musical instruments. The artist conveys the feelings through a Thai musician, showing a slightly twisted manner of the body, with the hairs curling and blowing back, sitting with bent knees with Rammana (Tambourine) placing on the lap. The left hand is touching the edge of the drum while the right hand is placing on the surface of drum, showing lifestyle of playing while sitting of Thai musical instruments. The principles of visual elements are used for creating the composition of art in this work. The external form of the sculpture is vertical oval with unequal angles. This work is distinguished by the line and form. 95% of the lines in the sculpture are curved. The sculpture is distinguished in term of the external texture which is smooth, round and neat, showing the wood grain texture. The work has been featured in mass and volume. The volume is mixed together to make the sculpture have the unique mass which balances in all aspects. The space is applied in creating this sculpture in order to make it softer, relaxing, airy, and also encourage movement in and around the sculpture and help in reducing the discomfort of the audiences. This work is featured in expressing rhythm and direction that makes audiences feel the lively movement in and around the sculpture.

3. Mr.Pramook Moonpramook

The contents of story are conveyed through the sculptural work called “Sangsan” (Creative) concerning the speed. The creative artist attempts to describe and show the significance of speed, inspired by the artist’s imagination of the pilot and Garuda Phraya as the symbol of a fly. The creator applies those symbols in creating the sculpture based on subjective art form, using people wearing a flying suit and a hat with wings on the head. The principles of visual elements are used for creating the composition of art in this work. The external form, the front and rear angles of the sculpture are oval, but the side angle is the trapezoid, showing the modern technology of the machines. This sculpture is featured in the external and internal form, consisting of 60% of straight lines and 40% of cured lines. The characteristics of the texture of the sculptures are smooth with the flat, convex and round surface. Besides, the other outstanding characteristics of this work are mass and volume, combining into one mass with unity. The sculpted form has the balanced proportion in all aspects and views. The space does not play a key role in this sculpted form, making the form strong, stable and powerful. This work effectively demonstrates the rhythm and direction, with the lines, forms and the human face acting as the leader in displaying the rhythm and direction in order to represent the speed of movement.

4. Mr.Chamreung Wichiankhet

The contents of story are conveyed through the sculptural work called “Klum” (Group), inspired by the curved shape of woman body and impressed by the overlapping sea waves while approaching the

shore as well as the towering cliffs at Phukradung. The creator has included all three parts together into a single one, applying them in creating abstract shapes. The principles of visual elements are applied in creating the composition of art in this work, showing the characteristics of line which are the same in all angles and aspects. The structure of the external shape is vertical oval or rectangular. The prominent feature of this work is the line. The lines in this work are straight and curved lines showing the width and depth. The texture of this work is smooth, round and neat around the surface of the sculpture. The prominent features of this work are mass and volume. The volume is mixed together to make the sculpture have the unique mass which balances in all aspects. However, this work is not featured in using space to create the sculpture. The work focuses on the rhythm and direction and the regular iteration of lines and forms, making the sculpture beautiful and providing the strong, stable feelings as well as feeling grouping, harmony and unity.

5. Mr.Chalood Nimsamer

The contents of story are conveyed through the sculptural work called Ongsam(PodDuang money). The sculpture is inspired by the old Thai money from different periods called Pod Duang money. The money is applied in creating the composition of art, stacking the three coins atop one another and sealing them together to form the new shape of sculpture. It represents the stability, security and harmony, providing a sense of cooperation and reflecting the cultural aspects of Thailand. The principles of visual elements are applied in creating the composition of art in this work. The structure of external shape of this sculpture is vertical oval with the same width of the two sides. All sides of shapes are same. The sculpture is seen as the prominent one with the very beautiful lines. About 95% of the lines are the curved lines which are created based on mass and volume. The work is featured in the texture. The characteristics of the texture are flat, firm, glossy, round and neat. The mass and volume of the sculpture are very beautiful, joining together in unity. This sculpture has been created by perfectly using of the characteristics of space together with the balance and beauty. The work expresses rhythm and direction that makes audiences easily access to the beauty of arts.

6. Mr.Inson Wongsam

The contents of story are conveyed through form of sculpture named "Prisana"(Puzzle). This work emphasizes on conveying the imagination in mind and then paves the way to search for aesthetic ideals and long experiences. This can be said that it is seen as the pains of human beings when they have to eliminate their own skin covers. The more the skin covers are removed, the more beauty appears. The principles of visual elements are applied in creating the composition of art in this work. The work shows the differences when comparing with the other sculpture works. The width of the form can be seen when it is looked at the front and back sizes. The flat shape, no form, can be seen when it is looked at the left and right sizes. This sculpture work is featured in lines which can be seen as the main factors for creating

this work. The lines are curvedly woven back and forth like a maze, showing the ambiguous feelings and the endless confusions of the audiences. The texture looks flat, glossy, round and smooth with the wood grain textures. However, this work has a lot of weaknesses on the mass and volume. There seem to be a little of influence of mass and volume seen in this sculpture work when it is looked at the front and back sizes. The flat shape, no mass and volume, can be seen when it is looked at the left and right sizes. It is seen as the very prominent sculpture in term of space. The artist has effectively applied the space in this sculpture work, providing the significant benefits to this work. The work shows the vital untidiness of rhythm and direction, transferring weight of direction inside the external rectangular form. The direction moves back and forth like a maze without beginning and ending.

7. Mr.Nonthawat Jantanapaling

The contents of story are conveyed through form of sculpture named “Samathi” (Mediation). The artist focuses on describing the new attitude in mind based on form of the sculpture as a tool of communication language. The answers to life based on the Buddha's sermon are found by the artist. Walking on the path of Dharma will bring the light of wisdom. Sculptures will then be seen as the language forever. The principles of visual elements are used for creating the composition of art in this work. The external form of this sculpture is vertically built with a triangular pyramid shaped structure. The larger form is on the bottom and the smaller form is on top. This work consists of a large number of curve lines - around 95%. This sculpture has been featured in the texture, that is to say, it is taut, smooth, round and neat. Especially, this work is featured in mass and volume. The external form is taut with texture, expressing the mass and volume which shows the stability, calmness, power and great respect. This sculpture is not featured in space, only a narrow gap on both sides of the seam of palms. It seems that the artist intends to leave some implications of their work for the audiences to consider. The rhythm and direction in this work are not quite prominent. This is because the artist intends to express the peace; therefore, he reduces the significant role of rhythm and direction.

Suggestions

1 Suggestions received from the study

1) In searching some sculptural works, there is only sculpture photo but there is no real one.

2) The first generation of national artists always created less sculptural works by using the deductive or subtractive process.

3) Information of some national artists is not available. The published personal information of national artists is not enough. Besides, three of national artists in this study were dead.

4) The researcher should be careful about the appropriate time before conducting the research concerning a large amount of people.

5) Doing survey and experimental research requires much time and budget; therefore, the research project should be written carefully and concisely in term of the amount and duration of the research.

2. Suggestions for the next research

1) This type of research should be conducted further by using information from this study.

2) There should be in-depth research on national artists individually.

3. There should be a research on the famous artists and sculptors nowadays concerning the influences from the sculptural worksof national artistsin the field of visual arts (Sculpture).

4. There should be a research onnationalartistsin the field of visual arts (Sculpture)on the aspects of the influencesin creatingthe sculptures.

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Discontinuous Automatic Control of Simulated Controlled System for Undergraduate Control System Instruction

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Abstract

It is widely accepted that the on/off controller is not only inexpensive but it is also easy to use. Moreover, it is used in factories in general. In regards to the undergraduate instruction of Control System, however, this particular type of controller is not widely used as part of the instruction comparing to the PID controller. It is due to the limitation of the on/off controller in terms of its high level of error-value occurring in steady state and its problems of chattering. This paper demonstrates how to develop the on/off controller in decreasing both error-value occurring in steady state and the impacts from chattering. The 3 different methods are shown as follows: 1) the change of hysteresis width of the on/off controller, 2) the adaptation of the on/off mode to a 3-leveled on-off function by using two on/off controllers, and 3) the connection of the on/off controller with delayed feedback. According to the simulation results with the use of WinFACT program and the experiment on the simulated controlled system (PT1 and PT1T2), it shows that the error-value result at the steady state is decreased significantly in relating to variables, the hysteresis width, the number of levels of the on/off function and time constant value of the first order delay.

Keywords : on/off controller, simulated controlled system, WinFACT

Introduction

The discontinuous controller has more advantages than continuous type in regards of its cheaper price, ease of control, reliability and low frequency of maintenance. The discontinuous controller can be used with both open-loop and closed-loop control. Therefore, the discontinuous type of controller should be taught first in the Control System subject [1]. In addition, regarding the nature of a basic on-off function, its simple operation can make the students understand the basic control system much better. Despite its obvious advantage, the discontinuous controller has been looked over due to the limitations of the on/off controller that are possible chattering and the high level of error-value occurring in steady state resulting in the damage of the actuator.

The adaptation of the on/off controller is therefore necessary to enable the controller to have more quick but adjustable response, functioning somewhat like the continuous controller. The three different adaptation methods are as follows: 1) the change of hysteresis value of the on/off controller, 2) the adaptation of the on/off mode to a 3-leveled on-off function by using two on/off controllers, and 3) the connection of the on/off controller with delayed feedback [2].

In addition, For more advanced control theories such as Bang-Bang Controller and Sliding Mode [3], they have been developed from this simple on/off controller with state equations.

The purpose of this paper is to demonstrate the application of the on-off controller in control system. To understand the behavior of an on-off controller in various aspects, the WinFACT version 6.1.1.251 (Education) program is used to simulate all cases including 2-leveled and 3-leveled on-off function with PT1 and PT1T2.

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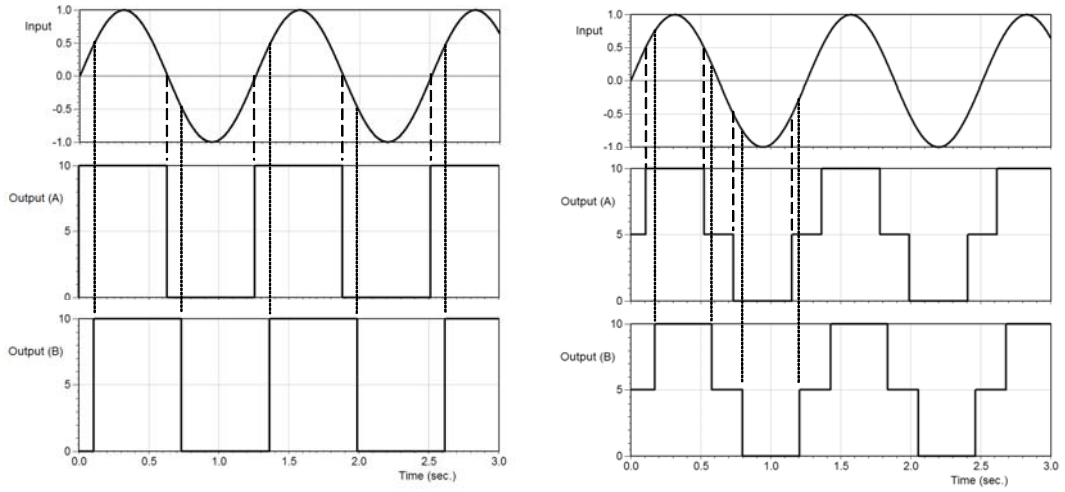
Methodology

1. Theory and related works

1.1 Characteristics of the 2-leveled and 3-leveled on-off function

In general, the basic 2-leveled on-off function generates two-status output signal with hysteresis (or differential gaps, S_d). But for the 3-leveled on-off function, it is composed of two 2-leveled on-off functions. Both 2-leveled and 3-leveled on-off functions can change the output signal depending on the direction of the input signal. If $S_d = 0$, the output signal will be changed to a high value when the input signal increases beyond the zero point. On the other hand, the output signal will be changed to a low value when the input signal decreases below the zero point. The equation (1) can also explain this operation accordingly. If the output signal is wanted to change at another turning point, not a zero, the differential gaps can be adjusted as $S_d \neq 0$. According to (Figure 1), both 2-leveld and 3-leveled with and without hysteresis cases are shown in a clear comparison.



a) b)

Figure 1 a) Characteristics of a 2-leveled on-off function
b) Characteristics of a 3-leveled on-off function

From (Figure 1a), regarding the Output (A), when $S_d = 0$, the output signal will be changed from 0 to 10 volts when the input signal increases and passes the zero point. On the contrary, the output signal will be changed from 10 to 0 volt when the input signal decreases and gets lower the zero point which can be explained by the equation (1). Moreover, regarding the Output (B) in (Figure 1a), when $S_d = 1$, the output signal will be changed from 0 to 10 volts when the input signal increases and passes 0.5 volt. On the contrary, the output signal will be changed from 10 to 0 volt when the input signal decreases and gets lower than -0.5 volt.

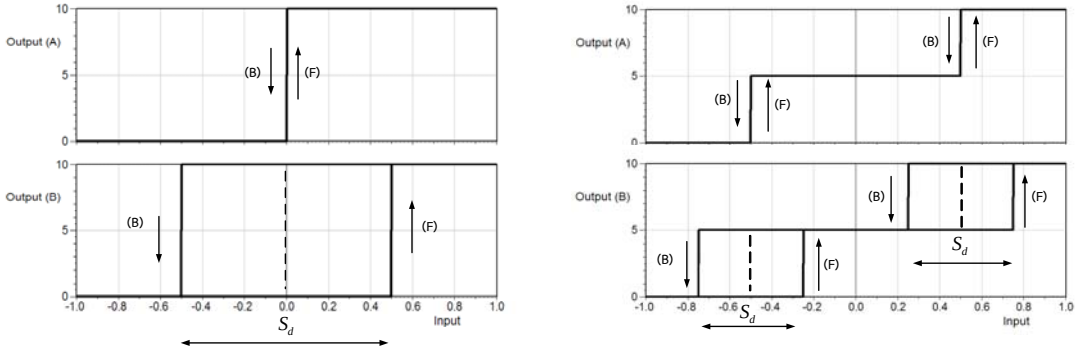
$$y(t) = \begin{cases} y_{\min} & \text{if } x(t) < 0 \\ y_{\max} & \text{if } x(t) > 0 \end{cases} \quad (1)$$

From (Figure 1b), regarding the Output (A), when $S_d = 0$, the output signal will be at 0 volt when the input signal is lower than -0.5 volt (x_u), and it will be 5 volts when the input signal is between -0.5 (x_u) and 0.5 volt (x_o), and it will be 10 volts when the input signal is more than 0.5 volt (x_o) which can be explained by the equation (2).

$$y(t) = \begin{cases} y_u & \text{if } x(t) < x_u \\ y_{\mathrm{m}} & \text{if } x_u \le x(t) \le x_o \\ y_o & \text{if } x(t) > x_o \end{cases} \qquad (2)$$

(Figure 2a) and (Figure 2a) below demonstate the two types of the controller, which are a 2-leveled and a 3-leveled on-off function respectively. For the Output (A), both graphs show the controlling function without hysteresis and for the Output (B), both graphs show the controlling function with hysteresis.
Regarding (Figure 2), it shows two graphs in x-y format in which the x axis is the input signal and the y axis is the output signal. When the input signal is assumed to vary its value from 0 up to 1.0 volt, this type of input signal change is called a forward direction (F). On the contrary, when the input signal varies its value from 1.0 down to 0 volt, this type of change is called a backward direction (B).

Regarding the Output (B) shown in (Figure 1b) and (Figure 2b), when $S_d = 0.5$ and the input signal moves in forward direction (F), it results in that the output signal is at 0, 5, and 10 volts when the input signal is between -1.0 and -0.25 volt, -0.25 and 0.75 volt, and higher than 0.75 volt respectively. On the other hand, in backward direction (B), the output signal is at 10, 5, and 0 volts when the input signal is between 1.0 and 0.25 volt, 0.25 and -0.75 volt and lower than -0.75 volt, respectively.



a) b)

Figure 2 a) 2-leveled on-off function in an x-y graph format
b) 3-leveled on-off function in an x-y graph format

1.2 Chattering problem

The high frequency switching itself is the chattering problem. It can possibly damage the equipment and the connected systems. One of the possible solutions is to choose a suitable differential gaps value for each individual case. To observe the chattering problem, a 2-leveled on-off function with PT1 simulated in a form of a block diagram shown in (Figure 3a) is chosen to study. Moreover, the chattering problem and its solution are shown in (Figure 4a) and (Figure 4b) respectively. The configuration parameters are given in details in Table 1 below.

Table 1 Configuration parameters

Elements	Groups	Parameter Values
Function generator	Sources	Pulse, Amplitude=5, Offset=0, TD=0.5
Junction	Function	+ -
HYST-element	Dynamic	yMin=0, yMax=10, GainK=100000, Hysteresis width dx=0.5
PT1-element	Dynamic	K=1, T=0.5
YTPLOT	Drain	--

Note: the step size = 0.01 sec.

(Figure 3) shows a series of simulated diagrams of the on-off function control. And (Figure 3a) is an example of the simulated diagram showing that the reference signal (w) is generated from the function generator. The error signal (e), which is the input signal for the controller (2-leveled on-off function, HYST), is resulted by the reference signal (w) subtracted by the feedback signal (r) at the junction point. The controller's output signal, which can be called a manipulated variable (y), is sent to stimulate the control plant according to the control law. The controlled signal (x) is the actual output signal received from the control plant.

In addition, the simulation result of (Figure 3a) is shown in (Figure 4) in the form of time-response curves, in which the simulation results both without and with hysteresis are explained with (Figure 4a) and (Figure 4b), respectively.

In (Figure 4a), the high frequency switching can be observed clearly in the output signal (y) curve. A possible solution for the chattering problem occurred in (Figure 4a), it is to adjust the hysteresis which is demonstrated in (Figure 4b), where the steady state error is seen in a larger magnitude and a longer time period when the hysteresis is adjusted in a higher value. The simulation results of the on-off function controller both without and with hysteresis give the same results as in the experiment shown in (Figure 5).

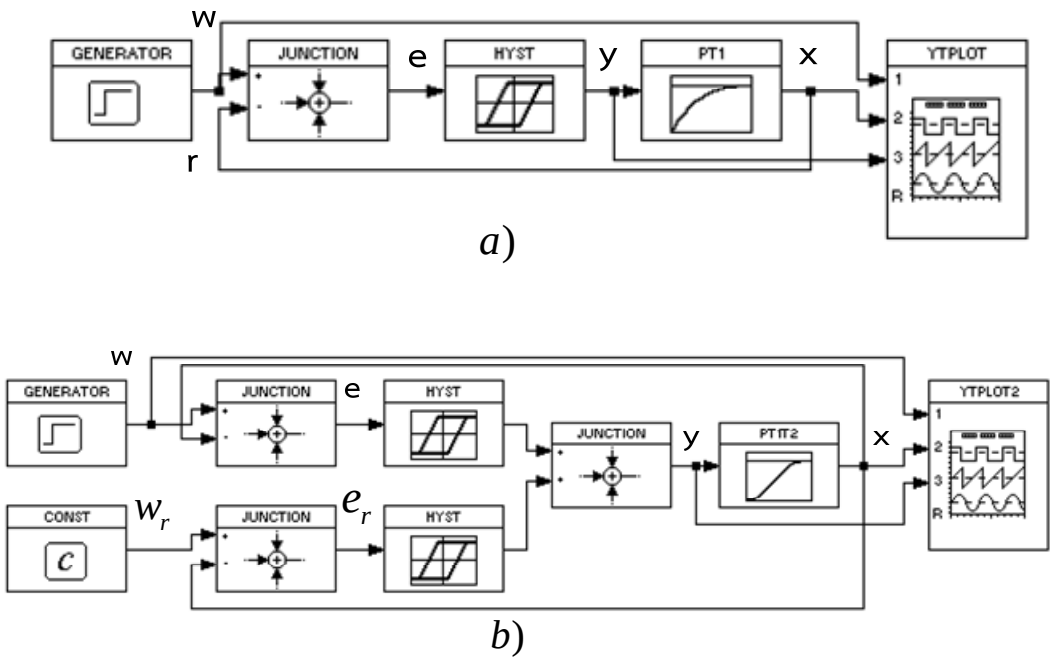


Figure 3 simulation diagrams of a) a 2-leveled on-off function with PT1

b) a 3-leveled on-off function with PT1T2

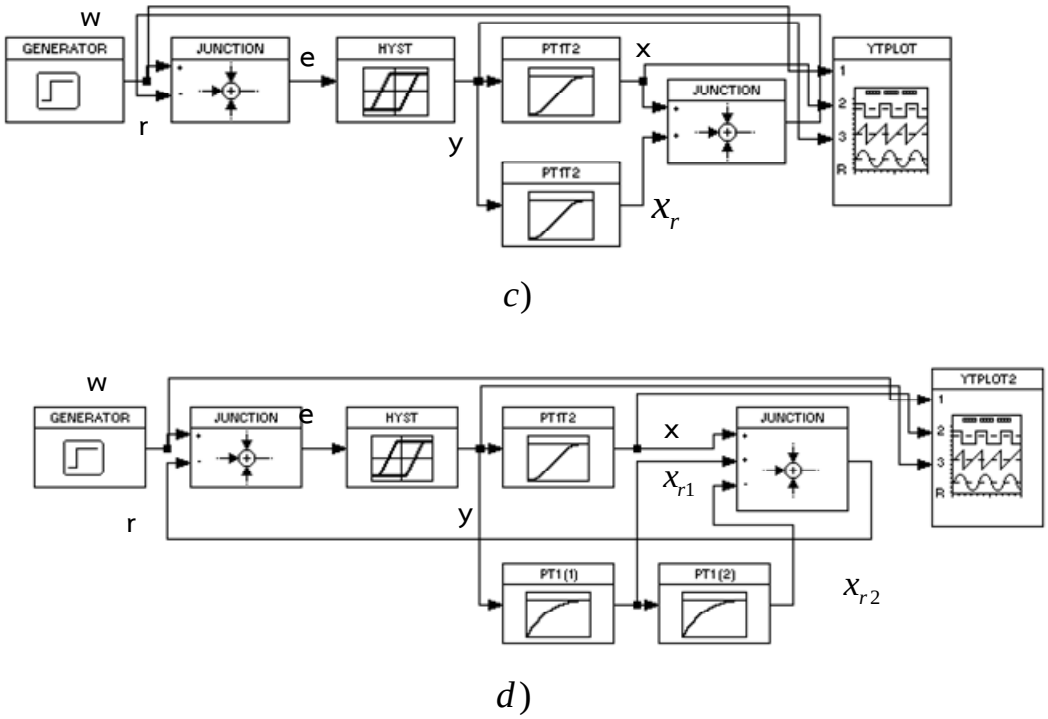
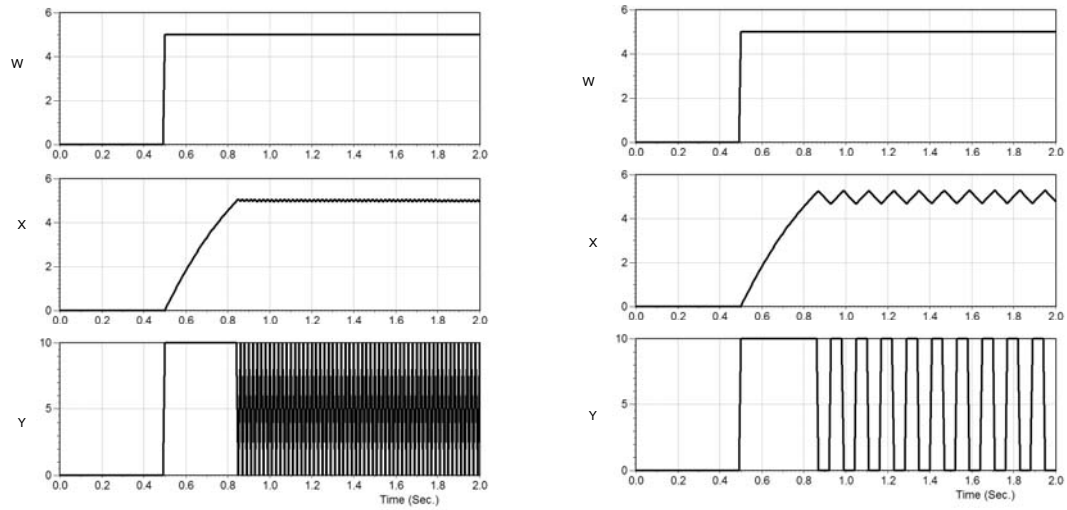


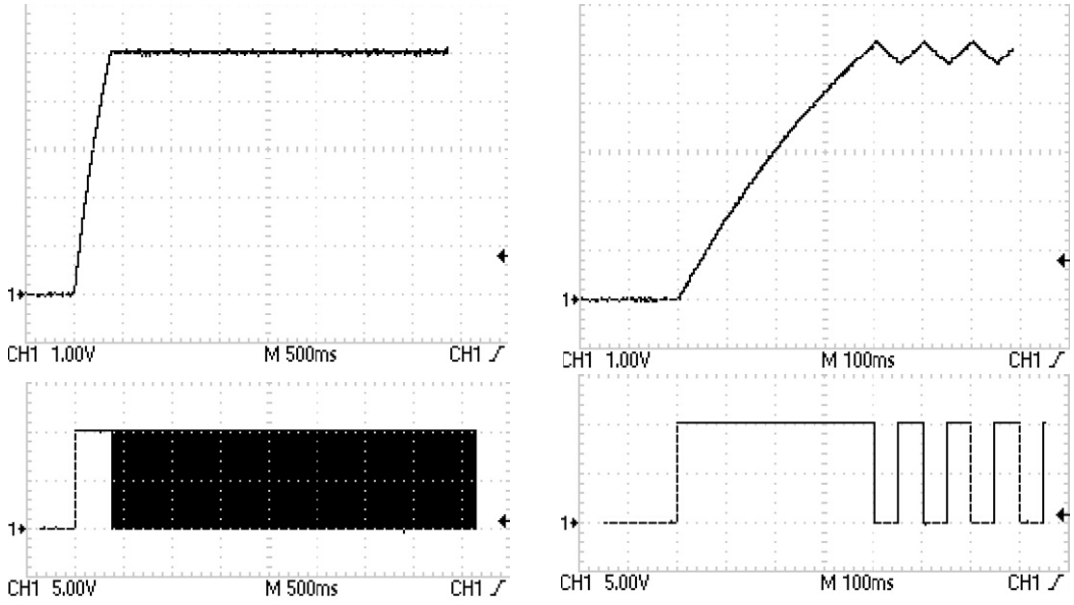
Figure 3 (Cont.) simulation diagrams of c) a 2-leveled on-off function with PT1T2 and delay feedback

d) a 3-leveled on-off function with PT1T2 and elastic feedback



a) b)

Figure 4 simulation results: a) without hysteresis b) with hysteresis $(S_d = 0.5)$



a) b)

Figure 5 experimental results: a) without hysteresis b) with hysteresis $(S_d = 0.5)$

2. Types of on-off function controller configuration

2.1 a 2-leveled on-off function with PT1T2 controlled system

Based on (Figure 3a), the simulation of a 2-leveled on-off function with PT1T2 control system needs the change of PT1 to PT1T2. The entire simulation done with the step size at 0.01 second. The configuration parameters are shown in details in Table 2.

Table 2 Configuration parameters of 2-leveled on-off function

Element	Group	Parameter values
Function generator	Sources	Pulse, Amplitude = 5, Offset=0, TD=0
Junction	Function	+ -
HYST-element	Dynamic	yMin=0, yMax=10,GainK= 100000,Hysteresis width dx=0.5
PT1T2-element	Dynamic	K = 1, T1 = 30, T2 = 10

2.2 a 3-leveled on-off function with PT1T2 controlled system

The simulation diagram is shown in (Figure 3b), where two reference signals: w and w_r are set according to the parameters given in Table 3.

Table 3 Configuration parameters

Element	Group	Parameter values
Function generator	Sources	Pulse, Amplitude = 4, Offset = 0, TD =0
CONST	Sources	6
Junction	Function	+ -
HYST-element	Dynamic	yMin=0,yMax=5,GainK=100000,Hysteresis width dx=0.5
PT1T2-element	Dynamic	K = 1, T1 = 30, T2 = 10

2.3 a 2-leveled on-off function with PT1T2 controlled system and delay feedback

The configuration parameters needed for the diagram setup as in (Figure 3c) are as same as shown in Table 3, but with an addition of PT1T2-element, where K = 1, T = 10, and T = 0.1, from which the output signal x_r is given. It, as a result, gives a simulation diagram where the level of error signal (w - (x+ x_r) is decreased, causing a high frequency switching with a slight amplitude oscilate, which yeilds an exact effect occurred in the case of decreasing hysteresis. The output signal amplitude is reduced by factor x_r (x = w – e - x_r).

2.4 a 2-leveled on-off function with PT1T2 controlled system and elastic feedback

To solve the problem of low output signal caused by x_r , the elastic feedback elements with two PT1s are connected in the diagram as shown in (Figure 3d), in which the required parameters are given

in Table 3, with an addition of PT1 (1) and PT1 (2). The two added PT1s make the entire system function as a PID controller, when PT1 (1) which has K = 1 and T = 30 functions like D controller and when PT1 (2) which has K = 1 and T = 10 functions like I controller.

Results and discussions

The definitions of parameters are given to explain the characteristics of each controller: $\overline{x}$ is the average value of a controlled signal, e is the result of w when it is subtracted by x, %ripple is the result of $\left(\left(x_{\max}-x_{\min}\right)/w\right)*100$, $\%T_{on}/T_{period}$ is the result of $\left(T_{on}/T_{period}\right)*100$ and T_{sw} is the switching period of a manipulated signal.

Table 4 shows the relationship between reference signal (w), manipulated signal (y) and error signal (e) in two cases: 1) without hysteresis and 2) with hysteresis. The 2-leveled on-off function without hysteresis causes high frequency switching or chattering problem. But the 2-leveled on-off function with hysteresis results in 25 %ripple when the reference signal is 2 and %ripple tends to decrease when reference signal is at a higher value. For average value of a controlled signal, both types of the 2-leveled on-off function give a slightly different result. The reference signal (w) at the middle of the manipulated signal causes the duty cycle of manipulated signal at approximately 50%.

Table 4 The simulation results of a 2-leveled on-off function with PT1

w	Without Hysteresis					With Hysteresis $\left(S_d=0.5\right)$				
	$\overline{x}$	e	$\%ripple$	$\%T_{on}/T_{period}$	T_{sw}	$\overline{x}$	e	$\%ripple$	$\%T_{on}/T_{period}$	T_{sw}
2	2	0	0	20	0.05	2.0	0.0	25	18.9	0.95
5	5	0	0	50	0.02	4.99	-0.01	10.2	50.0	0.61
7	7	0	0	75	0.04	6.99	-0.01	7.28	67.6	0.73

Table 5 shows the relationship between differential gaps, manipulated signal and error signal when the reference signal (w) is 5. When the differential gaps are increased, it results in a longer switching period and a higer steady state error value. The differential gaps have no significant impact on the manipulated signal duty cycle.

Table 5 The simulation results of a 2-leveled on-off function with PT1

S_d	$\overline{x}$	e	$\%ripple$	$\%T_{on}/T_{period}$	T_{sw}
0.2	4.99	-0.01	4.2	46.1	0.26
0.5	4.99	-0.01	10.2	50.0	0.61
0.8	5.0	0	16	50	0.97

Table 6 shows the relationship between a 3-leveled on-off function, manipulated signal and error signal. For the transient interval, when S_{d1} and S_{d2} is fixed at 0.5, the operation begins with the highest value (10 V). For the steady state interval, when the reference signal is lower than the middle value of the manipulated signal, the other two lower values are switching. However, when the reference signal is higher than the middle value of the manipulated signal, the two higher values are switching. In addition, transient response time is shown in the last column.

Table 6 The simulation results of a 3-leveled on-off function with PT1T2

w_1	w_2	$\bar{x}$	e	$\%ripple$	$\%T_{on}/T_{period}$	values	T_{sw}	TR*
1	2	2.005	0.005	33.5	42.6	0,5	2.93	0.78
4	6	5	0	0	100	5	-	2.19
6	8	6.1	0.1	12	22.3	5,10	3.99	3.44

*Note: TR = transient response time

Table 7 shows the relationship between reference signal (w), manipulated signal and error signal. Though a 2-leveled on-off function with PT1T2 and delay feedback gives a low %ripple, which is lower than 1%, the value of the steady state error is comparatively high.

Table 7 a 2-leveled on-off function with PT1T2 and delay feedback

w	$\bar{x}$	e	$\%ripple$	$\%T_{on}/T_{period}$	T_{sw}
2	1.48	0.52	0.3	16	4.77
5	2.47	2.53	0.2	24	3.15
7	3.47	3.53	0.14	35	2.56

Table 8 shows the relationship between reference signal (w), manipulated signal and error signal. The 2-leveled on-off function with PT1T2 and elastic feedback gives %ripple which is lower than 5%, and the value of the steady state error is lower than 0.03.

Table 8 a 2-leveled on-off function with PT1T2 and delay elastic feedback

w	$\bar{x}$	e	$\%ripple$	$\%T_{on}/T_{period}$	T_{sw}
2	1.97	-0.03	3.1	20.3	9.83
5	4.99	-0.01	0.7	54.4	6.15
7	7.01	0.01	0.65	70.3	7.44

(Figure 6) shows that a 2-leveled on-off function with PT1T2 controlled system has a steady state error at 16 %ripple, and a 3-leveled on-off function with PT1T2 controlled system shows no steady state error at over 140 seconds, and a 2-leveled on-off function with PT1T2 controlled system and delay feedback results in the highest error caused by X_r , and a 2-leveled on-off function with PT1T2 controlled system and elastic feedback functions like the PID controller because it has quick transient response and no steady state error.

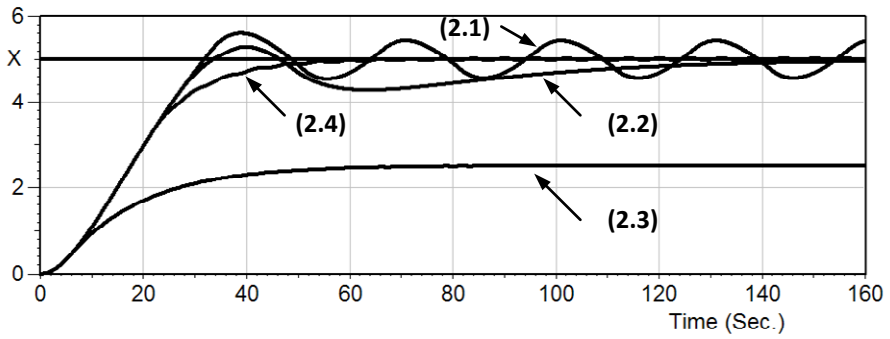
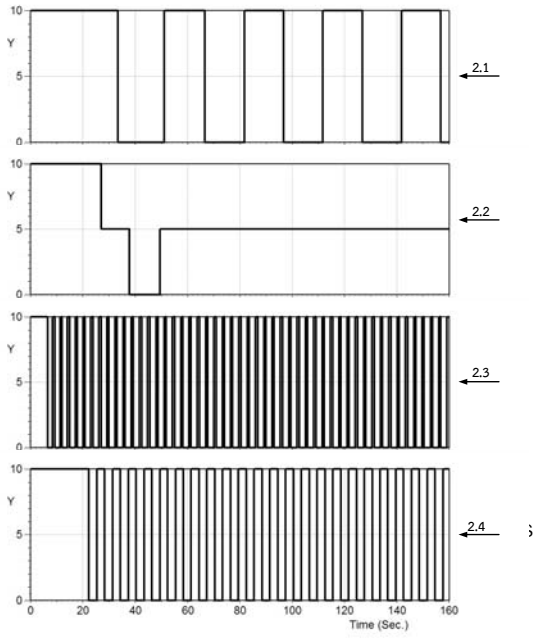


Figure 6 transient response of four controller types

(Figure 7) shows manipulated signal (y) of the four controllers. Regarding the switching period, a 3-leveled on-off function with PT1T2, a 2-leveled on-off function with PT1T2, a 2-leveled on-off function with PT1T2 and elastic feedback and a 2-leveled on-off function with PT1T2 and delay feedback are listed from the longest to the shortest respectively.



Conclusion

From the simulations and experiments on the 2-level and 3-level on-off function controllers, the results can be concluded as follows:

1. a 2-leveled on-off function without hysteresis, which is not generally used in the real working context, causes chattering problem;

2. the preferred reference signal (w) should be at the middle of the manipulated signal because the manipulated signal duty cycle will be approximately 50% which is safe for the actuator element;

3. if the differential gaps are increased, it results in a longer switching period and a higher steady state error value;

4. a 3-level on-off function allows appropriate manipulated signal level to be chosen for a better steady state error value;

5. although a 2-leveled on-off function with PT1T2 and delay feedback gives a smooth transient response, it results in a higher steady state error value;

6. a 2-leveled on-off function with PT1T2 and elastic feedback can solve the problem of a higher steady state error value;

7. the transient reponse caused by each controller type is slightly different; however, the steady state error value is significantly different depending on the type of controller.

8. a 2-leveled on-off function with PT1T2 and elastic feedback function as a PID, where PT1 (1) and PT1 (2) functions like D and I controller respectively, and parameters can be adjusted for a satisfying response.

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Optimized working conditions of Thai-made Irrigation Pump by Response Surface Methodology

Benya Kasantikul,[1*] Santi Laksitanonta[2] and Winai Bodhisuwan[3]

Abstract

This research aim was to study the effects of changes on the working conditions of Thai-made Irrigation Pumps and to establish the optimum conditions for maximum efficiency of a 6- inch- 6 ft Thai-made Irrigation Pump. The research was conducted by using experimental design to study the impacts on operating conditions, consisting of three independent variables: the number of impeller blades, speed and total static pressure, and two dependent variables: the efficiency of the pump and the flow rate. The results of statistical analysis showed that the number of impeller blades, speed and total static head pressure affected the efficiency of the pump. The results which were obtained from the experimental Box-Behnken design and response optimizer showed that at least 60 percent pump efficiency can be achieved by using eight blades on the impeller; a an operating speed of 1000 rpm and at a 0.95 m total static pressure, this could increase the efficiency up to 68.12 percent.

Keywords : Response Surface Methodology, Impeller, Efficiency and Thai-made Irrigation Pump

Introduction

From the past to present Thailand, Thai-made Irrigation Pumps (TmIP) have played an important role in Thai farming and irrigation systems (Figure 1) and Table 1. This can be evidently seen from the annually increasing number of them found and used either in paddy fields, vegetable and fruit orchards, or aquatic farms. This is also because of the TmIP's advantages of being cheap, easy to use and maintain, convenient to move and simple for even a small factory to produce. However, its operational efficiency and optimized suit abilities still have been rarely determined and need to be studied further and developed.

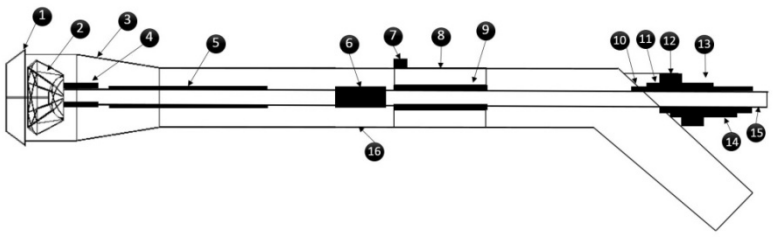

Figure 1 Thai-made Irrigation Pumps (TmIP)

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Table 1 Parts of Thai-made Irrigation Pumps (TmIP)

No.	Parts	No.	Parts
1	strainer	9	Rubber bearing
2	Mixed flow impeller	10	Oil seal
3	Diffusion vanes and bearing support	11	Bearing housing
4	Rubber bearing	12	Grease pot
5	Drive shaft	13	Oil seal
6	Shaft coupling	14	Ball bearing
7	Flange with rubber seal	15	Collar and lock unit
8	Extra bearing holder for longer pump	16	Discharge pipe

In order to properly design an irrigation pump of maximized efficiency, the nature of flow within is fundamentally required to be learned and understood, thus computer programs or IT techniques are included to be used as an alternative technique. According to Dick, *et. al.* (2001), a computer program of Fluent Code was used to predict the irrigation pump's performance through techniques of Multi Reference Frame (MRF), Mixing Plane (MP) and Sliding Mesh (SM). Then, it was found that the results from Multi Reference Frame (MRF) and Mixing Plane (MP) were less accurate than that from Sliding Mesh (SM) and a more definite pattern of the within flow was also found.

Later, Cheah, *et. al.* (2007) used a computer program of a flowing simulation model of ANSYS CFX Code and a confusing flowing simulation model of k-ε to examine the within flow patterns and the pressure fields at the designated point and others beyond and it was found that, at the designated point, the field of within flow of impeller blades was fairly smooth and the phenomenon of Flow Separation at the Leading Edge together with the Vertical Flow Structure, both single and double, in the flow channel was also discovered. In addition, at other points beyond the designated – at the middle of the flow channel, strongly circulated flow resulting in the phenomenon of Flow Blockage and less efficiency, respectively was also found. (Miner, 2005; Goto *et al*., 2002; Muggli *et al*., 2002)

As for the TmIP's operation, Keawprakaisaengkul C. (1996) examined pumps of smaller size, a 15 HP with a diameter of 152 mm. and total static pressure at 1.00 m. Before improvement, the maximized efficiency was at 56 % at 1,000 rpm, with the flow rate of 51.1 liter / second and transmission power of 2.37 kilowatt. After improvement, the maximized efficiency was at 58.7% with the flow rate of 50.9 liter / second and transmission power of 2.427 kilowatt. In terms of efficiency, however, it seemed there was very little improvement.

According to Kasantikul and Laksitanonta (2011), the effects of the number of impeller blades on the operation of the pump were studied through the method of flow simulation by a computer program. The results showed that the more impeller blades the pump had, the more discharge pressure increased. Six impeller blades gave a more consistent distribution of speed than 4 impeller blades. In addition, the phenomena of Tip-Vortex and strong recirculation were also found when the pump worked at a lower rate of flow.

Due to the significance mentioned above, this study therefore needs to be conducted. Even though some previous related studies using computer programs to simulate the flows in the pumps can provide more definite patterns of the flows and are very helpful in designing an efficient pump, the comparison of experimental results are the best way to indicate how accurate and valid the results are from flow simulation by computer programs. Accordingly, this study is to examine the impacts on operational conditions of the TmIP as well as to determine an appropriate variable to make the pump achieve an efficiency of 60%.

Materials and Methods

1. Conceptual Framework of the study

In an engineering design, first is to identify the independent variables and then to determine their degrees of impacts / influences on the dependent variables. Thus, the conceptual framework of the research consisted of the independent variables and their influence levels on the dependent variables are shown in (Figure 2.)

Variables and Levels to be studied

Independent Variables	Levels
No. of Blades	4, 6 & 8 Blades
Speed	600, 800, 1000 rpm

Figure 2 Variable influencing the pump' efficiency

According to Figure 2, these variables influence the pump's efficiency, we wanted to determine the proper values of the variables to achieve at least 60% efficiency; therefore, response surface methodology was used and at least 3 levels were set to determine the maximum values by the independent variables (Chutima, 2002). (Figure 3) shows the test rig for the experiment.

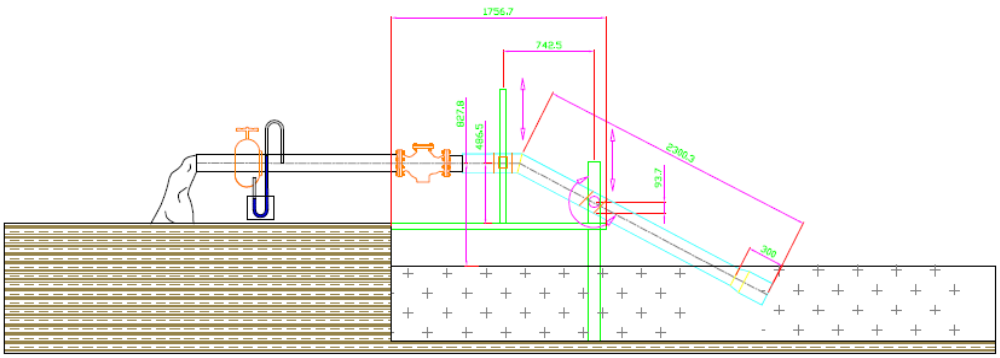

Figure 3 the test rig of the experiment

2. The response surface methodology and the Box-Behnken Design

Response surface methodology is designed to allow investigators estimating interactions, and therefore giving them an idea of the shape of the response surface they are studying. This approach is often used when simple linear and interaction models are not adequate, e.g. experimentation far from the region of optimum conditions (Meyers, 1971; Box et al., 1987). Here, the experimenter can expect the curvature to be more prevalent and will need a mathematical model which can represent the curvature. The simplest such model has the quadratic form Equation 1:

$$y = \beta_0 + \sum_{i=1}^{k} \beta_i x_i + \sum_{i=1}^{k} \beta_{ii} x_i^2 + \sum_{i=1}^{k} \sum_{j=1}^{k} \beta_{ij} x_i x_j + \varepsilon \quad (1)$$

which contains linear terms for all factors, squared terms for all factors, and products of all pairs of factors. In this study, for example, X1 and X2 terms correspond to reaction temperature and flow as they relate to predicting absorbance. In the above equation β is the coefficient, akin to a regression coefficient. In other words it gives a measure of the rate of change in absorbance per unit change in reaction temperature or flow.

The Box-Behnken design is considered as an efficient option in response surface methodology and an ideal alternative to central composite designs (Deming and Morgan, 1993). It has three levels per factor, but avoids the corners of the space, and fills in the combinations of center and extreme levels (Figure 4). Overall, it combines a fractional factorial with incomplete block designs to avoid the extreme vertices and to present an approximately rotatable design with only three levels per factor (Deming and Morgan, 1993).

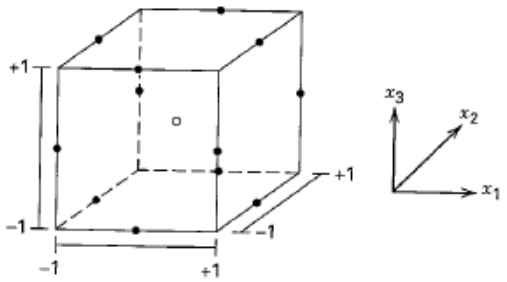

Figure 4 Box-Behnken design with three levels per factor

This study was conducted using the Box-Behnken design including 3 independent variables; number of blades, speed and total static pressure and the pump's efficiency, to be studied. The engineering design of the experiment (DOE) was applied to examine the influences (Montgomery, 2004) and to simplify them for further practice. Then, response surface methodology and response optimizer were used to determine the proper conditions.

This is a design of 3- Level response surface. It is the combination of 2^k factorial design and incomplete block design. The design result is the efficiency in terms of the target runs. Because it is a design of ball shape with 2 – inch radius not including any points of apex of the cube made from the upper and lower limits of each variable, it is very helpful when the points on the cube's corner are the factor-level combination which is so expensive that it can be impossible to do experiment due to the physical limitations of the procedure.

In combination, these two strategies can help in optimizing experimental procedures in a reduced number of studies as well as providing essential information for appropriate decisions of the future of the procedure. This approach is opposite to the classical univariate approach. Univariate methods are time consuming in that the response is investigated for each factor while all other factors are held at a constant level. This approach is relatively simple and suitable for factors that are independent. However, univariate methods do not take interactive effects between factors into account.

There were in total 15 experiments including 1 repetition in which 1, 0, -1 values of the blade number, head's height and speed were 8, 6 and 4; 0.85, 0.90 and 0.95 and 600, 800 and 1000 rpm, respectively as shown in Table 2.

Table 2 Data collected from experiments

Coded - Values Type						Uncoded - Values Type				
Std Order	Run Order	A	B	C		Std Order	Run Order	No. of Blades	Speed	Head
13	1	0	0	0		13	1	6	800	0.9
10	2	0	1	-1		10	2	6	1000	0.85
6	3	1	0	-1		6	3	8	800	0.85
15	4	0	0	0		15	4	6	800	0.9
11	5	0	-1	1		11	5	6	600	0.95
7	6	-1	0	1		7	6	4	800	0.95
9	7	0	1	-1		9	7	6	600	0.85
4	8	1	1	0		4	8	8	1000	0.9
2	9	1	-1	0		2	9	8	600	0.9
12	10	0	1	1		12	10	6	1000	0.95
5	11	-1	0	-1		5	11	4	800	0.85
8	12	1	0	1		8	12	8	800	0.95
1	13	-1	-1	0		1	13	4	600	0.9
3	14	4	1000	0.9		3	14	4	1000	0.9
14	15	6	800	0.9		14	15	6	800	0.9

Results and Conclusion

After all experiments had been respectively conducted according to Table 2, the results were as shown in Table 3.

The procedure of result analysis began with the validation of the experimental results through 3 hypotheses using Minitab 16.0. According to (Figures 5), the validations are as follows:

1. Validation of normal probability plot
2. Validation of residual versus order
3. Validation of variance stability versus fits

It was found that the experimental results were in the 3 hypotheses which could be statistically tested. Fractional factorial designs have been shown to have a major limitation, in that the main effects are often confounded with interaction terms. Taking this into account, along with the results achieved from the fractional factorial design, experiments aiming to determine if further optimization could be achieved were performed by a Box-Behnken design.

Table 3 Experimental Results

Order of Experiments	Independent Variables			Dependent Variables
	No. of Blades	Speed	Head	% of Eff
13	6	800	0.9	56.92
10	6	1000	0.85	66.69
6	8	800	0.85	24.08
15	6	800	0.9	56.92
11	6	600	0.95	26.15
7	4	800	0.95	35.55
9	6	600	0.85	31.98
4	8	1000	0.9	36.04
2	8	600	0.9	17.19
12	6	1000	0.95	68.12
5	4	800	0.85	39.07
8	8	800	0.95	33.02
1	4	600	0.9	17.26
3	4	1000	0.9	44.61
14	6	800	0.9	56.92

(Figure 6) shows the analysis data of the experimental results, the main variable which influences the pump efficiency is the speed; the regression equation representing the relationship is as follows:

$Y = 56.92 - 3.27$ No. of Blades $+ 15.36$ Speed $- 0.1275$ Head $- 21.725$ No. of Blades$^2 - 6.42$ Speed$^2 -$ 2.265 Head$^2 - 2.125$ No. of Blades x Speed $+ 3.115$ No. of Blades x Head $+ 1.1815$ Speed x Head

When R^2 is considered, it indicates the degree of variation which can be describe by a equation equal to 96.56 % which is considered high performance and can represent the relationship between independent and dependent variables.

(Figure 7) shows each variable which influences the pump efficiency.

(Figure 8) shows an interaction of the variables influence the efficiency.

(Figure 9) shows the contour plots of the dependent variables affecting the pump efficiency

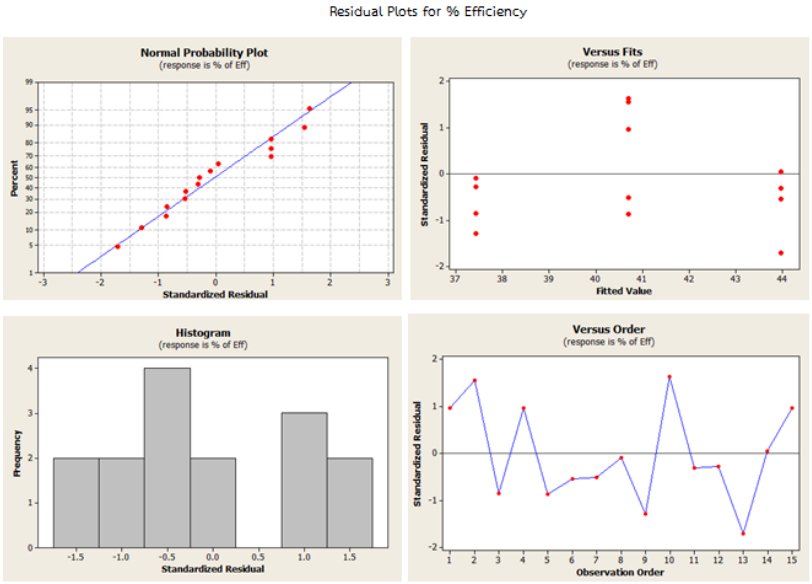

Figure 5 Validation of the analyzed results

Response Surface Regression: % of Eff versus No.of Blades, Speed, Head

The analysis was done using coded units.

Estimated Regression Coefficients for % of Eff

Term	Coef	SE Coef	T	P
Constant	56.9200	3.034	18.763	0.000
No.of Blades	-3.2700	1.858	-1.760	0.139
Speed	15.3600	1.858	8.268	0.000
Head	0.1275	1.858	0.069	0.948
No.of Blades*No.of Blades	-21.7250	2.734	-7.945	0.001
Speed*Speed	-6.4200	2.734	-2.348	0.066
Head*Head	-2.2650	2.734	-0.828	0.445
No.of Blades*Speed	-2.1250	2.627	-0.809	0.455
No.of Blades*Head	3.1150	2.627	1.186	0.289
Speed*Head	1.8150	2.627	0.691	0.520

S = 5.25432 PRESS = 2208.63
R-Sq = 96.56% R-Sq(pred) = 44.89% R-Sq(adj) = 90.36%

Analysis of Variance for % of Eff

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Regression	9	3869.85	3869.85	429.98	15.57	0.004
Linear	3	1973.11	1973.11	657.70	23.82	0.002
No.of Blades	1	85.54	85.54	85.54	3.10	0.139
Speed	1	1887.44	1887.44	1887.44	68.37	0.000
Head	1	0.13	0.13	0.13	0.00	0.948
Square	3	1826.68	1826.68	608.89	22.06	0.003
No.of Blades*No.of Blades	1	1662.85	1742.68	1742.68	63.12	0.001
Speed*Speed	1	144.89	152.18	152.18	5.51	0.066
Head*Head	1	18.94	18.94	18.94	0.69	0.445
Interaction	3	70.05	70.05	23.35	0.85	0.525
No.of Blades*Speed	1	18.06	18.06	18.06	0.65	0.455
No.of Blades*Head	1	38.81	38.81	38.81	1.41	0.289
Speed*Head	1	13.18	13.18	13.18	0.48	0.520
Residual Error	5	138.04	138.04	27.61		
Lack-of-Fit	3	138.04	138.04	46.01	*	*
Pure Error	2	0.00	0.00	0.00		
Total	14	4007.89				

Figure 6 Analysis data of the experimental results

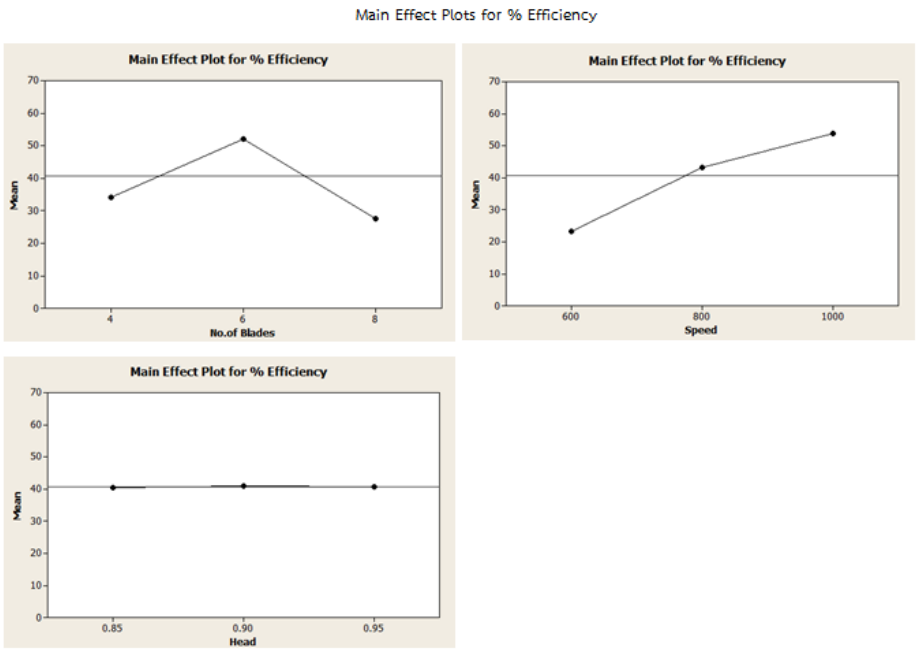

Figure 7 Variables influence the efficiency

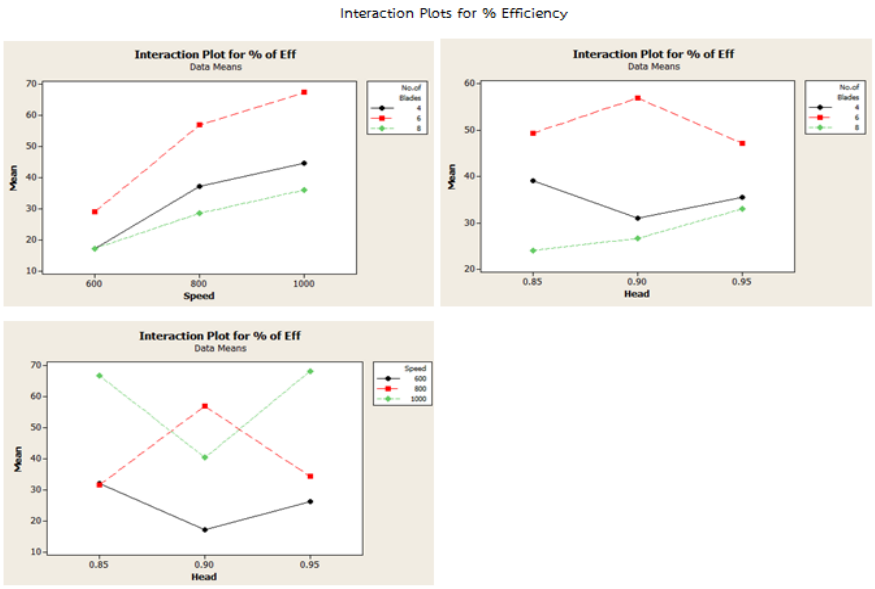

Figure 8 Interaction of the variables influence the efficiency

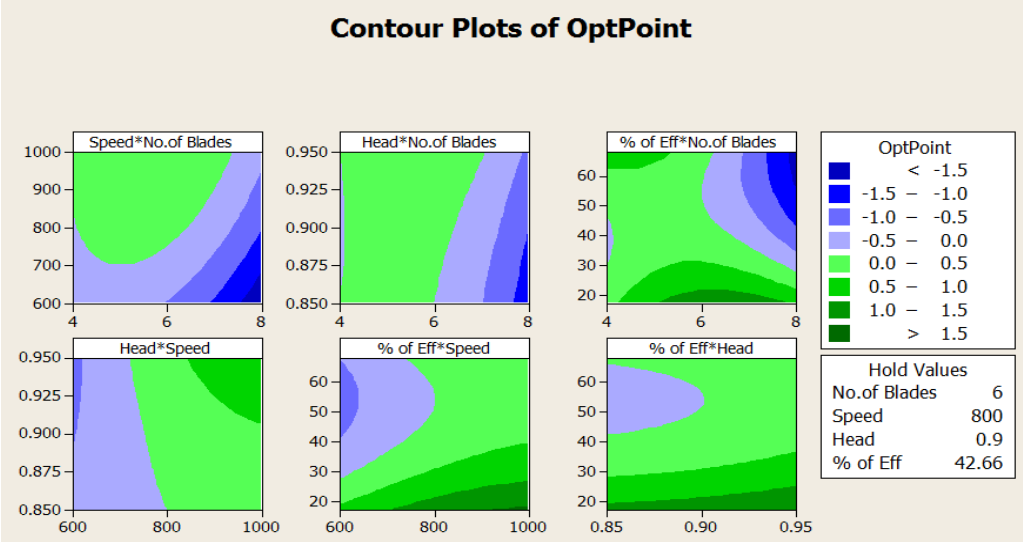

Figure 9 Contour Plots of the Dependent variables affecting the pump efficiency

According to (figure 7-9) when number of the blades is considered, it precipitously rises the pump efficiency from 4 to 6 blades whereas precipitously drops from 6 to 8 blades, in addition, from the interaction between variables influence, the higher the speed is, the efficiency in each number of blades increases. When the speed is considered, it precipitously raises the pump efficiency in all cases. When the head pressure is considered, it shows no significant.

After the influences of all variables have been analyzed and the regression equations have been determined, the function of Response Optimization in Minitab 16.0 is used to determine the optimized values of all variables to achieve the target efficiency.

Number of Blades	8	Blades
Speed	1000	rpm
Head's Height	0.95	m

Then maximized efficiencies are as shown in (figure 10):

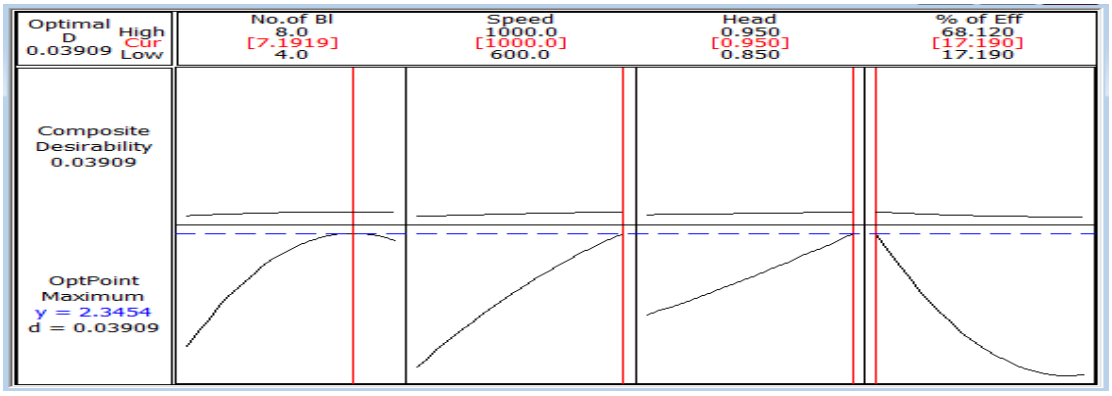

Figure 10 Optimal values of variables to achieve the target efficiency

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Micro hydropower : A review

Orawan Jantasuto[1*]

Abstract

Energy resources have three categories: fossil fuels, renewable resources and nuclear resources. Renewable energy resources can be taken to produce energy again and again e.g. hydropower, solar energy, wind energy, biomass energy etc. Hydropower technology has been with us for more than a century. Hydropower is the world's largest clean and renewable energy source with almost negligible levels of greenhouse gas emissions. Hydropower systems are based on a simple process, taking advantage of the kinetic energy freed by the flowing and falling of water. This paper consists of a brief description of the measurement of flow, methodology and hydro-turbines selection for developing a micro hydropower project.

Keywords : micro hydropower, hydro-turbine, measurement of flow

Introduction

Many hydropower projects built at the beginning of the 20th century are still operating today. Hydropower is the world largest clean and renewable energy source with almost negligible levels of greenhouse gas emissions. About 16% of the world electricity is from hydroelectricity which represents more than 85% of the world's renewable electricity produced. More than 150 countries now produce hydroelectricity. Total global hydropower potential is approximately 970 GW with the addition of 25 GW of new capacity in the year 2011. World hydroelectricity energy production was about 3500 TWh in the end of 2011: China, Canada and United States together produce almost half of the world's hydroelectricity. About seven countries have hydroelectricity production of more than 100 TWh and six countries produce more than 50% of their total electricity needs from hydropower [1].

Flowing and falling water have potential energy. Thus Hydropower comes from converting energy in flowing water by means of a water wheel or through a turbine into useful mechanical power [2]. The turbines installed at that time are still running at very high efficiencies of 80-90%. Indeed, hydropower is based on a simple process, taking advantage of the kinetic energy freed by falling water [3].

Micro hydropower

Micro-hydropower systems are relatively small power sources that are appropriate in most cases for individual users or groups of users who are independent of the electricity supply grid. Hydropower systems are classified as large, medium, small, mini and micro according to their installed power generation capacity. Electrical power is measured in watts (W), kilowatts (kW) or megawatts (MW) [2].

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Table 1 Classification of hydropower by size [4].

Large- hydro	More than 100 MW and usually feeding into a large electricity grid
Medium-hydro	15 - 100 MW - usually feeding a grid
Small-hydro	1 - 15 MW - usually feeding into a grid
Mini-hydro	Above 100 kW, but below 1 MW; either standalone schemes or more often feeding into the grid

A micro-hydropower system is generally classified as having a generating capacity of less than 100 kW. Systems that have an installation capacity of between 100 kW and 1000 kW (1.0 MW) are referred to as mini-hydro. Small hydro is defined as having a capacity of more than 1.0 MW and up to 10 MW, although in Canada small-hydro can be defined by provincial and territorial utilities as having a capacity of less than 30 MW or 50 MW [2].

Micro-hydro systems have the following components:

- a water turbine that converts the energy of flowing or falling water into mechanical energy that drives a generator, which generates electrical power - this is the heart of a micro hydropower system
- a control mechanism to provide stable electrical power
- electrical transmission lines to deliver the power to its destination

Depending on the site, the following may be needed to develop a micro-hydropower system [6] (Figure 1):

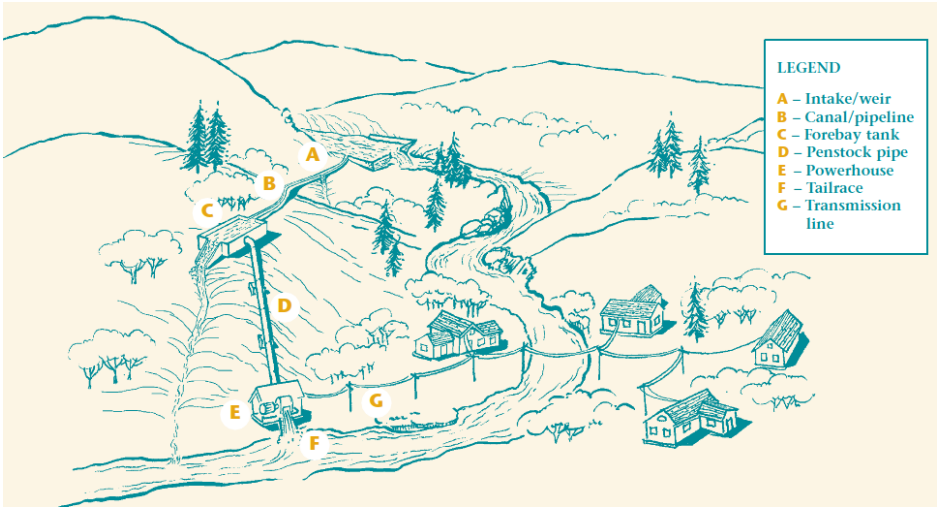

Figure 1 Principal components of a micro-hydropower system

- An intake or weir to divert stream flow from the water course
- Canal/pipeline to carry the water flow to the forebay from the intake
- A forebay tank and trash rack to filter debris and prevent it from being drawn into the turbine at the penstock pipe intake
- A penstock pipe to convey the water to the powerhouse
- A powerhouse, in which the turbine and generator convert the power of the water into electricity
- A tailrace through which the water is released back to the river or stream

Figure 2 shows the main components of a run-of-the-river micro-hydro scheme. This type of scheme requires no water storage but instead diverts some of the water from the river which is channeled along the side of a valley before being 'dropped' into the turbine via a penstock. In figure 2, the turbine drives a generator that provides electricity for a workshop. The transmission line can be extended to a local village to supply domestic power for lighting and other uses [4].

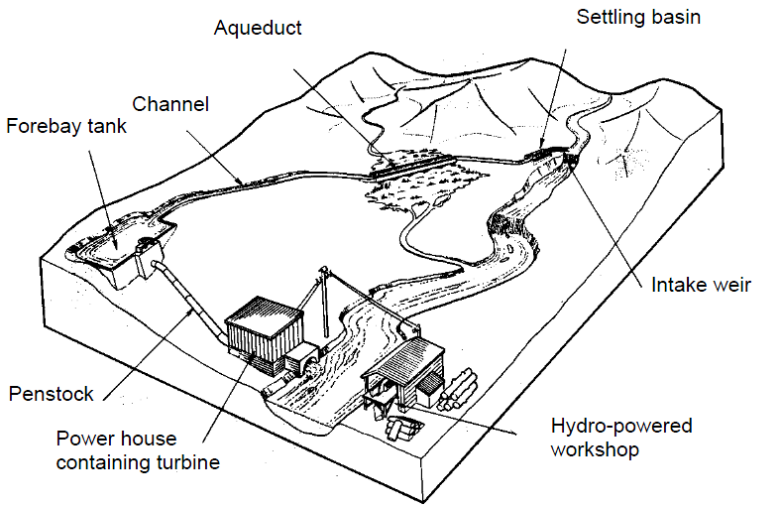

Figure 2 Layout of a typical micro hydro scheme

There are various other configurations which can be used depending on the topographical and hydrological conditions, but all adopt the same general principle [4].

1. Measurement of flow

The purpose of a hydrology study is to predict the variation in the flow during the year. Since the flow varies from day to day, a one-off measurement is of limited use. In absence of any hydrological analysis, a long-term measuring system may be set up. Such a system is often used to reinforce the hydrological approach and is also the most reliable way of determining actual flow at a site. One-off

measurements are useful to give a spot check on hydrological predictions. The flow measuring techniques discussed here are [5]:

1.1 Measuring weirs

A flow measurement weir is a weir with a notch in it through which all the water in the stream is made to flow/pass. The flow rate can be determined from the difference in height between the upstream water level and the bottom of the notch. For reliable results, the crest of the weir must be sharp and sediment must be prevented from accumulating behind the weir.

Weirs can be made of concrete, metal or even timber and must always be oriented at right angles to the stream flow. Location of the weir should be at a point where the stream is straight and free from eddies. Upstream, the distance between the point of measurement and the crest of the weir should be at least twice the maximum head to be measured. There should be no obstructions to flow near the notch and the weir must be perfectly sealed against leakage.

1.2 Rectangular notch measuring weir

For short-term or dry-season measurements, temporary measuring weirs (generally made of wood) are used and are staked into the bank and stream bed. It is necessary to estimate the range of flows to be measured before the weir, to ensure appropriate sizing of the weir notch. The use of permanent weirs may be a useful approach for small streams, but for larger streams staging of weirs would be a better alternative.

1.3. 'Salt gulp' method

The 'salt gulp' method of flow measurement is adapted from dilution gauging methods with radioactive tracers used for rivers. It is somewhat easy to carry out, reasonably accurate (error probability is less than 7%), and reliable for a wide range of stream types. It gives better results the more turbulent the stream. Using this approach, a spot check of stream flow can be taken in less than 10 minutes with very little equipment.

A bucket of heavily salted water is poured into the stream. The cloud of salty water in the stream starts to spread out while travelling downstream. After some distance downstream it will have filled the width of the stream. The cloud will have a leading part which is weak in salt, a middle part which is strong in salt and a lagging part which is weak again. The saltiness (salinity) of the water can be measured with an electrical conductivity meter. If the stream is small, it will not dilute the salt very much, so the electrical conductivity of the cloud (which is greater the saltier the water) will be high. Therefore low flows are indicated by high conductivity and vice versa.

The flow rate is therefore inversely proportional to the degree of conductivity of the cloud. The above phenomenon assumes that the cloud passes the probe in the same time in each case. But the slower the flow, the longer the cloud takes to pass the probe. Thus flow is also inversely proportional to the cloud-passing time. The equipment needed for 'salt gulp' flow measurement are a bucket, table salt, a thermometer and a conductivity meter (range 0-1000 m).

1.4. Bucket method

The bucket method is the simplest and fastest way of measuring flow in very small streams. The entire flow is diverted into a bucket or barrel and the time for the container to be filled is recorded. The flow rate is obtained simply by dividing the volume of the container by the filling time. Flows of up to 20 l/s can be measured using a 200-litre oil barrel. Equipment needed is a bucket/barrel and a stopwatch.

1.5. Float method

The principle of all velocity-area methods is that flow (Q) is equal to the average velocity (V) over a uniform cross-sectional area (A). Mathematically it can be represented as:

$$Q = V \times A \qquad (1)$$

The cross-sectional profile of a stream bed is selected in such a way that it does not alter too much over a certain distance/length of the stream (one can also take an average cross-section for a known length of stream – provided the stream bed is not altering too much). A series of floats, mostly pieces of wood, are then timed over a measured length of stream. A flow velocity is obtained by averaging the results over a large number of trails. This velocity must then be reduced by a correction factor which estimates the mean velocity as opposed to the surface velocity. By multiplying averaged and corrected flow velocity, the volume flow rate can be estimated.

1.6 Current meters

This is more accurate than the float method. A current meter consists of a shaft with a propeller or revolving cups connected to the end. The propeller is free to rotate and the speed of rotation is related to the stream velocity. A simple mechanical counter records the number of revolutions of a propeller placed at a desired depth. By averaging readings taken evenly throughout the cross section, an average speed of the stream can be obtained.

Methodology

To develop a micro hydropower project, there are a lot of considerations to be taken which are [6]:

1) Hydrology and site survey
2) Measurement of head
3) Measurement of flow
4) Civil work components
   - Weir and intake
   - Channels
   - Settling Basin
   - Spillways
   - Forebay tank
   - Penstock
5) Selection of turbine
   - Impulse turbines
   - Reaction turbines
6) Drive systems
7) Electrical power

One of the many methods for work for a micro hydropower project should cover the following [1]:

1) Pre-project activities
2) Planning
   - Site/hydrological surveys
   - Load demand and Socio-economic surveys
3) System planning/Engineering Design
4) Site Preparation
5) Procurement of Electro-Mechanical equipment (Turbines, Control devices/switch gears, generators)
6) Civil works (weirs, intake, track-rack, canal/channel, forebay, spillway, penstock, etc.)
7) Building of powerhouse
8) Installations of turbines and generators
9) Construction Local/mini grids
10) Testing
11) Commissioning
12) Local Capacity Building on post project management, operation and maintenance
13) Monitoring & Evaluation

3. Hydro-turbines selection

Turbines are also divided by their principle of operation and can be either impulse or reaction turbines. The rotor of the reaction turbine is fully immersed in water and is enclosed in a pressure casing. The runner blades are profiled so that pressure differences across them impose lift forces, akin to those on aircraft wings, which cause the runner to rotate. In contrast an impulse turbine runner operates in air, driven by a jet (or jets) of water, and the water remains at atmospheric pressure before and after making contact with the runner blades.

Turbines can be crudely classified as high-head, medium-head, or low-head machines, as shown in Table 2 [1].

Table 2 Impulse and reaction turbines

Turbine type	Head classification		
	High (>50 m)	Medium (10–50 m)	Low (<10 m)
Impulse	Pelton	Crossflow	Crossflow
	Turgo	Turgo	
	Multi-jet Pelton	Multi-jet Pelton	
Reaction		Francis (spiral case)	Francis (open flume)
			Propeller
			Kaplan

For small and micro hydro schemes choices are limited to either Francis, propeller or Cross flow types. The specific speed N_s is another criterion for selection of a turbine operating at its optimum efficiency. The specific speed is defined as [6].

$$N_s = \frac{N\sqrt{P}}{H^{0.25}} \quad (2)$$

Where N is rotational speed of turbine in rpm, p is output power in KW and H is net head in meter. The range of the specific speeds for various turbines is given in Table 3.

Table 3 Specific speed

Turbine	Specific speed
Pelton	8.5 to 47
Turgo	30 to 85
Cross flow	20 to 200
Francis	85 to 188

Conclusion

Hydropower is a clean source of energy. It does not consume but only uses the water, and after use the water is available for other purposes (although on a lower horizontal level). Hydropower covers a wide variety of projects of different sizes, functions and designs. This in turn leads to widely different impacts on and benefits for the natural and social environments. The conversion of the potential energy of water into mechanical energy is a technology with a high efficiency (in most cases double that of conventional thermal power stations). The use of hydropower can make a contribution to savings on exhaustible energy sources (fossil fuels). MHP (Micro hydropower) contributes to sustainable development by being economically feasible, respecting the environment (avoiding greenhouse gas emissions) and allowing decentralized production for the development of dispersed populations. MHP plants create local jobs for the monitoring of the operation of the plant [5].

Acknowledgment

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Eco-friendly Used Water Production using Natural Coagulants

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Abstract

The purpose of this research was to studying the most suitable conditions for the use of surface water and coagulant seeds. The variables were as following: kind of seeds, initial turbidity and initial hardness. Latin square was used as the experimental design. The initial turbidity were 62.5, 125, 250 and 500 NTU. The initial hardness were 75, 150, 300 and 600 mg/l and the kind of seeds were moringa seeds, tamarind seeds, corn seeds and green beans seeds. The statistical analysis results showed that the initial hardness, initial turbidity and kind of seeds were not significantly influence on the amount of reducing turbidity. However the initial hardness and kind of seeds were significantly influencing on the amount of reducing hardness, but the initial turbidity was not significantly influencing on the amount of reducing hardness.

Keywords : Coagulation, Natural coagulant.

Introduction

In Thailand surface water either from rivers or rain fed ponds are the main sources of water supply. River water drawn for human consumption and general household use can be highly turbidity particularly in the rainy season. Turbidity in wastewater caused by suspended matter, such as clay, silt, finely divided organic and inorganic matter, soluble colored organic compounds, and plankton and other microscopic organisms. A turbid water has muddy or cloudy appearance and it is aesthetically unattractive [1].The most widely applied conventional water treatment technology consists of coagulation and flocculation stage to remove turbidity in the form of suspended and colloidal material. These processes are effective at removing fine suspended particles that attract and hold bacteria and viruses to their surface. They can remove up to 99.9% of the bacteria and 99% of the viruses from water supplies[2]. Many coagulants are widely used in conventional water treatment processes, based on their chemical characteristics. These coagulants classified into inorganic, synthetic organic polymers, and natural coagulants. Aluminium and iron salts are the chemicals most commonly used together with synthetic organic polymers [3, 4]. However, AWWA; A. Ndabigengesereet al.; Raymond D. Letterman et al.; Robert G Miller et al. [5 - 8] have reported that aluminium which is the major component of alum may induced the Alzheimer's disease.

Plant extracts as an alternative method. This used for water purification for centuries. Moringa is especially has been rated as the best plant extracts used for water purification[9]. It will have been founding that the composition of Moringa causing coagulation during treatment. A protein that acts as a

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water-soluble cationic nature.It will have been founding that the composition of Moringa causing the capture during the driving force between particles.These particles are stable. So it must be a positive addition to help in the capture of particles. This will result in the reduction potential of suspended particles. This destabilize itself increase the likelihoodof exposure of suspended particles. Because agglomeration called 'flocs' are large enough to settle down with gravity [10].

Materials and Methods

1. Materials

1.1 Preparation of extracts from seeds.

The seeds were baking at 110 for 8 hr.Grinding dry seeds to a fine powder with a grinder. Screened with a 40 mesh screen size. By weighing 25 g dried powdered seeds mixed with sodium chloride and 1.0 mole / L spinning for 1 min, then filtered with muslin cloth. After filtering, the solution was filtered with a filter paper No. 1.

1.2 Preparation of synthetic raw water.

The natural properties of raw water are not static depending on the season. Therefore, in this research we used the synthetic raw water source. The quantity of the substance affects the hardness and turbidity in the raw water are constant.

1.2.1 Preparation of turbidity synthetic water.

Preparation of solution turbidity for the 4,000 NTU, taking hydrazine sulfate ($N_2H_4H_2SO_4$) 2.5 g of distilled water, 200 ml mixed with hexamethylene ethylene tetrachloride min ($C_6H_{12}N_4$) 25 g per 100 ml distilled water and adjust the volume as. 500 ml stored at room temperature for 20 to 48 hr of testing a Latin Square.

1.2.2 Preparation of hardness synthetic water.

Dissolve calcium chloride 0.304 g and magnesium chloride hexahydrated 0.304 g with distilled water 1 L. The solution has hardness 342 mg / L as a stock solution.

1.2.3 Test Jar tests

Jar test was using for flocculation as shown in Figure 1.The synthetic water 250 ml were puttingin a beaker, and put water plants in the prepared stir speed 150 rpm for 1 min stirring slow 25 rpm for 30 min and then set aside 1 hr.

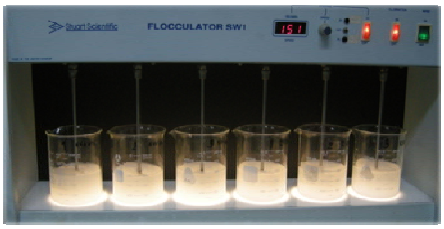

Figure 1 Jas test equipment.

2. Experimental Design and Latin Square

Since this experiment has 3 variables that affected the efficiency of turbidity reduction and reducing the hardness of the raw water wereinitial turbidity, initialhardness and kind of seeds. Each variable has four values, so be sure to experiment 64 times, each of these experiments are very time consuming. Therefore, the choice of the experimental design, Latin square to help reduce the number of trials on the remaining trials, only 16 times as shown in Table 1. Hardness and turbidity were analyzed byusing the American Standard Method for the Examination of Water and Wastewater, 20th.ed. 1998. [5]

Table 1 Experimental plan design by the Latin Square technique

initial hardness (mg/L)	kind of seeds			
	initial turbidity (NTU)			
	500	250	125	62.5
600	moringa	tamarind	corn	green beans
300	green beans	moringa	tamarind	corn
150	corn	green beans	moringa	tamarind
75	tamarind	corn	green beans	moringa

Results and Discussion

1.Experiments to determine the efficiency ofnatural coagulant.

The Latin square technique was used as an experimental plan design.The efficiency ofnatural coagulant calculated from turbidity reduction and hardness reduction. This calculated from the initial value and final value.

1.1 Reduction of turbidity

The effective in reducing turbidity were performed. The results are shown in Table 2. The statistical calculation was used for analyze the variance of reducing turbidity as are shown in Table 3, 4.

Table 2 Reduction of turbidity (%)

The initial hardness (mg/L)	The initial turbidity (NTU)			
	500	250	125	62.5
600	85.76	94.25	65.37	36.82
300	85.34	61.33	88.49	44.35
150	89.07	78.90	43.80	83.63
75	93.61	80.49	55.74	-171.24

Table 3 Column and row totals in each of the reducing turbidity.

(Row i) The initial hardness (mg/L)	(Column j) The initial turbidity (NTU)				Row Total
	500	250	125	62.5	
600	85.76	94.25	65.37	36.82	282.20
300	85.34	61.33	88.49	44.35	279.51
150	89.07	78.90	43.80	83.63	295.40
75	93.61	80.49	55.74	-171.24	58.60
X_j Column Total	353.78	314.97	253.40	-6.44	915.71

Table 4 The analysis of variance efficient reduction of turbidity.

Sort of variance (SOV)	Degree of freedom (df)	Sum of square (SS)	Mean square (MS)	F	$F_{0.1}$
Row	3	9,706.65	3,235.55	1.25	3.29
Column	3	19,747.05	6,582.35	2.54	3.29
The kind of seeds	3	16,071.02	5,357.00	2.07	3.29
Error	6	15,518.60	2,586.43		
Total	15	61,043.32			

In Table 4, to compare between F and $F_{0.1}$of row, column and the kind of seeds. All of F were less than $F_{0.1}$. The statistical analysis results showed that the initial hardness, initial turbidity and kind of seeds were not significantly influenced on the amount of reducing turbidity. Moringa, tamarind, corn and green beans were the good coagulanted for reducing turbidity.

1.2 Reduction of hardness

The effective in reducing hardness were performed. The results are shown in Table 5. The statistical calculation was used for analyze the variance of reducing hardness as are shown in Table 6, 7.

Table 5 Reduction of hardness (%)

Theinitial hardness (mg/L)	Theinitial turbidity (NTU)			
	500	250	125	62.5
600	27.60	57.32	10.91	23.43
300	29.09	68.15	60.51	27.00
150	22.96	49.33	28.78	68.88
75	77.82	46.00	56.92	61.11

Table 6 Column and Row totals in each of the reducing hardness

(Row i) The initial hardness (mg/L)	(Column j) initial turbidity (NTU)				Row Total
	500	250	125	62.5	
600	27.60	57.32	10.91	23.43	119.26
300	29.09	68.15	60.51	27.00	184.75
150	22.96	49.33	28.78	68.88	169.95
75	77.82	46.00	56.92	61.11	241.85
X_j Column Total	157.47	220.80	157.12	180.42	715.81

Table 7 The analysis of variance efficient reduction of hardness.

Sort of variance (SOV)	Degree of freedom (df)	Sum of square (SS)	Mean square (MS)	F	$F_{0.1}$
Row	3	1,908.48	636.16	8.92*	3.29
Column	3	672.88	224.29	3.15	3.29
The kind of seeds	3	3,242.86	1,080.95	15.16*	3.29
Error	6	427.84	71.31		
Total	15	6,252.07			

In Table 7, to compare between F and $F_{0.1}$ of row, column and the kind of seeds. F of row (the initial hardness) andthe kind of seeds were higher than $F_{0.1}$.The statistical analysis results showed that the initial hardness and kind of seeds were significantly influenced on the amount of reducing hardness, but the initial turbidity was not significantly influenced on the amount of reducing hardness.By comparison Orthogonal comparison showed that tamarind vs. green bean and corn vs. green bean were the significantly influenced for the reducing hardness.Tamarind was the good coagulanted for reducing hardness.

Conclusion

Reduction of turbidity: Moringa, tamarind, corn and green beans were the good coagulanted for initial turbidity 62.5 – 500 NTU and initial hardness 75 – 600 mg/L raw water.

Reduction of hardness: tamarind was the good coagulanted for initial turbidity 62.5 – 500 NTU and initial hardness 75 – 600 mg/L raw water.

Acknowledgement

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Solving the Relativity and Performance of Transmission Line Model with Computer Program

Wanchai Khamsen[1*]

Abstract

This paper presents a method to solve the relativity and performance of transmission line model with computer program. The transmission line parameters are an important of the power system used for calculating the voltage, current, power and others, which is the efficiency of the power transmission system. The relativity and performance of transmission line model program is programmed with Delphi in graphical user interface. This program can calculated the voltage, current, voltage regulation, power factor and efficiency of the short, medium and long transmission line. To verify the performance of the proposed program, the results are compared with the manual method. The results show that the program method is able to obtained 100 percent accuracy.

Keywords : Transmission Line, Computer Program

Introduction

Nowadays, the power system has been developed increasingly. Security and stability of the power systems are necessary for planning and generating the power system. The electricity demand is likely to increase. Form this case, the daily electrical energy used has changed over time. Therefore, the power systems require planning, analysis, protection economic dispatch and stability. Conductors are the main components in the power systems for transmitting the power to the load.

Transmission and distribution capability of the electric power transmission line depend on the parameters such as resistance, inductance, capacitance, and conductance. These parameters are an important factor used for calculating voltage, current, power factor and voltage regulation in the transmission line model. There are two methods to calculate the line model. The first one is to solve by hand. However, it may be difficult and cause error. The second method is to use the computer program.

Users put the parameter data into the program and then they are automatic calculated. This method has some advantages such as simplicity, fast, accurate and takes less time. Matlab program is used by Hadi Saadat [1]. Matlab functions are developed for calculating the line parameters and performance. However, users must have knowledge on the Matlab program. The Delphi program is developed for calculating the parameters of transmission line [2], electrical circuit design for electrical welder [3], condominium [4], motor [5], and voltage drop [6]. Because this program is written in a graphical format which is easy to use. Therefore, this paper develops it to solve the relativity and

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performance of the transmission line model where the short, medium and long transmission line are considered.

This paper is organized as follows. First section describes background of the line model and methodology of the proposed program. The second shows the results and discussions. And the last section concludes the paper.

Background

All transmission lines in power system show the electrical properties of resistance, inductance, capacitance and conductance. The conductance and capacitance are due to the effect of magnetic and electric fields around the conductor. These parameters are important for the development of the transmission line model used in power system analysis [1], [7]. The equivalent circuit of line model is shown in Figure 1.

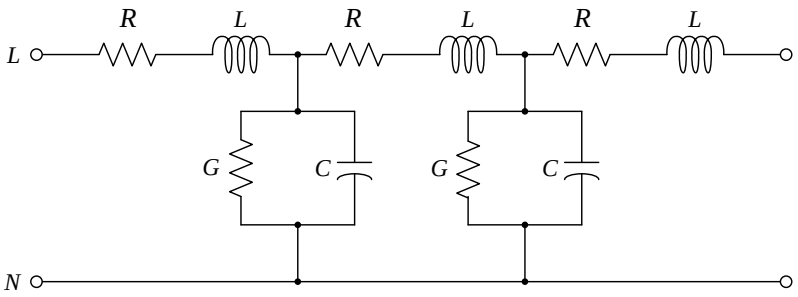

Figure 1 The equivalent circuit of line model.

The equivalent circuit of line model used to calculate voltage, current, power factor, voltage regulation and power flows depends on the length of the line. The lengths of the transmission line are divided three models: short, medium and long transmission line model.

1. Short transmission line model

The length of short transmission line is less than about 80 km. The capacitance may often be ignored without much error [1], [7]. Therefore, the short line model is obtained by multiplying the series impedance as shown in Figure 2.

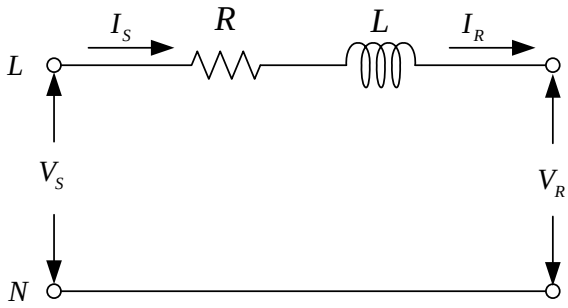

Figure 2 The equivalent circuit of short line model.

Where V_S and I_S are the phase voltage and current at the sending end of the line, V_R and I_R are the phase voltage and current at the receiving end of the line. Figure 2 is series circuit, the phase voltage and current at the sending end are

$$I_S = I_R = I \tag{1}$$

$$V_S = V_R + IZ \tag{2}$$

Voltage regulation of the line may be defined as the percentage change in voltage at the receiving end of the line in going form no-load to full-load is expressed as

$$\%\ voltage\ regulation = \frac{|V_{R,NL}| - |V_{R,FL}|}{|V_{R,FL}|} \times 100 \tag{3}$$

or

$$\%\ voltage\ regulation = \frac{|V_S| - |V_R|}{|V_R|} \times 100 \tag{4}$$

Where $V_{R,NL}$ and $V_{R,FL}$ are the no-load and full-load phase voltage at the receiving end of the line. The efficiency of the transmission line is expressed as

$$\eta = \frac{P_{out}}{P_{in}} \times 100 = \frac{\sqrt{3}V_R I_R \cos\theta_R}{\sqrt{3}V_R I_R \cos\theta_R + 3I_R^2.R} \times 100 \tag{5}$$

2. Medium transmission line model

The medium length lines are above 80 km and below 250 km [1], [7]. The transmission line may be represented by a nominal π and T models as shown in Figure 3-4.

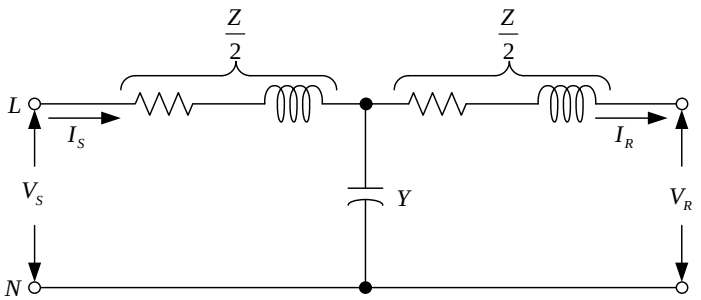

Figure 3 Nominal π model for medium length line.

From (Figure 3), the sending end voltage and current are express

$$V_S = (1+\frac{YZ}{2})V_R + (Z+\frac{Z^2Y}{4})I_R \quad (6)$$

$$I_S = YV_R + (1+\frac{YZ}{2})I_R \quad (7)$$

Comparing (6) and (7), the ABCD constant for the nominal π model are express as

$$A = 1+\frac{YZ}{2};\quad B = Z+\frac{Z^2Y}{4};\quad C = Y;\quad D = 1+\frac{YZ}{2} \quad (8)$$

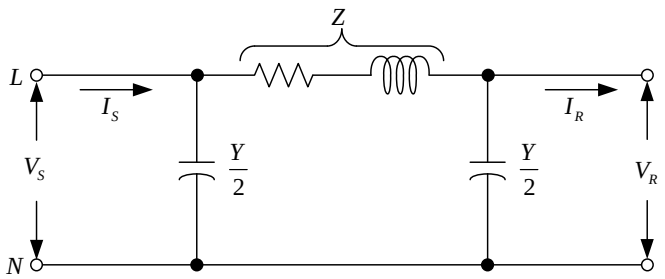

Figure 4 Nominal T model for medium length line.

From (Figure 4), the sending end voltage and current are express

$$V_S = (1+\frac{YZ}{2})V_R + ZI_R \quad (9)$$

$$I_S = (\frac{ZY^2}{4}+Y)V_R + (1+\frac{YZ}{2})I_R \quad (10)$$

Comparing (9) and (10), the ABCD constant for the nominal π model are express as

$$A = 1+\frac{YZ}{2};\quad B = Z;\quad C = \frac{Y^2Z}{4}+Y;\quad D = 1+\frac{YZ}{2} \quad (11)$$

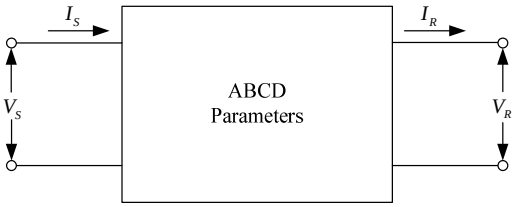

Figure 5 Two port network of transmission line.

The transmission line may be represented by a two port network as shown in Figure 5. The sending end equations can be written in term of generalized circuit as the ABCD constants

$$\begin{bmatrix} V_S \\ I_S \end{bmatrix} = \begin{bmatrix} A & B \\ C & D \end{bmatrix} \begin{bmatrix} V_R \\ I_R \end{bmatrix} \tag{12}$$

3. Long transmission line model

Line above 250 km and longer in length are termed as long lines. For a more accurate solution the exact effect of the distributed parameters must be considered [1], [7]. The voltage and current at any point on the line are derived. The one phase of a distributed line of length l km is shown in (Figure 6).

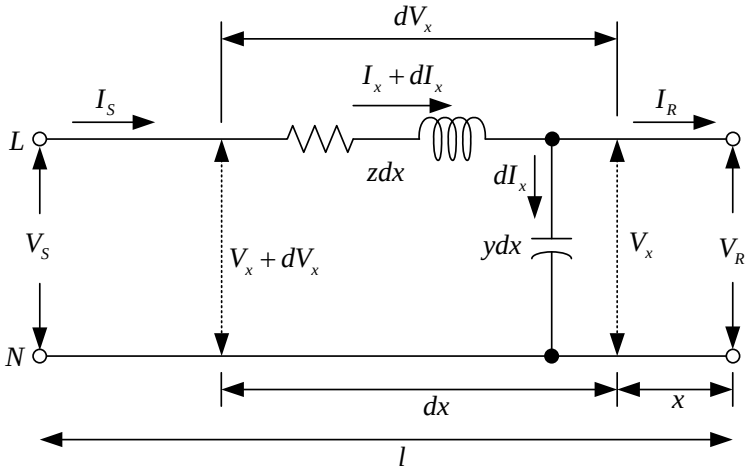

Figure 6 Long line with distributed parameters.

The sending end voltage and current are express

$$V_S = (\cosh \gamma l)V_R + (Z_C \sinh \gamma l)I_R \tag{13}$$

$$I_S = (Y_C \sinh \gamma l)V_R + (\cosh \gamma l)I_R \tag{14}$$

Represented as the ABCD constants are express

$$\begin{bmatrix} V_S \\ I_S \end{bmatrix} = \begin{bmatrix} A & B \\ C & D \end{bmatrix} \begin{bmatrix} V_R \\ I_R \end{bmatrix} \quad (15)$$

The ABCD constant for the long line are express as

$$A = \cosh \gamma l; \quad B = Z_C \sinh \gamma l; \quad C = Y_C \sinh \gamma l; \quad D = \cosh \gamma l \quad 16)$$

4. The relativity and performance of transmission line model with computer program

To solve the relativity and performance of transmission line model, the development of the Delphi program is proposed. It consists of various tools that allow for easier programming. This program is visual programming and rapid application development [8]. The proposed program used to calculate voltage, current, power factor, voltage regulation and efficiency which the short, medium and long transmission line.

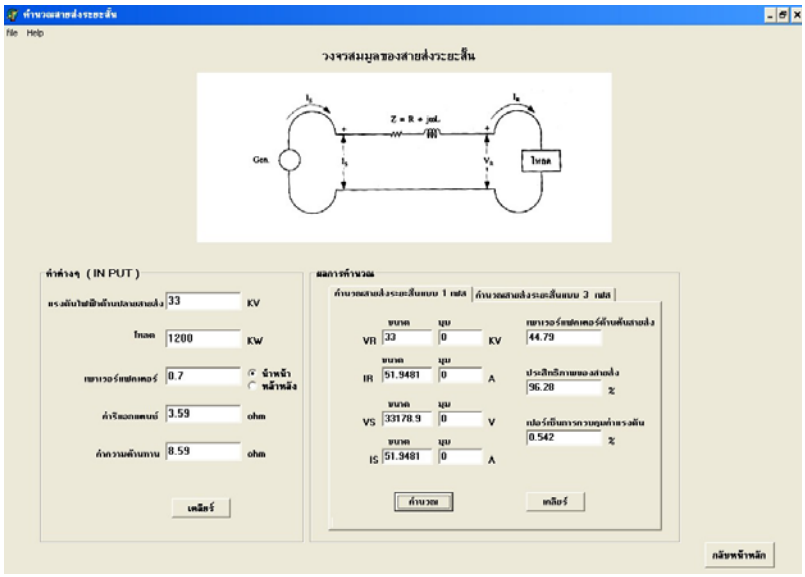

Figure 7 Window for calculating the short length line.

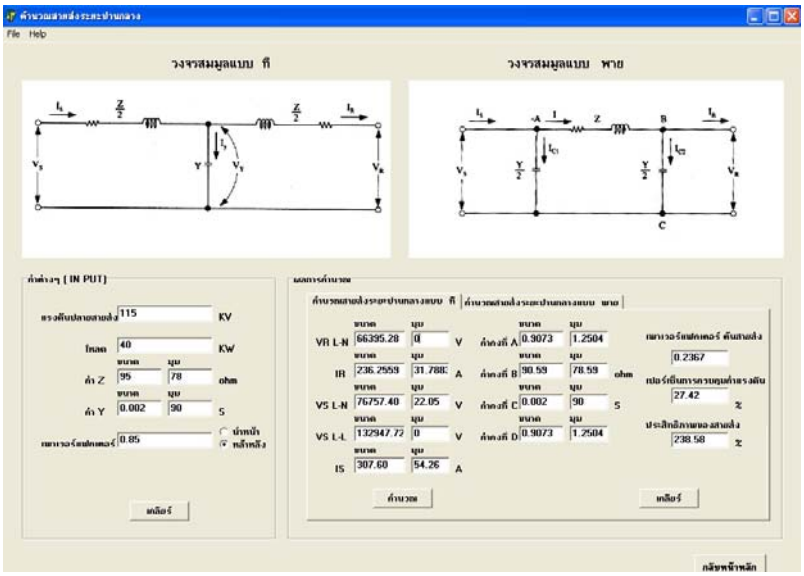

Figure 8 Window for calculate of medium length line.

(Figure 7-9) show window for calculating the short, medium and long length lines. The data of output and transmission line are entered into the proposed program. This proposed program used to calculate voltage, current, power factor, voltage regulation and efficiency as shown in the window.

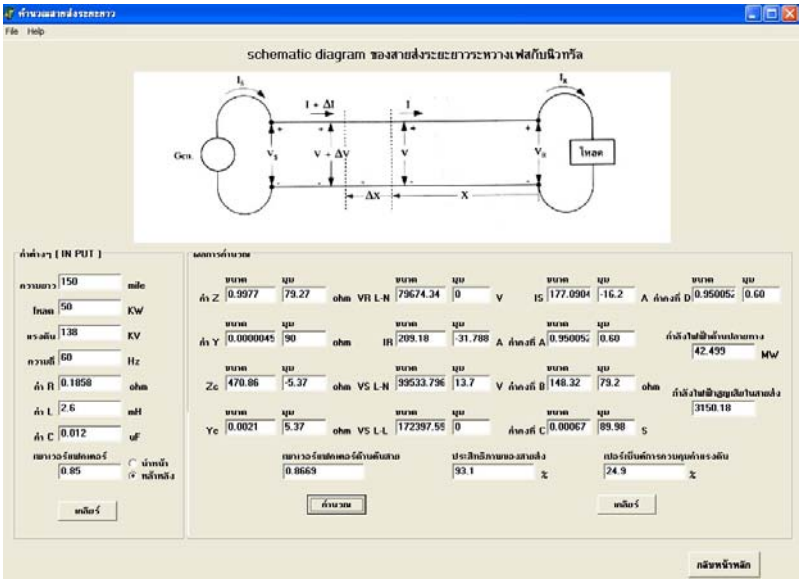

Figure 9 Window for calculate of long length line.

Results and Discussions

Performance of the proposed program is here investigated with different calculation techniques. Both sending and receiving end of the line model such as voltage, current, power factor, voltage regulation and efficiency are shown. The system parameters for test are three cases; short, medium and long length line.

In the case of short length line, the parameters are 220 kV three phase?????, distance = 40 km, f = 60 Hz, R = 0.15 Ω/km, L = 1.3263 mH/km and S_R = 381 MVA at 0.8 power factor lagging. In the case of medium length line, the parameters are 325 kV three phase, distance = 130 km, f = 60 Hz, R = 0.036 Ω/km, L = 0.8 mH/km, C = 0.0112 μF/km and S_R = 270 MVA at 0.8 power factor lagging. And the last case, long length line, the parameters are 500 kV three phase, distance = 250 km, f = 60 Hz, R = 0.045 Ω/km, L = 0.4 mH/km, Y = 4 μS/km and P_R = 800 MW at 0.8 power factor lagging. Test results from the proposed program, manual and method in [1] are compared shown in Table 1-3. The results indicate that the solutions of the proposed program are the same as the other methods. However, the computed time of the proposed program is lower than that of the other method.

Table 1 Performance of the proposed program, manual and Ref [1] method in case of the short length line.

Parameters	Methods		
	Manual	Ref [1]	Proposed program
V_S (kV)	250.018	250	250.017
V_R (kV)	220	220	220
I_S (A)	999.866	1000	999.89
I_R (A)	999.866	1000	999.89
pf_S	0.7455	0.7455	0.7456
η (%)	94.425	94.4	94.43
% VR	13.645	13.6	13.64

Table 2 Performance of the proposed program, manual and Ref [1] method in case of the medium length line.

Parameters	Methods		
	Manual	Ref [1]	Proposed program
V_S (kV)	344.862	345.002	344.734
V_R (kV)	325	325	325
I_S (A)	420.9517	421.132	420.95
I_R (A)	479.6448	479.64	479.64
pf_S	0.8704	0.8697	0.8703
η (%)	98.5266	98.52	98.53
% VR	7.2658	7.309	7.248

Table 3 Performance of the proposed program, manual and Ref [1] method in case of the long length line.

Parameters	Methods		
	Manual	Ref [1]	Proposed program
V_S (kV)	568.686	568.223	568.726
V_R (kV)	500	500	500
I_S (A)	1405.261	1409.249	1405.009
I_R (A)	1154.7	1154.7	1154.7
pf_S	0.8237	0.826	0.8239
η (%)	94.674	94.674	94.674
% VR	13.087	13.647	13.09

Conclusion

This paper proposes the method to solve the relativity and performance of transmission line model by the computer program. Delphi program is developed for calculating the line relativity and performance. The model is used to calculate voltage, current, power factor, voltage regulation and efficiency of the sending and receiving end which the short, medium and long transmission line. From the test results, proposed program can provide the solutions as same as the other methods in parameters. However, the period time of computation proposed program is lower than the results from the other method. And the proposed approach could be applied to solve the relativity and performance of transmission line model.

Acknowledgement

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The Analyze Designs and Development application Oscilloscope Program interface via Android Operating System.

Pichate Sujintawong,[1*] Wacheerapn Kaewprapan[1] and Surachai Suksakulchai[1]

Abstract

The purposes of this research were 1.) To analyze design and Development application Oscilloscope Program interface via Android. 2.) To evaluate efficiency of application Oscilloscope Program interface the quality assessment form of laboratory set based on learning problem for students who want to learn the operation of The Analyze Designs and Development application Oscilloscope Program interface via Android Operating System to the study content on the population was 30 students who are studying in the second year of diploma in electronics program from Chaibadan Industrial and Community Education College, and 25 of them were simple random sampling to be the sampled group. these groups were tested by pre-test and post-test of the laboratory set with laboratory sheets, comparison of achievement of learning with t-tested, and analysis of data for finding the efficiency of laboratory set with E1/E2. Laboratory set was at 82.62/80.12 the students who studied with the proposed laboratory set can understand by having learning achievement significant than learning without the proposed laboratory set at level of 0.01 3.) To evaluate users' satisfaction with the application Oscilloscope Program interface. This research studied the patterns of application Oscilloscope Program interface. The population of this study consisted of 30 residents from the Department electrical. Fifty percent of the populations, comprising 25 residents, were randomly selected as subjects of the evaluation efficiency of application Oscilloscope Program interface. And user satisfaction using a specially designed questionnaire. The results of the efficiency evaluation were as follows the level of satisfaction of application Oscilloscope Program interface. Users was at a high level (X = 4.43)

Keywords : Designs and Development, application Oscilloscope Program, interface via Android Operating System.

Introduction

The current education Thai system, the National Education A.D. 1999 promulgated since August 20, 1999, resulting in the Education Reform Act such systems involves significant. Thus, taught the process must study the doctrine that all learners have the knowledge. The ability to learn and develop themselves. And assume that the learner is of utmost importance. Need to develop a curriculum that emphasizes learner-centered. Focused on the cognitive skills to handle situations. And the application of knowledge to prevent and solve problems. In the event that the students have learned from experience to practice as a solution to a love of reading and the inquiry continued. Teaching by incorporating How to practice critical thinking skills and process layouts is to conduct experiments. I currently have a limit on the budget deficit in the supply of trial and testing. And a shortage of learning materials, the learning outcomes of students remained relatively low, indicating that the students lack an understanding of the

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lesson. Can build relationships and linking knowledge. Between theory and practice them. Is causing significant problems in the quality of the learner. The lack of teaching materials is a problem for the instructor. Making the students have been learning that cannot be learned fully. Education that develops the ability of students to instructor are not enough. Especially in teaching practice must be organized teaching. To develop the competencies of the learner by technology applications in teaching.

Condition of such problems has been thought and designed The Analyze Designs and Development application Oscilloscope Program interface via Android Operating System. To save the expense of buying equipment and effective teaching and helping the students understand the lesson better, hoping that the achievement of learners will be higher. The objectives lay of courses diploma in electronics program from Chaibadan Industrial and Community Education College

The create and study the performance of The Analyze Designs and Development application Oscilloscope Program interface via Android Operating System Generated can be used in teaching the practical performance by the 80/80. The compare the learning achievement of the experimental group. Working on a job together with a series created to the control group with the experimental studies, students who experiments with normal the control group generated a higher achievement than students taught with the job. Usual experimental

Materials and Methods

1. Theory and related works

What is The Analyze Designs and Development application Oscilloscope Program interface via Android Operating System? Is developing applications on the mobile using systems analysis and design principles in the creation and development of information systems. Because analysts. Systems need to communicate with multiple people. Learn the management and operation of the organization to be knowledgeable about computer systems. Who can analyze the system should have experience in programming. Knowledge of networking and databases. Which was used in the design of knowledge systems are different to the conditions, so the role of the analyst is to study the system. And make recommendations for improvement and development are complete. Which all work must be sequenced and studied how to analyze and design systems to understand each step during system analysis to design a new system. You can decide whether a new system should be designed Input / Output. Electronic instrumentation used to measure and display the waveform as the image appears on the screen, such as measuring electrical current. Or voltage is AC or DC power measurements to measure the frequency of the phase of the signal. Including measurement and pulse readings amplitude of the signal at the peak - to - peak or the peak signal can display single or multiple signals on the same screen. A detail of the above is that of application development oscillator scope on the Android operating system. To the device. Using equipment and application scope oscillator on the Android operating system in the training of the teaching process, learning through practice or action which Knowledge is the Knowledge

gained from experience. Learning process leading to the development of various fields such as the physical, emotional, social and intellectual , and the oscillator device price compared with the market scope and

Application scope oscillator operating system. Ann will have Android devices are cheaper. And can be used to train students were similar.

1.1 The purpose of the research?

The Analyze Designs and Development application Oscilloscope Program interface via Android Operating System by asking experts and satisfaction of the application scope oscillator on the Android operating system. A total of 25 people.

Design requirements for The Analyze Designs and Development application Oscilloscope Program interface via Android Operating System project was developed by following the concepts described by Shelly, Cash man & Rosenblatt (2003) in System Development Life Cycle: SDCL. The five phases of the development cycle are shown in Figure 1. They are:

1. System planning to perform a preliminary investigation to identify the nature and scope of the system or problem. A feasibility study was conducted to review the anticipated costs and benefits and to recommend a course of action based on operational, technical, economic and time factors.

2. System analysis to build a logical model of the new system. The Analyze Designs and Development application Oscilloscope Program interface via Android Operating System analysis process gathered data from various internal sources and a system requirements document was produced, describing management and user requirements, costs and benefits, and outlining alternative development strategies.

3. System design to create a blueprint satisfying all documented requirements for the system. The Analyze Designs and Development application Oscilloscope Program interface via Android Operating System had a user interface designed for it, and all necessary outputs, inputs, process and infrastructure to support the system were identified.

4. System implementation to construct The Analyze Designs and Development application Oscilloscope Program interface via Android Operating System. This included converting data to the new systems' files, training users, and performing the actual implementation and transition to the new system.

5. System operation and support to maintain changes, correct errors and adapt to changes in the environment.

Figure 1 The Summary of development stages followed in The Analyze Designs and Development application Oscilloscope Program interface via Android Operating System.

1.2 How the Program work?

The Design Programming App Inventor is a tool used to develop apps on mobile applications At present, mobile and tablet. Ann organizations operating system Android has many applications and application developers in order to meet the needs of users. Difficult for application developer's rookie. I want to learn about programming App Inventor is a tool used to develop apps on mobile applications. Which was designed and developed by the team of long latency? And now in the direction of the MIT (Massachusetts Institute of Technology) for the work through the Internet is the main which use a web browser to work with Web servers. Applications now being developed will be stored on a computer server. This time we run it. To visit the website. appinventor.mit.edu / to be used with applications built EDIT. And develop further. Another approach is to develop applications with new mobile and to be used as a basis for the development of advanced applications further.

Figure 2 The Programming App Inventor is a tool used to develop apps on mobile applications

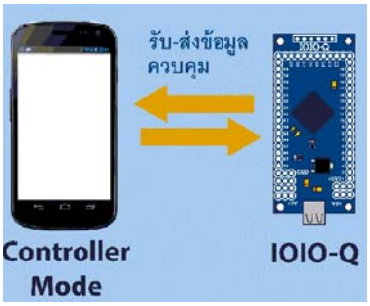

Figure 3 The Connected to the Input and output board connected Android device .

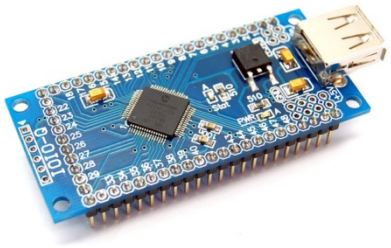

Figure 4 The Connected to the Input and output Circuit interface board Circuit interface.

Connected to the Input and output Circuit interface board Circuit interface. Microcontroller Numbers PIC24FJ128DA a module USB OTG inside so it can work as a USB host and load the firmware , the IOIO and use it to develop applications with the way the device side only. no need to write the program into the microcontroller.

- an input port 48 output channels .
- 16-channel analog input modules convert the analog signal to a digital resolution of 10 bits, inside the chip .
- 10-bit resolution PWM output channels 9 .
- A serial port UART 4 series.
- There is a bus system, the second leg of the third set compatible with bus I2C.
- There is a USB A connector to USB cable connection port that came with Android device to connect instantly. Without any modification .
- The LED display function and LED power indicator .
- Power supply 5 to 12V.
- The power supply on the board with two sets of 3.3V for microcontroller circuit and 5V 1500mA PIC24FJ128 and a switching device to lead the party to bring Android to share it with.

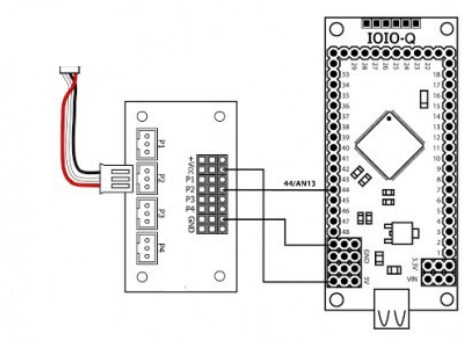

Figure 5 The Connected to the Input and output Circuit interface board

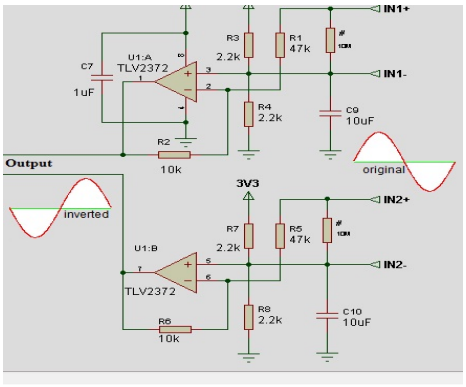

Figure 6 The Circuit interface application Oscilloscope Program interface via Android Operating System.

Testing Program works?

Comparison Oscilloscope and The Development of virtual Oscilloscope interface application on Android Operating System.

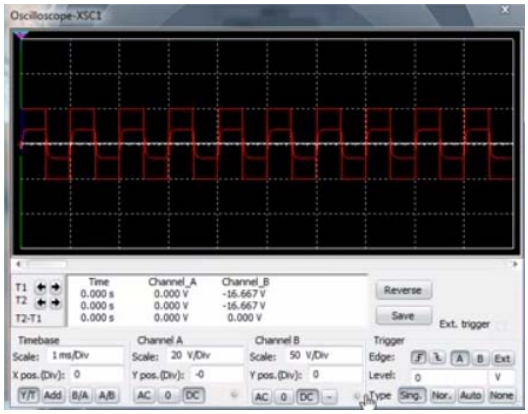

Figure 7 The Comparison of application Oscilloscope Program interface via Android Operating System.

1.3 The research design and data collection Research and statistics

1.3.1 IOC : Index of item objective congruence

$$IOC = \frac{\sum R}{N} \quad (1)$$

1.3.2 Level of Difficulty and Power of Discrimination

$$P = \frac{P_H + P_L}{2N} \quad (2)$$

1.3.3 Discrimination

$$r = \frac{P_H - P_L}{N} \quad (3)$$

1.3.4 Mean

$$\overline{X} = \frac{\sum fx}{N} \quad (4)$$

1.3.5 Kuder-Ricchardson 20:KR_{20}

$$r_n = \frac{n}{n-1}\left[1 - \frac{\sum pq}{S^2}\right] \quad (5)$$

1.3.6 Standard Deviation

$$S.D. = \sqrt{N\frac{\sum fx^2 - (\sum fx)^2}{N(N-1)}} \quad (6)$$

1.3.7 E_1 and E_2

$$E_1 = \frac{\left[\frac{\sum X}{N}\right]}{A} \text{ X } 100\%$$

$$E_2 = \frac{\left[\frac{\sum F}{N}\right]}{B} \text{ X } 100\% \quad (7)$$

1.3.8 T-dependent sample test

$$t = \frac{\sum D}{\sqrt{\frac{n\sum D^2 - (\sum D)^2}{(n-1)}}} \quad (8)$$

2. Experiments detail

This research is experimental research. Use single group pretest sample should be tested prior to Pre - test and post - test to find effective after learning of a series of experimental studies of student achievement. This teaches a series of experiments that are based on diploma electronic courses. For the Office of Vocational Education Commission with the following steps: determining population and sample Student of 25 people. Create a tool used in research and the experimental assembly.The research design and data collection Research and statistics

Results and Discussions

The research in this experimental research. The objective is to create a set of experiments and to determine the efficiency and foremost learning sample. Used as a medium of instruction and the course content. The vocational courses in Chaibadan Industrial and Community Education College. This study was conducted according to the procedures and data collection as designed by assembling equipment used in the normal course. The experimental set built for performance. Install the power supply and

connect the signal cable to the unit. And used to measure signals at various points. As defined in the job. Record of the trial and data collection. The first class will test score. And test scores after each treatment course of 3 trials and the scores of the test after learning all the experiments. Student sample of 25 people, the detail of which is shown in the table.

Table 1 Experiment setting for Test scores at the end of the experiments and tests, including the study of a sample of 25 people.

No.	The Pretest scores [A]				The end of the experiments and tests [B]
	20	20	10	50	50
1	12	8	4	18	35
2	10	10	6	28	34
3	9	11	7	22	29
4	11	12	5	20	31
5	13	11	5	26	36
6	15	11	4	22	34
7	11	15	6	29	36
8	10	13	3	18	29
9	11	14	4	20	34
10	10	12	5	18	35
11	13	13	4	28	34
12	12	11	3	22	29
13	11	14	3	20	31
14	11	11	5	26	36
15	10	12	5	22	34
16	12	14	6	29	36
17	10	10	4	18	29
18	14	11	4	20	34
19	10	13	4	18	35
20	11	11	5	28	34
21	10	11	4	22	29
22	13	10	4	20	31
23	10	12	5	26	36
24	11	13	4	22	34
25	12	11	6	29	36

E_1 and E_2

$$E_1 = \frac{\left[\frac{\sum X}{N}\right]}{A} \text{ X } 100\%$$
$$E_2 = \frac{\left[\frac{\sum F}{N}\right]}{B} \text{ X } 100\% \quad (9)$$

With a confidence 82.62 /80.12 performance.

Table 2 Experiment setting for Tables Test a sample of 25 people

No.	Pre-test	Post-test
1	18	35
2	28	34
3	22	29
4	20	31
5	26	36
6	22	34
7	29	36
8	18	29
9	20	34
10	18	35
11	28	34
12	22	29
13	20	31
14	26	36
15	22	34
16	29	36
17	18	29
18	20	34
19	18	35
20	28	34
21	22	29
22	20	31
23	26	36
24	22	34
25	29	36

Table 3 Experiment setting for Tables T-Test Dependent

	n	$\overline{X}$	S.D.	T-Test
Pre-test	25	21.95	3.75	11.04**
Post-test	25	32.5	3.03	

**P>0.01

Conclusion

In this paper, is intended to create. And a performance diploma classes for students Chaibadan Industrial and Community Education College with two years on the 80/80 up by achievement test generated a total of 50 multiple-choice questions with four options, the difficulty levels between 0.54 to 0.80 power. Classification between 0.20 - 0.68 and 0.87, with a confidence 82.62/80.12 performance. Users was at a high level ($\overline{X}$ = 4.43)

Acknowledgement

This research work done well. The authors would like to thank the concepts and recommendations As well as the various solutions that benefit the research with attention as well, and thanks to the electronics department. Chaibadan Industrial and Community Education College the support and tools. Sample of students used in the experimental research.

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Curve Fitting by Computer Programming for Interpreting Soil Mechanics Testing Results

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Abstract

This paper, based on the numerical methods, proposes the computer programming to interpret the soil mechanics testing results. The numerical methods which are the cubic spline fitting and the third-order polynomial regression were used as the process for curve fitting and interpreting the soil mechanics properties. The vertex of the curve is determined to interpret the results of testing. The results show that the third-order polynomials regression method is appropriate for plotting the curve of unconfined compressive strength because the curve is smooth and the shear strength parameters are similarly which compare to the cubic spline fitting method. For the compaction curve, both the cubic spline fitting method and the third-order polynomials regression method are appropriate for plotting the curvebecause the compaction curve is smooth and through the points which corresponding to the recommendation of ASTM D698 and ASTM D1557.

Keywords : Curve Fitting, Numerical Methods,Computer Programming, Soil Mechanics Testing Results

Introduction

A fundamental problem of interpreting in engineering and science is that of interpolation. Many properties of materials used in civil engineering are obtained from laboratory testing. Soil mechanics laboratory is the one of materials testing in civil engineering. It is used to determine the strength of soil which is an important property for construction materials or foundation work.For construction materials, compaction test always experiment to determine the optimum moisture content (OMC) and maximum dry density which can obtained from compaction curve. For foundation work, unconfined compression test is always experiment to obtain the undrained shear strength from curve fitting.Therefore, experimental data are used to draw a curve and predict the vertex of curve. Dawidoswski and Koolen [1] suggest that the determination of the vertex of curve is corresponding to the smallest radius of curvature. Many researchers [2, 3, 4, 5] classified the method for curve drawing in twogroups: the regression method and the fitting method. Gregory et al. [3] reported that the polynomial method successfully used for predicting the vertex of curvature. Zamani [6] used the methods which are based on B-spline and Bézier curves and computer graphic for fitting the smooth curve. According to ASTM D689 [7] and ASTM D1557 [8], they recommended the compaction curve should be plotted as a smooth curve through the points. Therefore,

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this curve can be drawn by two processes which are human drawing and numerical method. Curve fitting by human drawing is not precise because of human error, therefore; numerical method is more suitable.

This purpose is to compare the curve drawing by the cubic spline fitting method (recommended by ASTM) to the third-order polynomial regression method (recommended by Gregory et al.). The algorithm and the computer programming which are developed to be an application used to draw the curve and report the strength properties of soil at the vertex of curve. Section 2, materials and methods are the theoryand the algorithm to draw the curve and report the strength properties at the vertex.Section 3, is the results and discussion which show the developed program and the comparison of the soil properties between fitting method and regression method. Finally, in Section 4, the conclusions show the appropriated method for interpreting the soil mechanics testing and also the efficiency the developed program.

Materials and Methods

1. Theory and related works

1.1 The Third-Order Polynomials Curve Fitting[9]

The least-squares procedure can be readily extended to fit the data to the third-order polynomial. This polynomial is described by the following equation for 4 unknowns, a_0, a_1, a_2, a_3. The equation is

$$f(x) = y = a_0 + a_1 x + a_2 x^2 + a_3 x^3 + e \tag{1}$$

and the sum of square of the residuals is

$$S_r = \sum_{i=1}^{n} e_i^2 = \sum_{i=1}^{n} \left(y_i - a_0 - a_1 x - a_2 x^2 - a_3 x^3 \right)^2 \tag{2}$$

To generate the least-square fit, the derivative of Eq. (2) with respect to each of the unknown coefficients of the polynomial, as in

$$\begin{aligned}
\frac{\partial e}{\partial a_0} &= (n)a_0 + \left(\sum_{i=1}^{n} x_i\right)a_1 + \left(\sum_{i=1}^{n} x_i^2\right)a_2 + \left(\sum_{i=1}^{n} x_i^3\right)a_3 - \sum_{i=1}^{n} y_i &&= 0 \\
\frac{\partial e}{\partial a_1} &= \left(\sum_{i=1}^{n} x_i\right)a_0 + \left(\sum_{i=1}^{n} x_i^2\right)a_1 + \left(\sum_{i=1}^{n} x_i^3\right)a_2 + \left(\sum_{i=1}^{n} x_i^4\right)a_3 - \sum_{i=1}^{n} x_i y_i &&= 0 \\
\frac{\partial e}{\partial a_2} &= \left(\sum_{i=1}^{n} x_i^2\right)a_0 + \left(\sum_{i=1}^{n} x_i^3\right)a_1 + \left(\sum_{i=1}^{n} x_i^4\right)a_2 + \left(\sum_{i=1}^{n} x_i^5\right)a_3 - \sum_{i=1}^{n} x_i^2 y_i &&= 0 \\
\frac{\partial e}{\partial a_3} &= \left(\sum_{i=1}^{n} x_i^3\right)a_0 + \left(\sum_{i=1}^{n} x_i^4\right)a_1 + \left(\sum_{i=1}^{n} x_i^5\right)a_2 + \left(\sum_{i=1}^{n} x_i^6\right)a_3 - \sum_{i=1}^{n} x_i^3 y_i &&= 0
\end{aligned} \tag{3}$$

These equations can be set in form of matrix as follows:

$$\begin{bmatrix} n & \sum_{i=1}^{n} x_i & \sum_{i=1}^{n} x_i^2 & \sum_{i=1}^{n} x_i^3 \\ \sum_{i=1}^{n} x_i & \sum_{i=1}^{n} x_i^2 & \sum_{i=1}^{n} x_i^3 & \sum_{i=1}^{n} x_i^4 \\ \sum_{i=1}^{n} x_i^2 & \sum_{i=1}^{n} x_i^3 & \sum_{i=1}^{n} x_i^4 & \sum_{i=1}^{n} x_i^5 \\ \sum_{i=1}^{n} x_i^3 & \sum_{i=1}^{n} x_i^4 & \sum_{i=1}^{n} x_i^5 & \sum_{i=1}^{n} x_i^6 \end{bmatrix} \begin{Bmatrix} a_0 \\ a_1 \\ a_2 \\ a_3 \end{Bmatrix} = \begin{Bmatrix} \sum_{i=1}^{n} y_i \\ \sum_{i=1}^{n} x_i y_i \\ \sum_{i=1}^{n} x_i^2 y_i \\ \sum_{i=1}^{n} x_i^3 y_i \end{Bmatrix} \quad (4)$$

where$n$ is the number of pairs of data values in the interval $[a_i, a_{i+1}]$. The problem of determining a least-squares third-order polynomial is equivalent to solving a system of four simultaneous linear equations. In addition to standard error, a coefficient of determination can also be computed for polynomial regression with formula as:

$$r^2 = \frac{(y_i - \bar{y})^2 - (y_i - y)^2}{(y_i - \bar{y})^2} \quad (5)$$

wherer^2 is called coefficient of determination and r is the correlation coefficient.For a perfect fit, $r = r^2 = 1$, signifying that the line explains 100 percent of the variability of the data.

1.2The Cubic Spline Interpolation [9]

The objective in cubic spline is to derive a third-order polynomial for each interval between knots.Let $f_i(x) = a_i x^3 + b_i x^2 + c_i x + d_i$as the cubic in the interval $x_i \leq x \leq x_{i+1}$ and let $f(x)$ denote the collectionof all the cubics for the entire range of x.The second derivatives can be represented by a first-order Lagrande interpolating polynomial (Cheney and Kincaid, 1985) as follows:

$$f_i''(x) = f_i''(x_{i-1})\frac{x - x_i}{x_{i-1} - x_i} + f_i''(x_i)\frac{x - x_{i-1}}{x_i - x_{i-1}} \quad (6)$$

where$f''_i(x)$ is the value of the second derivative at any point x within the ith interval of 1, 2, 3, …, n. Formula (6) can be integrated twice to yield an expression for $f_i(x)$. This expression will be contained two unknown constants of integration which can be evaluated by invoking the function-equality condition as follows: $f(x)$ must equal $f(x_{i-1})$ at $x_{i-1}$and $f(x)$must equal $f(x_i)$ at x_i. Results from these evaluations, the cubic equation can be described by

$$f_i(x) = \frac{f_i''(x_{i-1})}{6(x_i - x_{i-1})}(x_i - x)^3 + \frac{f_i''(x_i)}{6(x_i - x_{i-1})}(x - x_{i-1})^3 + \left[\frac{f(x_{i-1})}{x_i - x_{i-1}} - \frac{f_i''(x_{i-1})(x_i - x_{i-1})}{6}\right](x_i - x) + \left[\frac{f(x_i)}{x_i - x_{i-1}} - \frac{f_i''(x_i)(x_i - x_{i-1})}{6}\right](x - x_{i-1}) \quad (7)$$

According to Formula (7), it contains only two unknowns which are the second derivatives at the beginning and the end of the interval namely $f''(x_{i-1})$ and $f''(x_i)$, respectively. The second derivatives can be evaluated by invoking the condition that the first derivatives at the knots must be continuous:

$$f_i'(x_i) = f_{i+1}'(x_i) \quad (8)$$

Formula (7) will be taken the first derivatives for both the (i– 1)th and the ith interval and the two results are set equal according to Formula (8), the following relationship results:

$$(x_i - x_{i-1}) f_i''(x_{i-1}) + 2(x_{i+1} - x_{i-1}) f_i''(x_i) + (x_{i+1} - x_i) f_i''(x_{i+1}) = \frac{6}{(x_{i+1} - x_i)}\left[f(x_{i+1}) - f(x_i)\right] + \frac{6}{(x_i - x_{i-1})}\left[f(x_{i-1}) - f(x_i)\right] \quad (9)$$

If Formula (9) is written for all the interior knots, n – 1 simultaneous equations result with n – 1 unknowns because the second derivatives at the end knots are zero [$f''(x_o) = f''(x_n) = 0$]. In addition, notice that the system of equations will be tridiagonalsystems as follows:

$$\begin{bmatrix} x & x & & & & & \\ x & x & x & & & & \\ & x & x & x & & & \\ & & \ddots & \ddots & \ddots & & \\ & & & \ddots & \ddots & \ddots & \\ & & & & x & x & x \\ & & & & & x & x \end{bmatrix} \begin{Bmatrix} f''(x_1) \\ f''(x_2) \\ f''(x_3) \\ \vdots \\ \vdots \\ f''(x_{n-2}) \\ f''(x_{n-1}) \end{Bmatrix} = \begin{Bmatrix} x \\ x \\ x \\ \vdots \\ \vdots \\ x \\ x \end{Bmatrix} \quad (10)$$

1.3 Unconfined compression test [10]

For soils, the undrained shear strength (s_u) is necessary for thedetermination of the bearing capacity of foundations, dams, etc. The undrained shear strength of clays is commonly determined from

an unconfinedcompression test. The undrained shear strength of a cohesive soil is equal toone-half the unconfined compressive strength (q_u) when the soil is under the ϕ = 0condition (ϕ = the angle of internal friction). The most critical condition for the soilusually occurs immediately after construction, which represents undrainedconditions, when the undrained shear strength is basically equal to the cohesion(c).In addition, the unconfined compressive strength can be represented by Mohr circle as shown in Figure 1.For many naturally deposited clay soils, the unconfined compression strength is greatly reduced when the soils are tested after remolding without any change inthe moisture content, as shown in Figure 2. This property of clay soils is called*sensitivity*. The degree of sensitivity may be defined as the ratio of the unconfined compression strength in an undisturbed state to that in a remolded state.

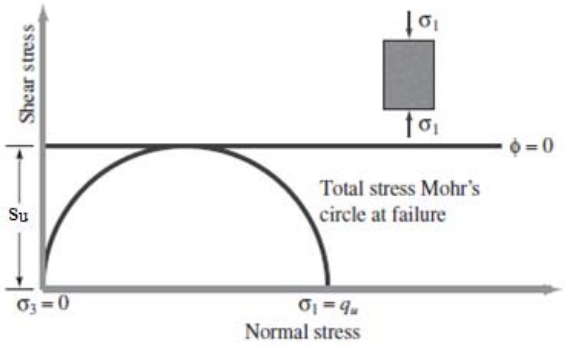


Figure 1 Unconfined compressiontest. [9]

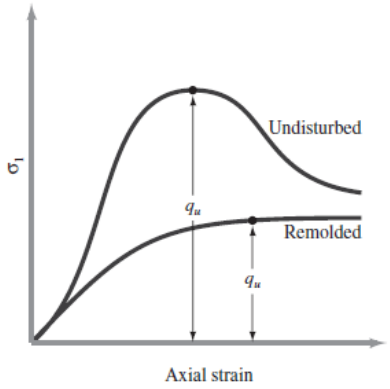


Figure 2 Unconfined compression strength for undisturbed and remolded clay. [9]

1.3 Compaction test [10]

Compaction, in general, is the densification of soil by removal of air, which requiresmechanical energy. The degree of compaction of a soil is measured in terms of its dryunit weight. When water is added to the soil during compaction, it acts as a softeningagent on the soil particles. The soil particles slip over each other and move intoa densely packed position. The dry unit weight after compaction first increases as themoisture content increases (Figure 3).When the moisture content is gradually increased

and the same compactive effort issued for compaction, the weight of the soil solids in a unit volume gradually increases.Beyond a certain moisture content *w* = *w2*, (Figure 3), any increase in the moisture content tends to reduce the dry unit weight. This is because the water takes up thespaces that would have been occupied by the solid particles. The moisture content at which the maximum dry unit weight is attained is generally referred to as the *optimummoisture content (OMC)*.The laboratory test generally used to obtain the maximum dry unit weight of compaction and the optimum moisture content is called the *Proctor compaction test* (Proctor, 1933).

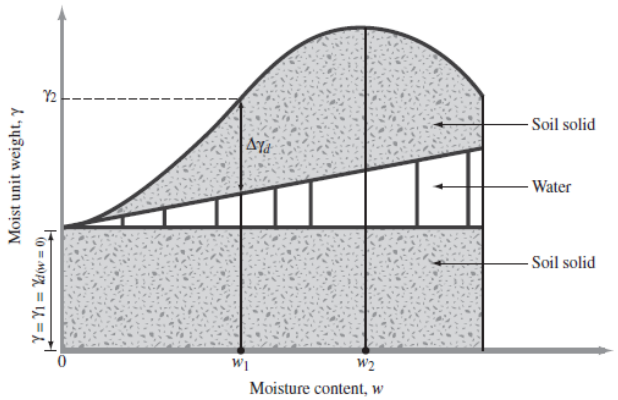


Figure 3 Principles of compaction.[9]

2. Methodology

2.1 Algorithm of numerical method

According to the theory of the interpolation and soil mechanics laboratory, the vertex of curve which represents the unconfined compressive strength and optimum moisture content is determined by using numerical methods.The cubic spline fitting method and the third-order polynomials regression method are applied todraw the curvefor predicting the unconfined compressive strength and the compaction parameters. The algorithm of both the cubic spline interpolation and the third-order polynomials curve fitting including the report ofthe soil properties at the vertex are as follows:

2.1.1 Algorithm of the cubic spline fitting method

This algorithm used to draw the curve through the data points as follows:

READ $x_{0\rightarrow n}$, $y_{0\rightarrow n}$ *(Data from testing)*

Call tridiag_ sys

Call matrix_sol (Solving system of equationsfor determining $d2x_i$*)*

Call interpol_csl

SUBROUTINE tridiag_sys

$B1=2*(x_2- x_0)$

$C1=(x_2- x_1)$

$D1=6*[(y_2- y_1)/(x_2- x_1) + (y_0- y_1)/(x_1- x_0)$

For $i=2: n-2$

$A_i=(x_i- x_{i-1})$

$B_i=2*(x_{i+1} - x_{i-1})$

$C_i=(x_{i+1}- x_i)$

$D_i=6*[(y_{i+1}- y_i)/(x_{i+1}- x_i) + (y_{i-1}- y_i)/(x_i- x_{i-1})$

End

$A_{n-1}=(x_{n-1} - x_{n-2})$

$B_i=2*(x_n – x_{n-2})$

$D_i=6*[(y_n – y_{n-1})/(x_n – x_{n-1}) + (y_{n-2} – y_{n-1})/(x_{n-1} – x_{n-2})$

END tridiag_sys

SUBROUTINE interpol_csl

For $i=1: n-1$

$np = abs(x_i- x_{i+1})/0.01$ *'np is number of point for interval between* x_i *and* x_{i+1}

For $j=1: np$

If $j=1$ *then* $x_u=x_i$ *else* $x_u=x_i+0.01$

If $x_u>x_{i+1}$ *then* $x_u=x_{i+1}$

$S_1=d2x_{i-1}/[6*(x_i- x_{i-1})]*(x_i- x_u)^3$

$S_2=d2x_i/[6*(x_i- x_{i-1})]*(x_u - x_{i-1})^3$

$S_3=[y_{i-1}/(x_i- x_{i-1}) - d2x_{i-1}*(x_i- x_{i-1})/6]*(x_i- x_u)$

$S_4=[y_i/(x_i- x_{i-1}) - d2x_i *(x_i- x_{i-1})/6]*(x_u - x_{i-1})$

$y_u=S_1+S_2+S_3+s_4$

$ij=ij+1$

$X_t(ij)=x_u$: $Y_t(ij)=y_u$

End

End

END interpol_csl

2.1.2 Algorithm of the third-order polynomials regression method

This algorithm used to draw the curve which is not through the points as follows:

READ $x_{0\rightarrow n}$, $y_{0\rightarrow n}$ *(Data from testing)*

Callelem_sys

Call matrix_sol (Solving system for the coefficients'a_0, a_1, a_2, a_3)

Call interpol_cpm

SUBROUTINE elem_sys

For i=1: n

$x=x + x_i$

$y=y + y_i$

$x2=x2 + x_i^2$

$x3=x3 + x_i^3$

$x4=x4 + x_i^4$

$x5=x5 + x_i^5$

$x6=x6 + x_i^6$

$xy=xy + x_i*y_i$

$x2y=x2y+x_i^2 y_i$

$x3y=x3y+x_i^3 y_i$

End

END elem_sys

SUBROUTINE interpol_cpm

$np = x_n/0.01$ *'np is number of point for plotting*

For j=1: np

If j=1 then $x_u=x_i$ *else* $x_u=x_i+0.01$

$y_u=a_0+a_1*x_u+a_2*x_u^2+a_3*x_u^3$

$ij=ij+1$

$X_t(ij)=x_u$: $Y_t(ij)=y_u$

End

END interpol_cpm

2.1.3 Algorithm of vertex point determination

This algorithm used to predict the soil properties at the vertex of curve as follows:

SUBROUTINE vertex_point

maxY=0

Forij=1:np

If maxY>$Y_t(ij)$ *then*

$maxY=maxY$

$maxX=X_t(ij)$

Else

$maxY=Y_t(ij)$

$maxX=X_t(ij)$

End If

End

END vertex_point

2.2Computer programming

The algorithms are used to create the computer program. The developed program used Microsoft visual basic programming for creating the graphic user interface (GUI) as the event-driving program which can be shown in Figure 4 for unconfined compression test and Figure 5 for compaction test.This development used Microsoft Access database to store the input data. Both developed programs are used for interpreting the soil mechanics testing results and reporting the soil properties by print out paper.

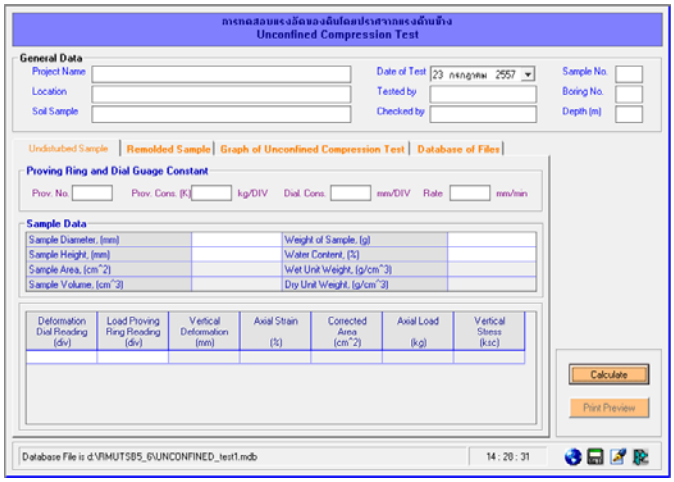


Figure 4 GUI for Unconfined compression test.

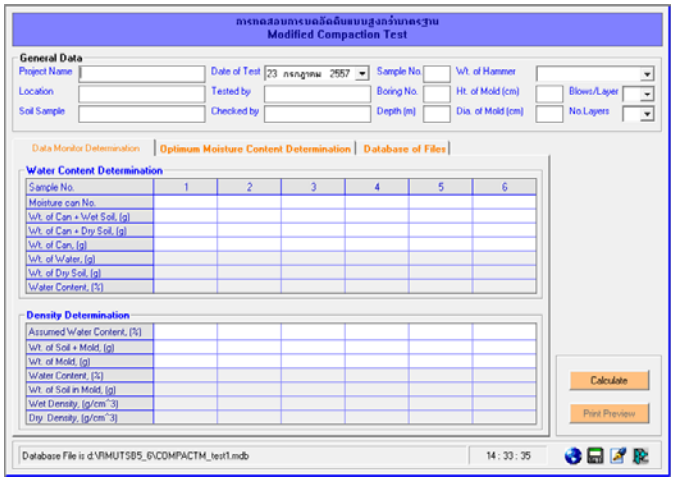


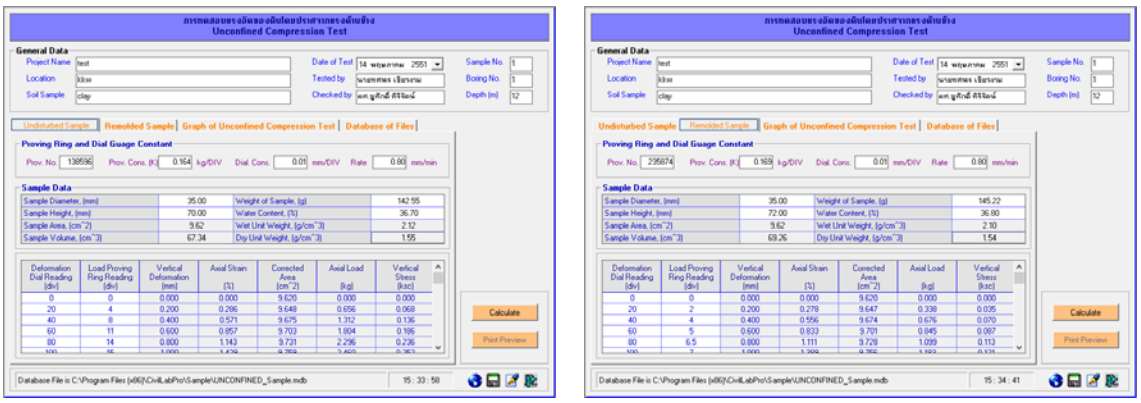
Figure 5 GUI for Compaction test.

Results and Discussions

The developed program was design to have usability like Microsoft office. The description of this program can explain as follows:

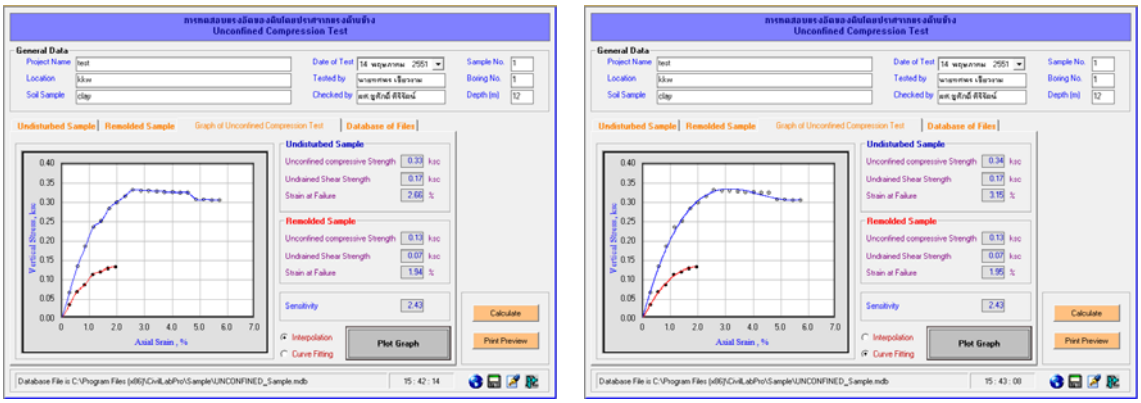
1.Unconfined compression test

The program is run with the raw data from laboratory testing. After input data, the calculation button can perform by clickingat the calculate button and then the program will show the calculated data as shown in Figure 6. This program provides the input data interface for both undisturbed and remolded samples. Consequently, the graph can be plotted by clicking at the plot graph button. This program provides twooptions for curve plotting which are the interpolation and the curve fitting refer to the theory. The comparison of the interpolation and the curve fitting can be shown the curve as in Figure 7.



a) Undisturbed sample display b) Disturbed sample display

Figure 6 Calculation results display for unconfined compression test.



a) Curve plotting by using cubic spline b) Curve plotting by using the 3rd polynomials

Figure 7 The comparison of the plots by using numerical method.

According to Figure 7, the curve plotted by using the third-order polynomials regression methodshows the curve is smootherthan that by using cubic spline fitting methodbecause of a number of the data from testing and the small interval of each point. Moreover, the curve would have a sinusoidal or unsmoothed zigzag form that would not be acceptable and would not be usable for engineering problems. These reasons corresponding to the mention by Zamani[11]. In addition, the curve plotting by the third-order polynomials vertex from the developed program is the same as the plot by MS-Excel which

it confirms the precision of this developed program. However, the MS-Excel cannot determine the vertex of curve but this developed program can predict the vertex of curve and also report the soil properties.The comparison of shear strength parameters is shown in Table1. According to Table 1, the soil properties by using cubic spline fitting method compare to that by using the third-order polynomials regression method are similarly. Therefore, the third-order polynomials regression method is appropriated to curve plotting andpredict the unconfined compressive strength.

Table 1 The comparison of shear strength parameters from developed program.

Shear strength parameters	Cubic Spline	The 3rd polynomials
Undisturbed sample		
Unconfined compressive strength (ksc)	0.33	0.34
Undrained shear strength (ksc)	0.17	0.17
Strain at failure (%)	2.66	3.15
Remolded sample		
Unconfined compressive strength (ksc)	0.13	0.13
Undrained shear strength (ksc)	0.07	0.07
Strain at failure (%)	1.94	1.95
sensitivity	2.43	2.43

2.Compaction test

The raw data from laboratory testing is used as the input data for the developed program. The calculated data can be displayed by clicking the calculate button as shown in Figure 8. After that, the compaction curve can be plotted by clicking the plot graph button which provides in both options of the cubic spline fitting and the third-order polynomials regression as shown in Figure 9.According to Figure 9, both curve plotting methods show the smooth compaction curve through the points which corresponding to the recommendation of ASTM D689 and ASTM D1557. Moreover, the curve plotting by using the third-polynomials from the developed program is the same as the plot by MS-Excel. The developed program can determine the compaction parameterswhich are at the vertex of curve as shown in Table 2 and also report by printing. The results reveal that the soil properties by using cubic spline fitting method compare to that by using the third-order polynomials regression method are similarly.

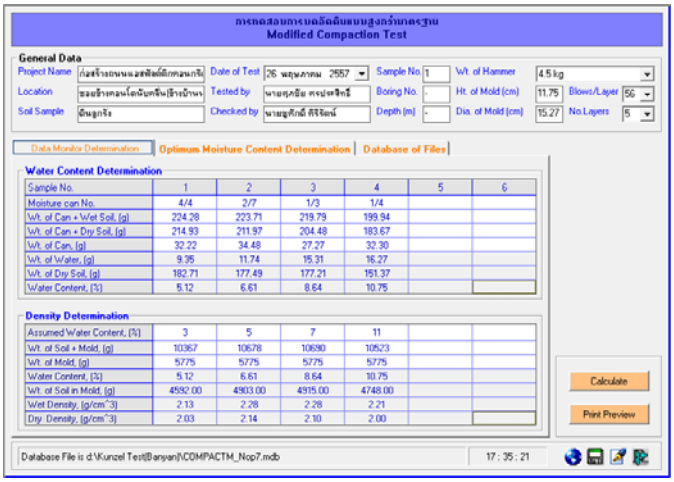
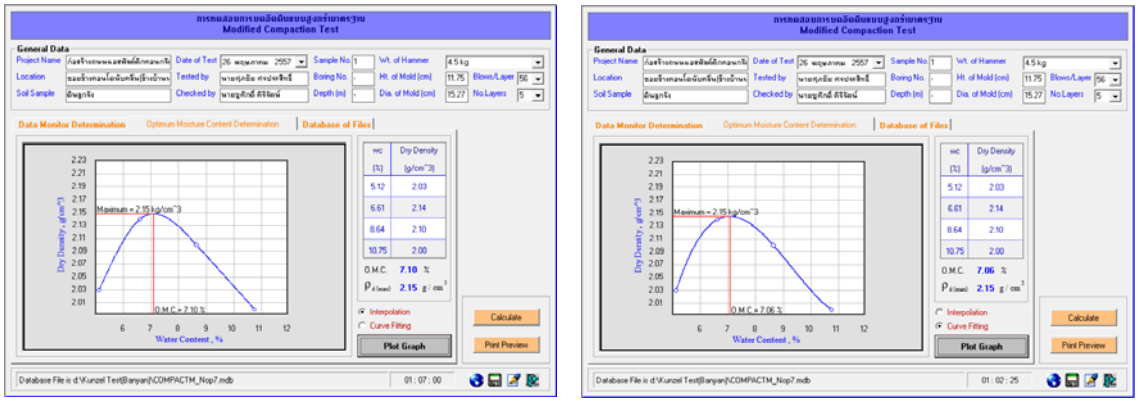


Figure 8 Calculation results display for Compaction test.



a) Curve plotting by using cubic spline b) Curve plotting by using the 3rd polynomials

Figure 9 Compaction curve and compaction parameters for compaction test.

Table 2 The comparison of compaction parameters from developed program.

Compaction parameters	Cubic Spline	The 3rd polynomials
Maximum dry density, $\gamma_{d(max)}$ (g/cm^3)	2.15	2.15
Optimum moisture content, OMC (%)	7.10	7.06

Conclusion

This paper presents the curve fitting by using the cubic spline fitting and the third-order polynomials regression for interpreting the soil mechanics properties. The computer program is developed to plot the curve and determine the vertex of curve which is the properties of soil for the soil mechanics testing. According to the results, the third-order polynomials regressionmethodis appropriate for plotting the curve of unconfined compressive strength because the curve is smooth and the shear

strength parameters are similarly which compare to the cubic spline fitting method.For the compaction curve, both the cubic spline fitting method and the third-order polynomials regression method are appropriate for plotting the curve because the compaction curve is smooth and through the points which corresponding to the recommendation of ASTM D698 and ASTM D1557. Moreover, the developed programs can use easily for user andit can decrease the human error because the results from this program are precise for every user.

Acknowledgement

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Dielectric Barrier Discharge (DBD) Ozone Generator Using a Single Switch Flyback Inverter

Surachai Jodpimai,[1*] Veeradate Piriyawong[2] and Pichet Limsuwan[1]

Abstract

This paper proposes the design and analysis of an ozone generator using a single switch of a flyback inverter. Ozone tube was analyzed with parallel combination of resistor and capacitor. High voltage transformer was represented using ideal transformer with series combination of resistor and inductor in primary and secondary. Dielectric barrier discharge was carried out to produce the ozone. Ozone was produced from oxygen gas. Effect of switching frequency and oxygen flow rate on ozone production was investigated. The ozone production was maximized at resonant frequency depending on equivalent circuit of ozone system such as capacitance of ozone tube, inductance of high voltage transformer in primary and secondary winding. The ozone concentration was increased by decreasing oxygen flow rate.

Keywords : Ozone generator, dielectric barrier, discharge, ozone power supply, ozonizer

Introduction

Ozone (O_3) is unstable oxidizing gas. It is more soluble than oxygen at standard temperature and pressure (STP) about 13 times [1] and decomposes back to oxygen molecules without chemical residues. As a result, it is widely used for disinfection, deodorization, color removal, food processing, laundry system, ground water remediation, bleaching of paper pulps, swimming pool water treatment and advanced oxidation processes (AOP) [2-5].The ozone production can be described as following equation [6].

$$e^- + O_2 \rightarrow 2O + e^- \quad (1)$$

$$O + O_2 + M \rightarrow O_3 + M \quad (2)$$

where M is a third body collision partner such as O^+, O_2^+, O^-, O_2^-, etc.

In recent years, the dielectric barrier discharge (DBD) has been the popular method to generate ozone. Two electrodes separated by dielectric were used in DBD. The major dielectric materials such as borosilicate glass, ceramics and mica were used to prevent breakdown voltage across the electrode. The AC voltage source was applied between two electrodes to distribute the electron flow. A high voltage (3,000 – 20,000V) and high frequency (1-50 kHz) were used to increase ozone production. Dried air or oxygen gas can flow through a small discharge gap. More than fifty chemical reactions took place in this gap.

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The standard enthalpy of ozone formation is 142.67 kJ $mole^{-1}$ or 0.82 kWh/kgO_3. Therefore, the 1,220 gO3/kWh of ozone production is 100% of efficiency [7]. However, the efficiency of commercial ozone generator is around 4 – 11 %. The efficiency of ozone generator in terms of power consumption can be described as [8].

$$Eff = (0.82 / Es) \times 100\% \quad (3)$$

where Eff is the power efficiency (%), the minimum power consumption for producing 1kg of ozone is 0.82 kWh, and Es is the specific energy consumption (kWh/kgO_3).

Many techniques have been proposed to supply high voltage to ozone generator, e.g., pulsed power, rotating spark gap switch, full bridge inverter, and single switch [9-12]. The single switch flyback inverter was designed for several cases such as portable equipment, battery application, minimize of power switch, reduced print circuit board, and low cost [13]. However, it was sensitive to variation of ozone system and high switching loss in switch [14].

In this paper, the ozone generator using dielectric barrier discharge was implemented. The single switch of flyback inverter was utilized as a power supply of the ozone generator. The effect of switching frequency and flow rate of the ozone generator were discussed.

Materials and Methods

1. Experimental setup

The configuration of the experimental setup is shown in (Figure 1). An oxygen tank with 95% of concentration was used as a feed-gas source. The oxygen flow rate was controlled between 1-6 LPM by the O_2 flow meter. The concentration of ozone was monitored by a UV-absorption ozone analyzer (TELEDYNE Instruments, 454M). The ozone capacity was calculated by following equation:

$$\text{Ozone capacity } (gO_3/hr) = \text{Ozone concentration } (gO_3/m^3) \times \text{Flow rate } (m^3/hr) \quad (4)$$

Current of the high voltage transformer was measured by AC/DC current clamp (HANTEK, CC-65). Digital oscilloscope (RIGOL, DS1052E) was used to measure the electrical waveforms. The high voltage was measured by a high voltage differential probe (Pintek, DP-20K).

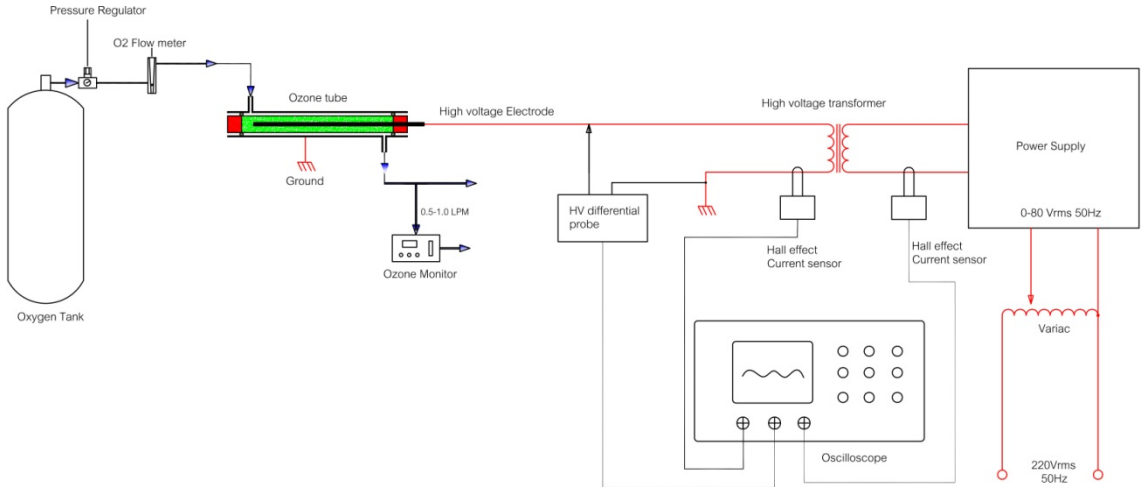

Figure 1 the experimental setup of ozone generator.

2. Ozone tube

The structure of ozone tube used in this experiment is shown the (Figure 2). A borosilicate glass tube with outside diameter (OD) of 10 mm, 1 mm thick and 100 mm length was utilized as a dielectric material. The aluminum powder was used to fill inside glass tubes as high voltage electrodes. There is one electrode inside an aluminum enclosure with outer diameter of 15.875 mm which has the effective corona discharge length 95 mm. The discharge gap is 1.94 mm. The capacitance of ozone tube (Coz) and the equivalent parallel resistance (Roz) were measured by the LCR meter (HIOKI, IM3533-01). The Coz and Roz are 54 pF and 9.19 MΩ, respectively. However, these values will be changed when the ozone tube is applied by high voltage but they are suitable to use as an initial design values.

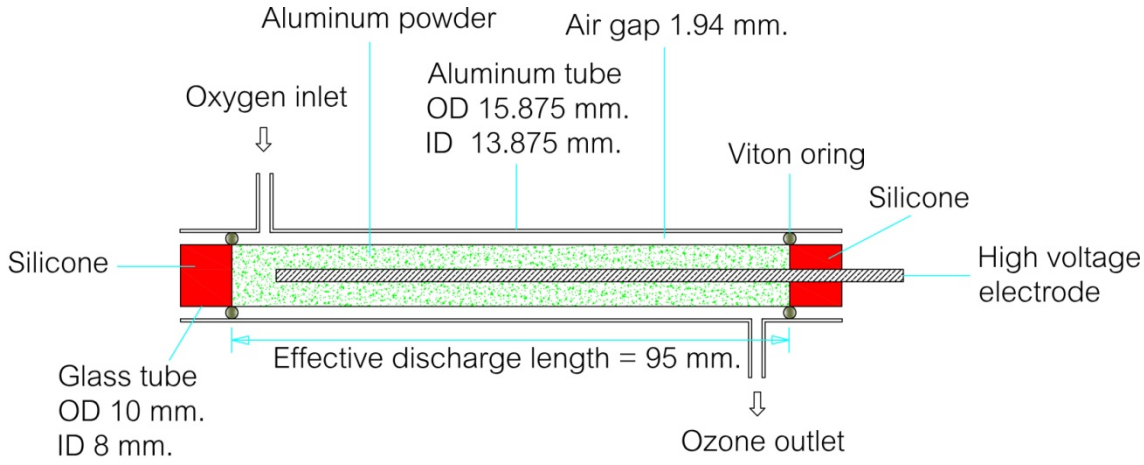

Figure 2 the structure of ozone tube

3. Power supply

The electrical diagram in (Figure 3) was used as a power supply of the ozone generator. A single switch flyback inverter obtained sinusoidal output voltage and current waveform were proposed in this work. A capacitor (C1) has no significant effect the resonant frequency because it has large value capacitance. It was used to keep constant dc voltage for the inverter. The IGBT (Fairchild semiconductor, HGTG40N60A4) was selected as a switch with RCD snubber (500 Ω, 10 nF and MUR1560 G) for reducing switching voltage. The dc voltage (Vdc) was rectified by the bridge diode (Taiwan semiconductor, GBPC3508) and was controlled to the fixed value of 100 Vdc by the variac. The winding turn ratio of the high voltage transformer is 1:46. The EE ferrite core was selected to construct the high voltage and high frequency transformer.

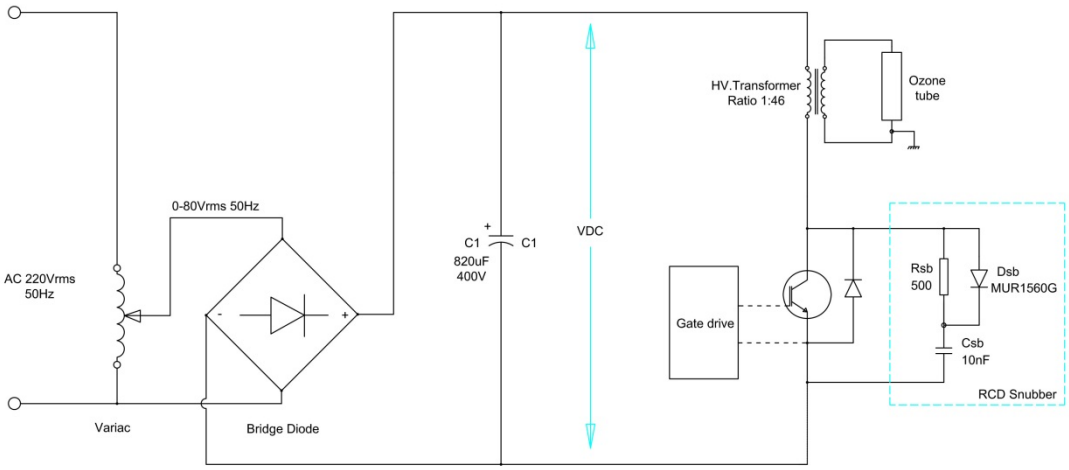

Figure 3 Schematic of a single switch flyback inverter.

The electrical equivalent circuit of high voltage transformer and ozone tube are shown in (Figure 4. The linear model of ozone tube is represented by parallel of capacitor (Coz) and resistor (Roz) as shown in (Figure 4 a) and the parameters of ozone tube refer to primary is shown in (Figure 4 b) . To achieve a maximum power transfer to the ozone tube, the impedance of source must equals to the load impedance. The impedances of high voltage transformer refer to the primary side can be calculated as below [15]

$$\text{Since } Z_p = a^2 Z_s \text{ then,} \quad (5)$$

$$R_{p\text{-}oz} = (1/46)^2 \times 9.19\ \text{M}\Omega = 4.34\ \text{k}\Omega \text{ and}$$

$$C_{p\text{-}oz} = (46/1)^2 \times 54\ \text{pF} = 114.3\ \text{nF}$$

The resonant frequency (fr) used for initial design is 21.8 kHz.

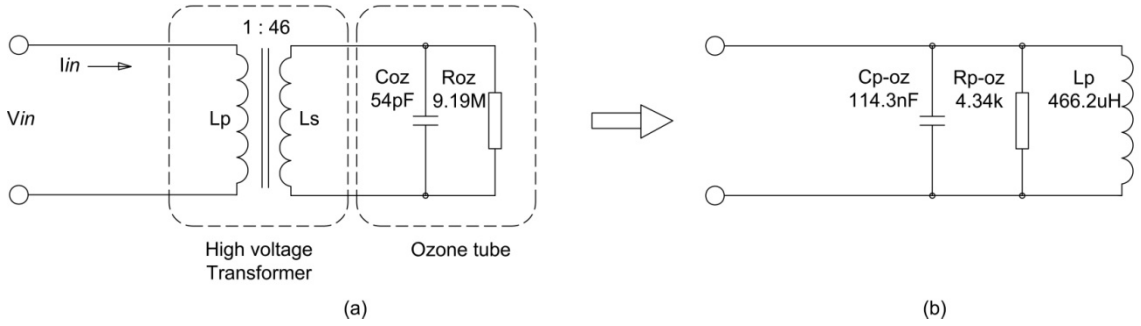

Figure 4 Electrical circuits of (a) high voltage transformer and the linear model of ozone tube and (b) high voltage transformer and ozone tube refer to the primary side of high voltage transformer.

The EE ferrite core with A*l* = 680 nH/N^2 (3 mm. air gap) was utilized for making the transformer. The primary turns (Np) can be expressed as follows

$$\begin{aligned} \text{Np (turns)} &= \sqrt{\text{Lp (nH)} \div \text{A}l\ (\text{nH/N}^2)} \\ &= \sqrt{466.2 \times 10^3\ \text{nH} \div 680\ \text{nH/N}^2} \\ &= 26\ \text{turns} \end{aligned} \quad (6)$$

The secondary turns (Ns) = Np / a = 1196 turns.

Discussion

(Figure 5) shows the frequency response and phase of the ozone generator obtained from the LCR meter. The scanning frequencies ranging from 100 to 30,000 Hz were used to investigate the resonance frequency of the ozone generator. The resonant frequency of the ozone generator from the measurement was 21.8 kHz. The practical resonant frequency neared the design frequency because the capacitance of ozone tube was changed when high voltage is applied to the ozone tube [16]. The practical switching frequency of the flyback inverter in this work was 20.8 kHz.

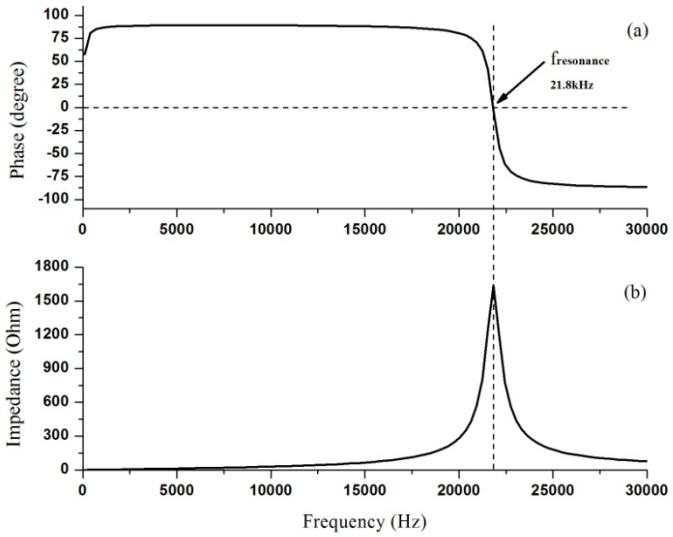

Figure 5 Frequency response and phase of the ozone generator.

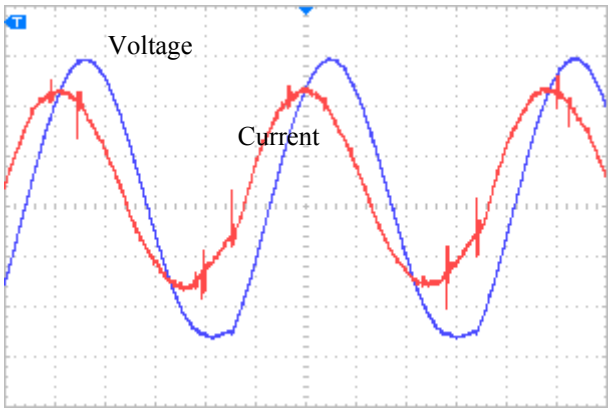

Figure 6 Voltage and current output waveforms were supplied to ozone tube1500 V/div, 200 mA/div and 10 μs/div.

The waveforms of secondary side of the high voltage transformer is shown in (Figure 6). It can be seen that the ozone tube current advances the voltage across the ozone tube that is less than 90°. Therefore, the behavior of this ozone tube is not a pure capacitance during appliying high voltage to ozone tube. The AC voltage supplied to the ozone tube was about 4.5 kVpeak and AC current was about 480mA peak.

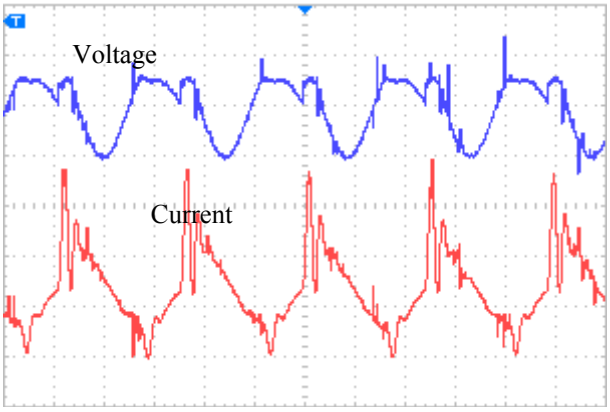

Figure 7 Voltage and current input waveforms were applied to the high voltage transformer 150 V/div, 1A/div and 20μs/div.

The waveforms of the primary voltage (Vin) and the input current (Iin) are shown in (Figure 7). They were not sinusoidal waveforms. However, the harmonic frequencies of these waveforms were filtered by the high voltage transforemer, then the secondary side waveforms of the highvoltage transforemer were sinusoidal waveforms as shown in (Figure 6).

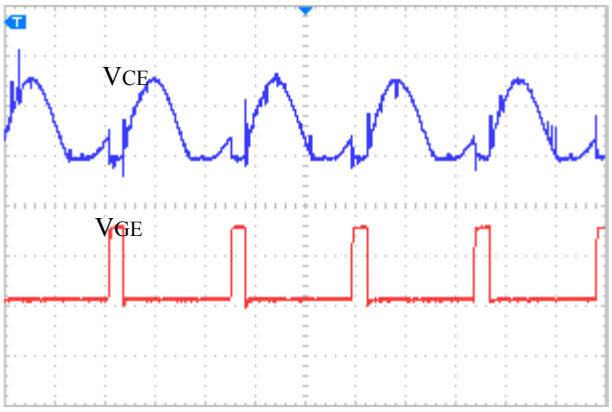

Figure 8 Collector-emitter voltage (VCE) and gate-emitter voltage (VGE) 150V/div, 10V/div and 20μs/div.

(Figure 8) shows the collector - emitter voltage (VCE) of the insulated gate bipolar transistor (IGBT) or switching voltage and the gate-emitter voltage (VGE) obtained from the gate drive circuit. The VCE was about 240Vp-p. The frequency of gate drive circuit was 20.8 kHz with 12.5% of duty cycle.

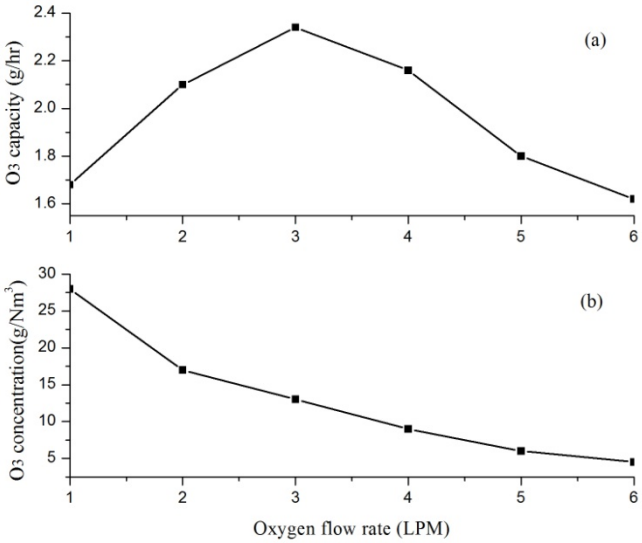

Figure 9 (a) Ozone capacity and (b) ozone concentration at different oxygen flow rates.

(Figure 9) shows (a) the ozone capacity and (b) the ozone concentration versus different flow rates of 1, 2, 3, 4, 5 and 6 liter per minute (LPM). The ozone capacity in (Figure 9 a) was calculated from equation (4). The maximum of ozone capacity was 2.3 g/hr at oxygen flow rate 3 LPM. In (Figure 9 b), the increasing of oxygen flow rates tends to decrease the ozone concentration because the input oxygen has shorter time for staying in the ozone tube and for formation of ozone. In this experiment, the maximum ozone concentration was 28 gO_3/m^3 at minimum oxygen flow rate 1 liter/min. However, this point is not the optimum point due to low of ozone capacity.

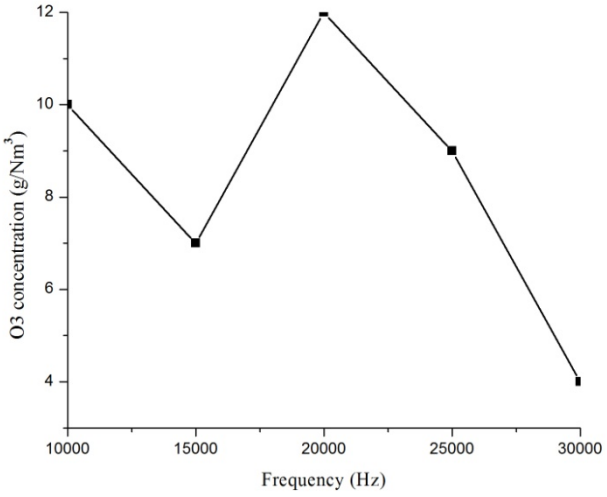

Figure 10 Ozone concentrations in different switching frequencies (oxygen flow rate 3 LPM).

(Figure 10) shows the ozone concentration was measured as a function of switching frequency. When the switching frequency was less than the resonant frequency, the ozone concentration was

increased with increasing of switching frequency but the ozone concentration was decreased above resonant frequency. However, the sinusoidal damp frequency that near the resonant frequency can be produced in the practical result at the switching frequency 10,000 Hz. The ozone generator can operate at this frequency for reducing loss of switch but the ozone concentration is lower than to operate at the resonant frequency.

Conclusion

The design and analysis of ozone generator using dielectric barrier discharge (DBD) have been clearly described. The electrical characteristics of the proposed ozone generator were investigated. A single switch flyback inverter was used as a power supply of the ozone generator. The best condition of switching frequency in this study was close to resonant frequency obtained from LCR analyzer. The ozone concentration depended on flow rate and switching frequency. The maximum ozone capacity and ozone concentration were 2.3 g/hr and 28 g/Nm^3, respectively.

Acknowledgement

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Development of Mechanical property by Agricultural Waste, Bagasse Ash, for Portland blended cement

Piyanut Muangtong[1*] and Duangrudee Chaysuwan[2]

Abstract

This research has a purpose to study and develop the mechanical property of Portland blended cement by reducing partial amount of clinker in the production of type I Portland cement. The cement industry has emissions of greenhouse gases in which resulting in global warming; therefore, Portland cement replaced with agricultural waste, bagasse ash (BA), as pozzolan material is one of choices to solve the environmental problems caused global warming. BA of 0, 10 and 30 wt% was mixed with clinker and cured in 3, 7 and 28 days. Then chemical physical and mechanical properties of samples were analyzed. Chemical composition of BA consisted of high SiO_2, the main phase of pozzolanic reaction to enhance compressive strength of cement. BA had influenced the compressive strength of blended cement which corresponding with clinker replacement with 30 wt% BA provided maximum compressive strength in laboratory scale.

Keywords: Bagasse Ash, Agricultural Waste, Portland blended cement, Mechanical Property

Introduction

In present the global warming is extremely important environmental problem. The main cause of global warming occurs from the CO_2 emission which is produced by nature and human-made. It is one kind of greenhouse gases to incur global warming. The fundamental industry such as cement industry is the largest CO_2 emitting industry [1] which is reported that one ton of CO_2 emission are produced from one ton of cement production [2]. The current situation of cement industry is more growing to obey the economic growth. The CO_2 emission is high intensity according to high volumes of cement production and it is difficult to reduce capacity of cement production for control amount of CO_2 emission produced from industry. Robert McCaffrey [3] proposed solution for decreasing of CO_2 emission by method of replacing amount of cement with pozzolan materials such as agricultural ash and industrial wastes. It is one of choices to be interesting and suitable solution for Thailand where there are full of agricultural wastes. Thailand is an agricultural country. It has a total 238,794 million square meters of agricultural landuse which by 6.36% of area for sugar cane growing. Here, it was able to produce approximately 97.98 million tons of sugar cane in 2012/2013 [4]. Almost all sugar canes are sent to the sugar factory and finally products as sugar are produced. Bagasse ash (BA) is a by-product after sugar cane is used as fuel for boilers to generate steam during production of sugar and it is an agricultural waste to be

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removed from the factory. In general, BA is used for the treatment of acidic soils and disposed of in landfill that is now becoming an ecowaste to decrease environmental problems. Many inert waste materials consist of high silica and alumina contents, e.g., fly ash, silica fume and agricultural wastes such as BA, rice husk ash and oil palm ash. BA is an outstanding waste consisting of very high silica content approximately 60%. It is claimed as a pozzolanic material reacting with calcium hydroxide (CH), a by-product of the hydration of cement, to form additional calcium silicate hydrate (C-S-H) as new products from the pozzolanic reaction. These phases are a supplementary cementing material to support the higher compressive strength of cement [5]. This research has a purpose to study and develop the mechanical property of Portland blended cement by the clinker replaced with BA for cement production in laboratory scale.

Materials and Methods

1. Materials

The fundamental raw materials consisted of clinker, gypsum and sand. For As-received bagasse ash was an important parameter for amount of clinker replacing by them. They were composition of Portland blended cement used in this laboratory experiment.

1.1 Fundamental raw materials

Clinker and gypsum were supported by Siam City Cement Public Co., Ltd. They were calcined at 100 °C for 24 hr in the heating oven. They were crushed to fine powder by a forged steel ball mill machine (artificial machine made of carbon steel) for 30 hr and passed through a mesh size of 1 mm. which is shown in Figure 1. Table 1, according to ASTM C150 [6], showed chemical composition that was analyzed by X-ray fluorescence (XRF, Bruker, S8 Tiger, Germany)

Figure 1 Fine powder of clinker after grinding for 30 hr.

Table 1 Chemical composition of raw materials

Composition	Portland cement (wt%)	Clinker (wt%)	Gypsum (wt%)	BA (wt%)
SiO_2	17.84	19.09	2.12	64.11
CaO	66.83	68.14	42.48	5.75
Al_2O_3	3.88	4.02	0.87	5.26
Fe_2O_3	3.71	4.22	0.46	2.78
K_2O	0.67	0.78	0.02	2.59
Na_2O	0.17	0.19	-	0.32
MgO	1.40	1.49	0.13	1.28
TiO_2	0.26	0.26	0.06	0.38
P_2O_5	0.07	0.06	-	1.37
SO_3	4.10	1.11	50.28	0.41
Loss on ignition (L.O.I)	0.90	0.48	3.48	15.09

Sand was prepared by drying on the natural air for 3 days and sieve passed through a mesh size of 850 and not above 600 micron.

1.2 Mineral admixture

As-received bagasse ash was an agricultural waste that was a by-product of the sugar factory from Kaset Thai Sugar Co., Ltd. During the sugar production, bagasse was burnt to become ash at approximately 700 ^{o}C in boilers. It was prepared to fine bagasse ash that exhibited the pozzolan property by centrifugal ball mill machine (Retsch, S2, Germany) and sieved through a mesh size of 45 micron [7-8]. The microstructure of BA is shown in Figure 2 which revealed particles of angular and irregular shape. Surface of particles were rough and plenty of pores. Table 1 and Figure 3 presented the chemical composition of BA that was carried out by X-ray diffractometer (XRD, Philips, X'pert, The Netherlands) between 10^{o} - 65^{o} 2θ, which consists of quartz (SiO_2; JCPDS 85-1054), calcite ($CaCO_3$; JCPDS 83-1762), iron oxide (FeO; JCPDS 01-1223) and carbon (C; JCPDS 26-1077), respectively.

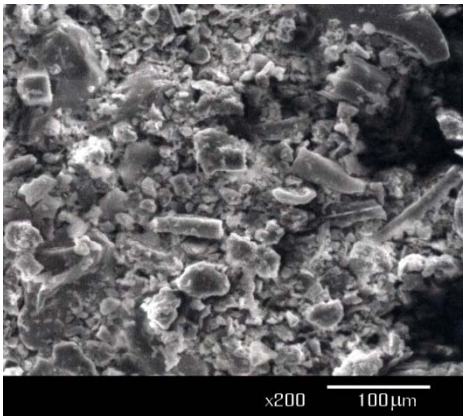

Figure 2 SEM images of BA after grinding at a magnification of 200X.

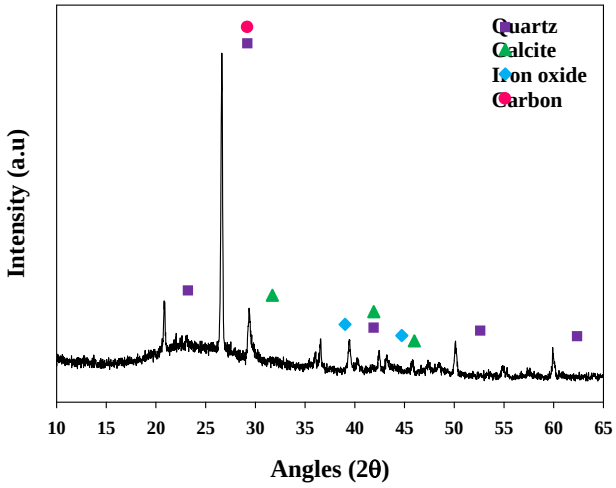

Figure 3 XRD pattern of BA burnt approximately 700 °C.

2. Methods

2.1 Mixing raw materials

Proportions of Portland blended cement were presented as in Table 2 which varied according to the clinker replaced with BA as 1) C100BA0 (clinker 100: BA 0 wt%), 2) C90BA10 (clinker 90: BA 10 wt%) and 3) C70BA30 (clinker 70: BA 30 wt%) and all proportions mixed fine gypsum of 3.5 wt%. Ratios for casted sample consisted of water: Portland blended cement: sand as 0.485: 1: 2.75, according to ASTM C305 [9].

Table 2 Proportions of Portland blended cement

Samples	Clinker (wt%)	BA (wt%)	Gypsum (wt%)
C100BA0	96.5	-	3.5
C90BA10	86.85	9.65	3.5
C70BA30	67.55	28.95	3.5

2.2 Casting of cement specimens

All proportions of Portland blended cement were casted to mortar and paste samples. Paste samples were an admixture of Portland blended cement and water. After mixing, they were cast into square plastic molds for characterizations of chemical composition and microstructure. Mortar samples were an admixture of sand, Portland blended cement and water. They were cast into cube molds for compressive strength testing.

2.3 Characterizations of cement specimens

2.3.1 Compressive strength

The cement mortars had proportion according to Table 2. Samples were mixed in a mechanical mixer. They cast and compacted by tamping for two layers in cube molds. Mortar cubes were demolded after casting at room temperature for 24 hr. Consequently, each ratio had 4 cubes of mortar samples for testing and were cured mortar samples in the moist zip plastic bags until curing ages of 3, 7 and 28 days according to ASTM C 109 [10] by a universal testing machine (UTM, CT-746, Versa-Tester (Evanston), U.S.A.). The compressive strength was calculated using Eq. 1.

$$f_m = \frac{P}{A} \quad (1)$$

Where f_m is compressive strength in psi or MPa,

P is total maximum load in lbf or N and

A is area of loaded surface in in^2 or mm^2

2.3.2 Chemical composition

Cement pastes were cast into square plastic molds. Paste samples were demolded after 24 hr curing and period of curing process as same as mortars. They were prepared as powder by grinding and investigated at curing ages of 3, 7 and 28 days for chemical composition by XRD from 10^o - 65^o 2θ.

2.3.3 Microstructure

Paste samples for microstructure analysis by SEM were prepared as same as samples analyzed by XRD technique. Fracture surface of samples was prepared and other sides of cement pastes were ground flat to shape them nearly small cubes. Samples were dried and removed water from samples immediately to stop any further reactions with a desiccator. Samples were gold sputtered before analysis by SEM technique. Their microstructures were observed at curing ages of 3 and 28 days by SEM.

Results and Discussions

1. Compressive strength

In Figure 4, the compressive strength is the one of important mechanical property to estimate the possibility of the experimental ratio of Portland blended cement by clinker replacing with BA. It was indicated that the most effective ratio to the compressive strength was C70BA30 which was the clinker replaced with 30% BA cement and it showed the effect of amount of BA on the compressive strength of cement mortars. Because the best compressive strength (33.20 MPa) is clinker replacing with 30% BA (C70BA30) comparing other ratios, 0 10 and 30% BA, at curing age of 28 days.

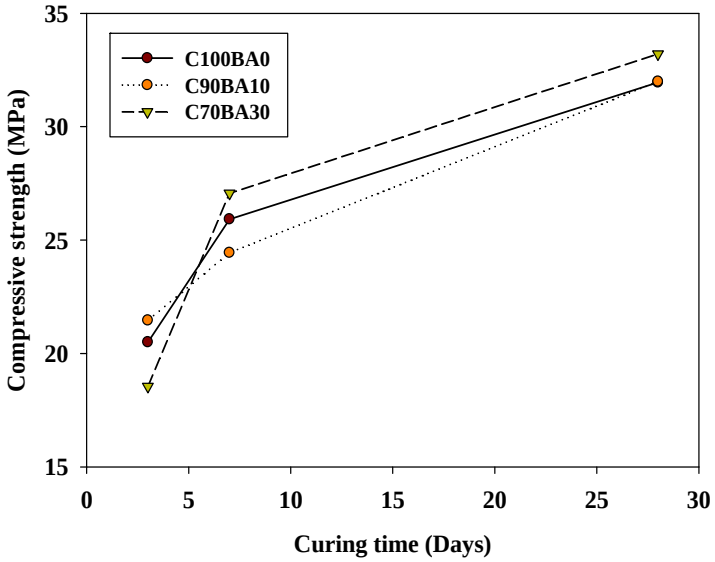

Figure 4 Compressive strength of cement mortars.

The compressive strength of Portland blended cements developed with the curing time elucidated by the value of compressive strength of graph. It was found that the most value of compressive strength of last age (28 days) was C70B30. It was shown that C70B30 has a tendency to increase compressive strength than other ratios in longer time. The pozzolanic reaction is the reason of increasing compressive strength when $Ca(OH)_2$,by-product of hydration reaction, reacts with SiO_2 (from BA) to become C-S-H from the pozzolanic reaction and to cause the increasing of compressive strength in cement mortars [11].

2. Chemical composition

The C-S-H phase is a supplementary cementing phase which effects on increasing of compressive strength to confirm the occurred pozzolanic reaction of Portland blended cement in this experimental [12]. The chemical composition of Portland blended cement are analyzed by XRD and detected as calcium hydroxide ($Ca(OH)_2$, CH; JCPDS 44-1481), calcium silicate hydrate ($Ca_{1.5}SiO_{3.5}.xH_2O$, C-S-H; JCPDS 33-0306), tricalcium silicate (Ca_3SiO_5, C_3S; JCPDS 49-0442), dicalcium silicate (Ca_2SiO_4, C_2S; JCPDS 29-0369), quartz (SiO_2; JCPDS 85-1054), and ettringite ($Ca_6Al_2(SO_4)_3(OH)_{12}.26H_2O$; JCPDS 41-1451), respectively. In the first period of curing age at 3 and 7 days, the transition of intensity of CH phase of all ratios is increasing; due to cement and water react the hydration reaction to become the CH and other phases. The last curing age of 28 days, the intensity of CH phase that especial ratios of cement replaced with BA (C90BA10 and C70BA30) are decreasing. It points to initiation of the second reaction, the pozzolanic reaction, inside Portland blended cement. The CH phase reacts together with SiO_2 phase to be new phase as C-S-H phase which support the compressive strength of Portland blended cement according to Figure 5-7.

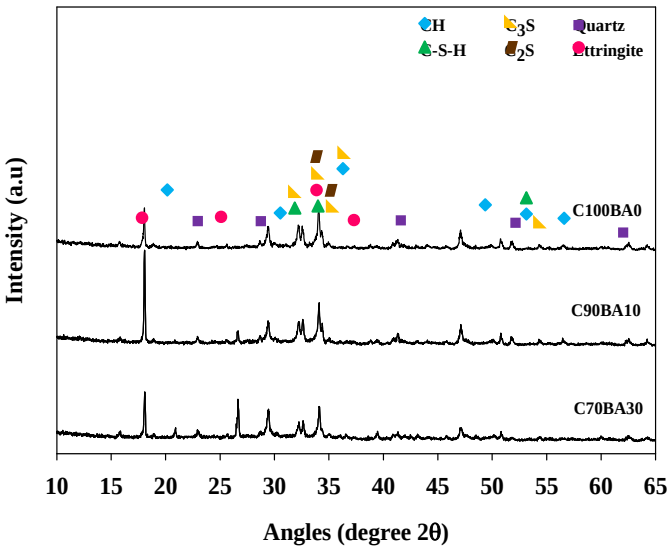

Figure 5 XRD patterns of Portland blended cement at curing age of 3 days.

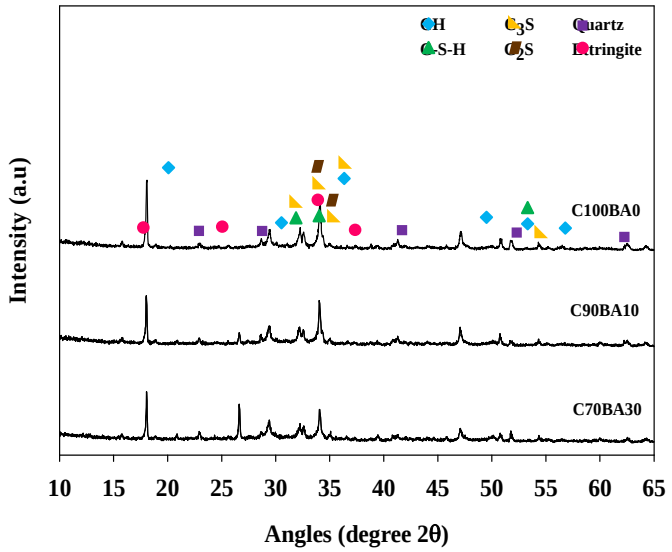

Figure 6 XRD patterns of Portland blended cement at curing age of 7 days.

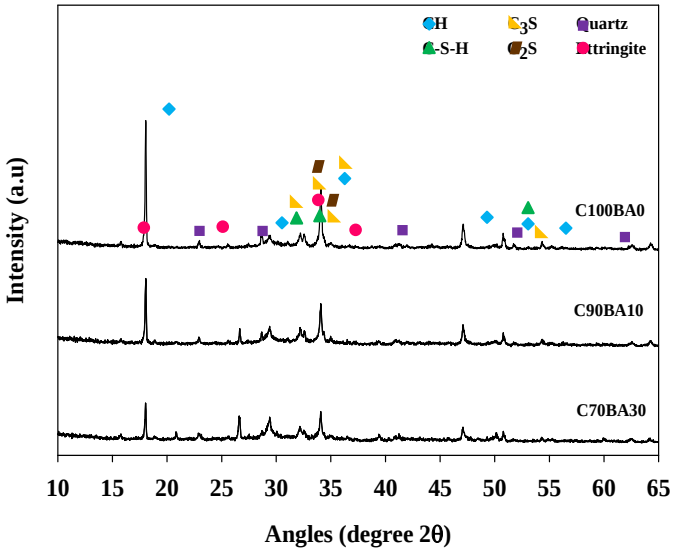

Figure 7 XRD patterns of Portland blended cement at curing age of 28 days.

3. Microstructure

The SEM micrograph of Portland blended cement replaced with 30% BA (C70BA30) indicated that the microstructure of blended cement is higher density surface according to the curing time and support the reason of compressive strength increasing of blended cement. In Figure 8a, blended cement structure shows rich pores and needle-like ettringite structures at curing age of 3 days. After that the last curing age at 28 days presents development of blended cement structure to more dense structure than old curing age as shown in Figure 8b; due to the supplementary phase of C-S-H gel from the pozzolanic reaction infiltrates within pore structure and adheres lateral phases to develop compressive strength of blended cement [13].

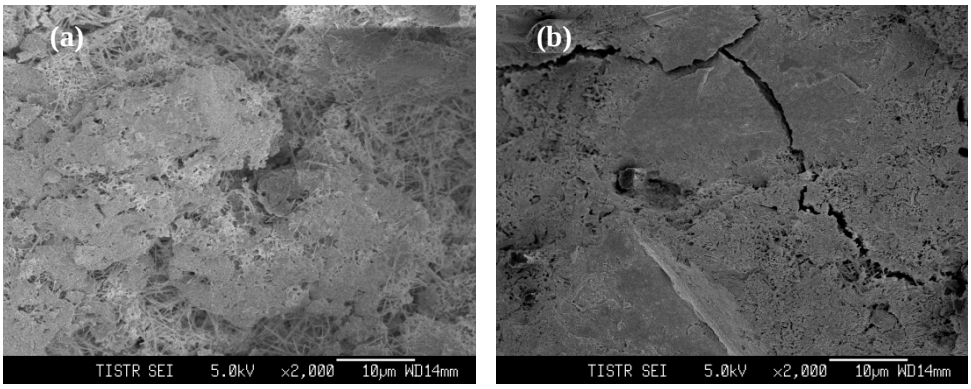

Figure 8 SEM micrograph of C70BA30 at curing ages of (a) 3 days and (b) 28 days at a magnification of 2000X.

Conclusion

Based on the experimental results of this research, the following conclusions can be drawn: Bagasse ash is the agricultural pozzolan material which influenced on compressive strength of Portland blended cement. Clinker replacing with 30% BA is the appropriate proportion of Portland blended cement in this research, and for future trend in industrial scale production.

Acknowledgement

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Use of Fiber Reinforced Composites in Civil Engineering Applications

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Abstract

Since the introduction of Fiber Reinforced Polymer (FRP) reinforcements into the construction industry, the use of these materials has been growing exponentially. Owing to their distinctive material properties, FRPs can offer an ideal solution for specialist applications where the use of steel reinforcement might be undesirable. On-going research around the world has addressed, and continues to address, these various areas of concern. This paper highlights advantages and disadvantages of composite materials and discusses their potential applications in the civil construction industry. On-going research work at Rajamangala University of Technology Tawan-Ok is presented and commented upon.

Keywords : Fiber Reinforced Polymer, FRP, Reinforced Concrete, Prestressed Concrete.

Introduction

Non-Ferrous reinforcement (NFR), in the form of Fiber Reinforced Polymer (FRP) rebars has been widely used worldwide as a valid alternative to conventional steel reinforcement to overcome the problem of corrosion[1]. Owing to its superior durability characteristics, the use of FRP reinforcement can extend the lifespan of concrete structures and reduce the need for maintenance or repair [2,3]. All known in the construction industry, have proved to possess superior mechanical properties and have been used extensively in the aerospace, automobile and defence industries for several decades. Civil engineers, however, have only relatively recently begun to gain confidence and experience in applying this technology. FRP products made an extraordinary entry into the construction market 20 years ago and since the first demonstration projects were constructed in the late 80's and early 90's [3,4] the interest in these materials has grown exponentially. The main reasons behind the rapid growth of the use of FRPs in construction were the light weight of the reinforcing products and their electromagnetic neutrality. The earliest commercial applications were as non-magnetic or radio-frequency transparent reinforcement for advanced transport systems, in specialized defence applications and in structures housing magnetic resonance imaging medical equipment [4]. Nowadays, repair and strengthening of existing structures with FRP reinforcement is undoubtedly the most attractive application of FRPs.

This paper gives a brief overview of the physical and mechanical properties of FRP products and discusses areas where the use of advance composites as reinforcing material for concrete structures can benefit the construction industry.Finally on-going research work at Rajamangala University of Technology Tawan-Ok, Uthenthawai Campus is presented and commented upon.

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What are FRPs?

FRP reinforcement is a composite of continuous fibers in a resin matrix. The commonly used fibers are glass, aramid or carbon [5,6,7], while the resins are usually thermosetting resins, such as polyester, vinyl ester or epoxy. Fibers are the main load carrying constituent, while the matrix transfers stresses between the fibers, protects the fibers from environmental or mechanical damage, provides lateral support against fiber buckling under compression, and ensures interaction with the surrounding concrete. Fillers may be added to the matrix to impart desirable properties such as improvement of load transfer [4]. For structural purposes, the matrix content typically ranges from 0.25 to 0.5 by weight, or equivalently, the fiber volume fraction ranges from 0.5 to 0.7 [4]. The surface preparation of the FRP rebar has a direct impact on bond. Various surface conditions are commercially available, such as sand coated, ribbed, indented and braided (Figure 1). A combination of surface treatments is also used. However, there is no standardized classification of surface conditions [4,5]. Manufactured from a combination of natural or synthetic fibers within a polymeric matrix, FRPs display excellent resistance to environmental factors such as freeze-thaw cycles, chemical attack and temperature variations. Carbon, glass and aramid fibers, immersed in a thermosetting resin, are the constituents most widely used in the manufacture of the various types of reinforcement for concrete structures. New types of fibers and resins, however, are being developed continuously and new products comprising basalt fibers have recently been made commercially available.

FRP materials are manufactured using different techniques such as pultrusion, filament winding, moulding, braiding and manual lay-up. They also can be produced in various shapes. Reinforcing products for concrete, however, are usually manufactured in the form of rebars, sheets, grids and links to resemble the more familiar shapes already available for steel reinforcement (Figure 1).

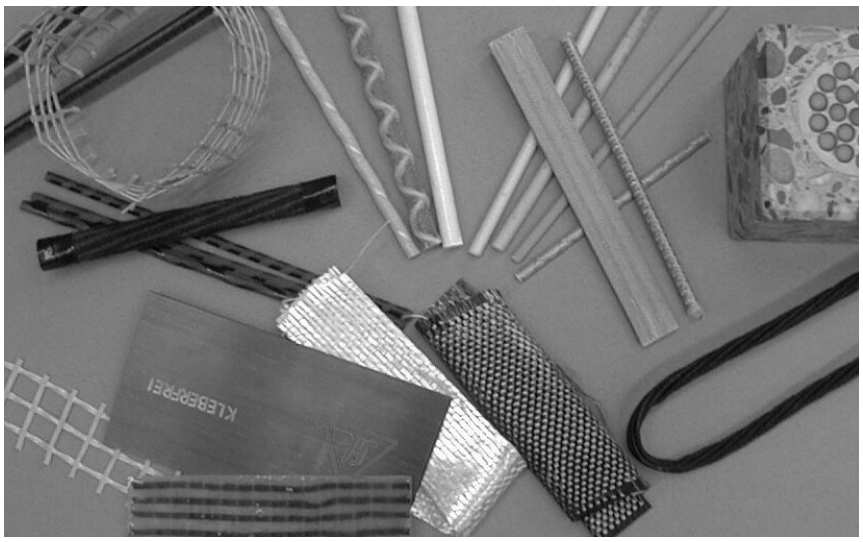

Figure 1 Various available commercial FRP products [1]

FRP composites show linear stress-strain behaviour under tension up to failure. Compared to the ductile steel, FRP generally have brittle behaviour, with higher tensile capacity, limited strain range and lower modulus of elasticity. Table 1 and (Figure 2) show typical tensile characteristics of glass, carbon and aramid FRP (GFRP, CFRP and AFRP) rebars compared to steel. The mechanical characteristics of FRPs differ in many respects from that of conventional steel reinforcement and depend on the type of fibers and resins used as well as the selected manufacturing process. FRP products are characterized by perfectly elastic behavior up to failure and can develop higher tensile strength than conventional steel in the direction of the fibers. The elastic modulus of FRP materials used in construction generally varies between 20% of that of steel for glass fibers and 75% of that of steel for carbon fibers (Figure 2). High strength, lightweight and a low modulus of elasticity, together with the fact that FRPs, unlike steel, do not display plasticity, are the key properties that differentiate the performance of these materials.

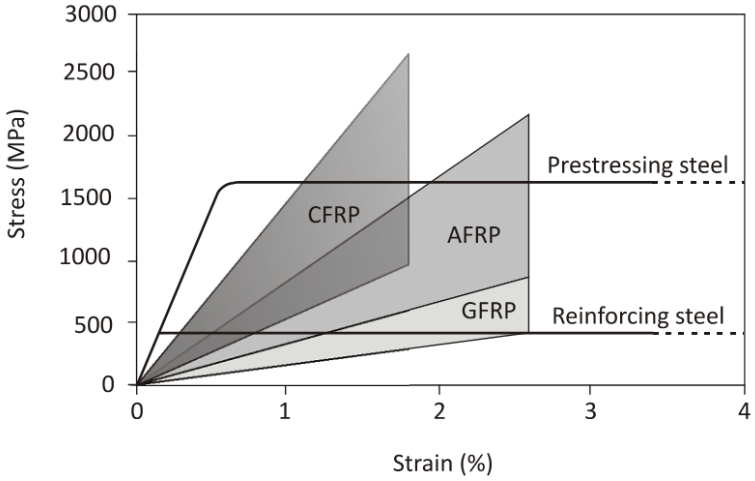

Figure 2 Stress-strain characteristics for concrete and reinforcing materials [1]

The main advantages and disadvantages of these advanced composite materials compared to steel are listed in Table 1.

Table 1 Advantages and disadvantages of FRP reinforcement.

Advantages	Disadvantages
Higher strength to self-weight ratio (10-15 times greater than steel)	Higher raw material cost and relatively poor availability
Excellent fatigue characteristics (carbon and aramid FRPs only)	Lower elastic modulus (except some Carbon FRPs)
Excellent corrosion resistance and electromagnetic neutrality	Glass FRP reinforcement suffers from stress corrosion
Low axial coefficient of thermal expansion	Lack of ductility; durability issues in alkaline environments

Due to the distinctive mechanical properties of the reinforcement, the behavior of concrete structures reinforced with FRPs is normally governed by large deformations and brittle modes of failure [1], which are generally considered to be undesirable. As a result, engineers rarely choose to use FRP reinforcement unless substantiated by comparable successful applications. FRPs are often mistakenly perceived by the engineer as a direct replacement for steel reinforcement and the same design philosophy is applied without due consideration of the advantages that these materials can offer in particular applications and environmental contexts. The lack of confidence, knowledge and experience in the use of FRPs is one of the most difficult obstacles to overcome in order to expand the use of this relatively new technology. An additional major barrier to the use of FRPs in construction is the lack of design codes. Although national design tools for concrete structures, reinforced or strengthened with advanced composites are already available to the public (e.g. [6,8,9]), these are still 'guidelines' and have not yet achieved formal standard status. Nonetheless, the interest in FPRs is still high and their use in specialist applications could greatly benefit the construction industry.

Composites in reinforced concrete construction

The crucial need to find durable and cost effective solutions to the problem of corrosion in RC structures is one of the main driving forces behind the use of advanced composites in newly built structures. FRP reinforcement represents a valid and competitive alternative to epoxy-coated and stainless steel reinforcement for anti-corrosive purposes and it has many possible applications in structures in or near marine environments, in or near the ground, in chemical and other industrial plants and in places where good quality concrete can not be achieved [1].The exceptional durability of FRPs gives the possibility of reducing the concrete cover needed to protect the reinforcement. This could promote the development of novel designs and the optimization of pre-cast elements. Owing to their inherent physical properties, FRP reinforcement can also be used successfully in applications where electromagnetic neutrality is required, as in structures situated in the vicinity of transmitting stations or receiving devices (Figure 3).

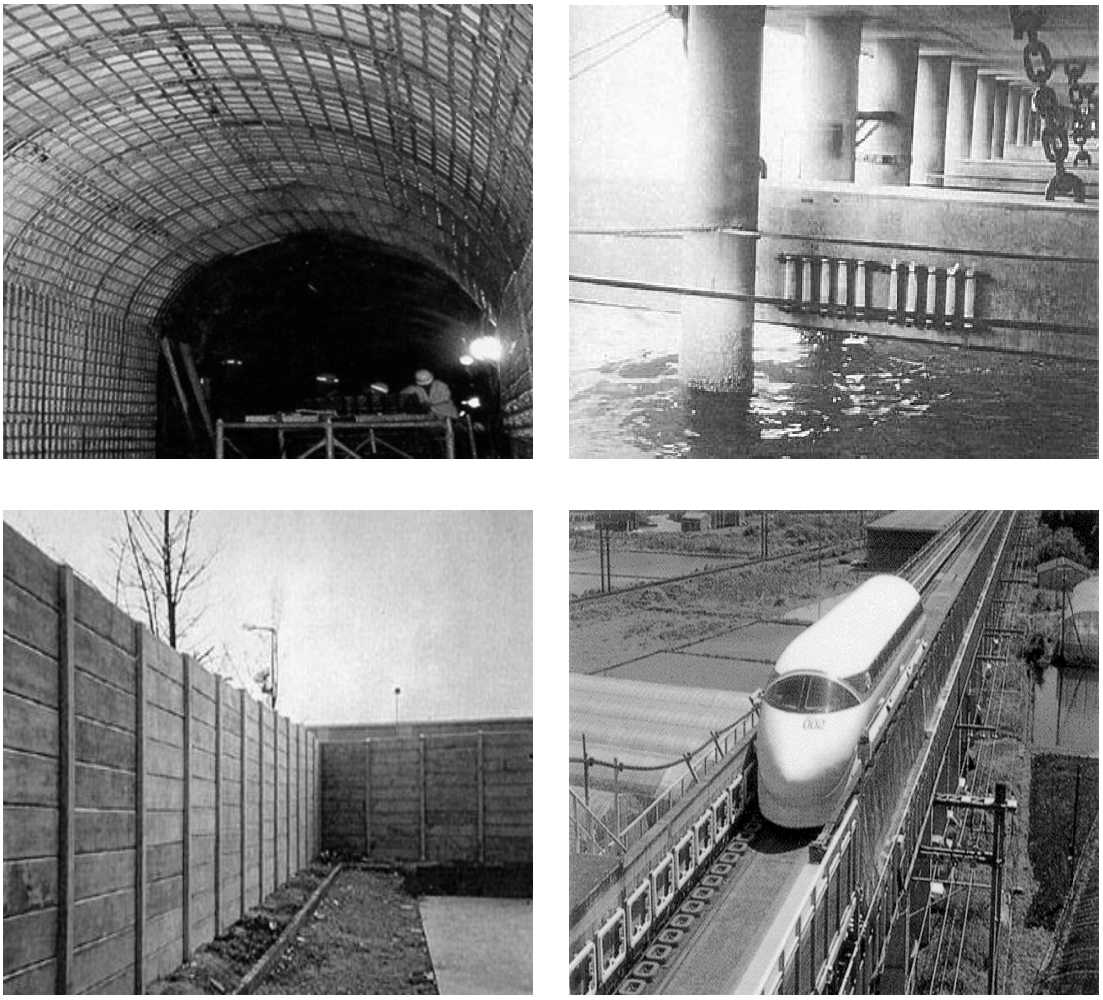

Figure 3 Various application of FRP products in reinforced concrete constructions [1]

Composites in Prestressed Concrete construction

One of the most important properties of FRPs is the very high strength that they can develop, allowing a reduction in the amount of reinforcement needed in certain applications. High strength can only be achieved, however, when high strains are developed in the reinforcement, making FRPs the ideal reinforcing material [10]. Because of the stress corrosion that affects FRP materials, particularly glass fiber based products, however, only carbon and aramid FRPs are likely to dominate the applications in this field. FRP prestressing tendons and cables have been used successfully in cable stay bridges and in other anchoring applications such as ground anchors or rock bolts (Figure 4).

Figure 4 Various composites in prestressed concrete bridge construction [1]

Externally Bonded Reinforcement

The light weight of FRP reinforcement has important practical advantages in construction, especially in specific applications in which work must be carried out in confined spaces and lightweight reinforcement can speed up construction. The light weight of FRPs becomes particularly relevant when dealing with externally bonded reinforcement for repair purposes. Given the ease-of-application, the commercial interest in FRP reinforcement for externally bonded applications is considerable and the use of FRP fabrics and plates is rapidly replacing both conventional plate bonding and jacketing techniques (Figure 5).

Figure 5 Use of FRPs as externally bonded reinforcement [1,13]

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The unique characteristics of FRPs, such as their low stiffness in comparison to that of conventional steel reinforcement and their distinct bond properties, generally lead to the development of wider cracks and can result in the comparatively larger deflections of concrete beams reinforced with such type of reinforcement. An adequate estimate of maximum deflections at serviceability limit state, as well as at higher level of loads, is hence necessary to ensure an acceptable level of structural performance. Although all of the equations included in the current design recommendations to calculate the deflections of FRP RC members were derived from those originally developed for steel reinforced concrete elements, which were proven to provide acceptable estimates, researchers in the field have questioned their performance as these equations have often been shown to underestimate overall deformations [11].

In the Rajamangala University of Technology Tawan-Ok, extensive work dealing with a series of experimental results on FRP RC beams [12,13] has provided evidence that the development of diagonal

cracking due to high shear forces can result into additional deformation components, the magnitude of which can be significant and should not be neglected (Figure 6). On the basis of such observations, two analytical models were developed to calculate the additional amount of deformation induced by diagonal cracking and are presented and discussed in the following. Moreover, experimental program including shear behavior, pullout and bend strength of FRPs are also under investigation and testing program is underway to bridge the gap between academic and industry in Thailand (Figures 7-10).

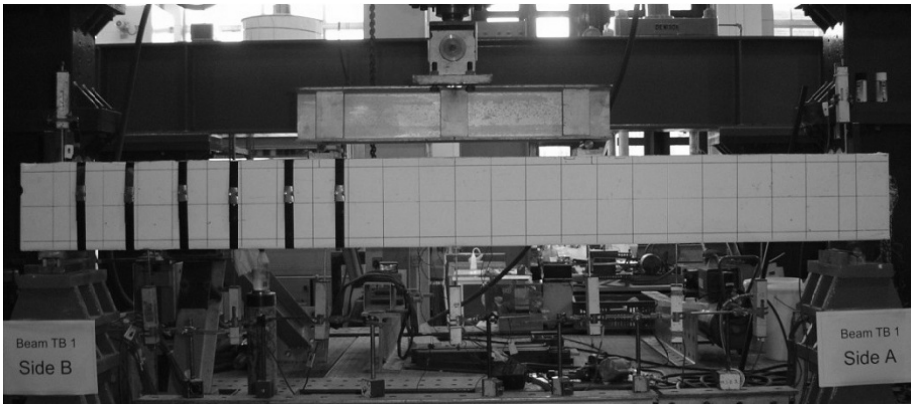

Figure 6 Experimental investigation on flexural capacity of FRP RC beam [11,12]

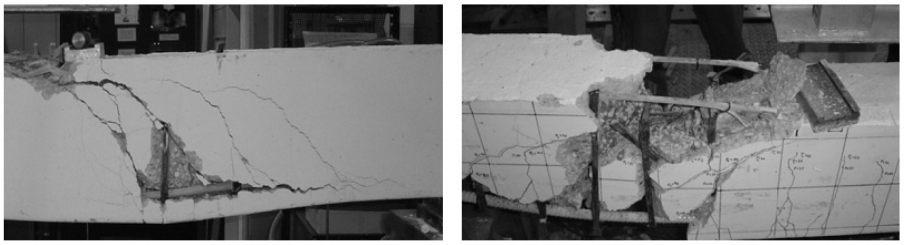

Figure 7 Experimental investigation on shear behavior of FRP stirrups [11,12]

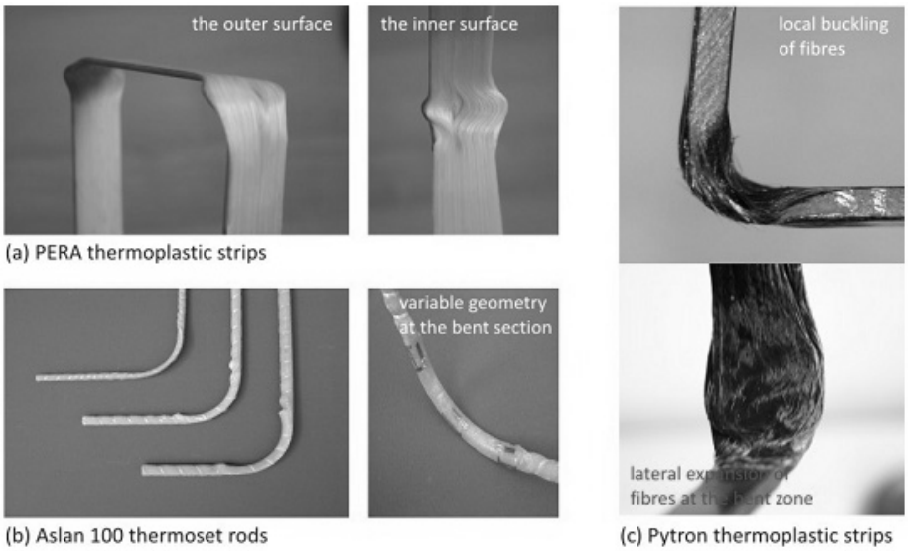

Figure 8 Investigation of bending strength of fiber reinforced composite[11,12]

Figure 9 Externally strengthening technique for concrete beams

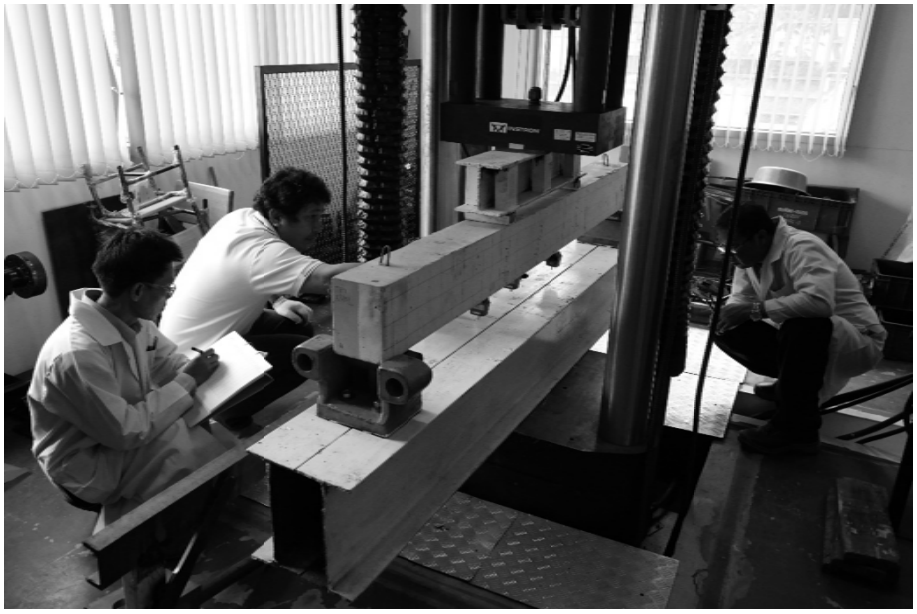

Figure 10 Laboratory investigation of concrete beams strengthened with FRP composites

Concluding Remarks

The use of FRP reinforcement can offer significant structural and economical advantages and should not be considered as a mere replacement for steel reinforcement. Use of FRPs benefits primarily specialist applications where their particular chemical, physical and mechanical properties will lead to more practical and economic solutions. FRP materials offer an effective solution to the problem of steel durability in aggressive environments and where the magnetic or electrical properties of steel are undesirable. They also appear to be highly suited for the manufacture of non-structural precast elements where the combined weight of the reinforcement and concrete necessary to provide adequate cover is a

major concern. Prestressing applications can make optimal use of the high stresses and strains that can be developed in FRP reinforcement. The use of FRP materials for strengthening and rehabilitation of deficient structural elements is quickly pervading the construction market and the available commercial systems already have proved an economically competitive alternative to traditional repair solutions.A concerted effort towards the development of recognized design standards for the use of composites in construction together with the education and training of professional engineers is paramount to facilitate the acceptance of this innovative, promising technology. In the Rajamangala University of Technology Tawan-Ok, extensive experimental program including shear behavior, pullout and bend strength of FRPs are also under investigation and testing program is underway to bridge the gap between academic and industry in Thailand.

Acknowledgement

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Study on the Effect of Ultraviolet Light to Reduce Ozone Concentration

Sutee Leejongpermpoon[1*]

Abstract

This paper presents a study on effect of ultraviolet light to reduce ozone concentration. The experiment has been finding ultraviolet source installation propose for UV energy we expect together with find the result of relation between UV energy and variance ozone concentration. Ozone in this experiment is generate by ozone generator with rated voltage is 3.16 kV, 20 kHz and result of variance ozone concentration will be measuring by ozone monitor- MODEL 450M. The results obtained show that the most effective to reduce the concentration of ozone in this experiment is intensity of ultraviolet light by 2 mw/cm^2 at installation source 1.3cm. That can reduced ozone concentration by 20.37% and efficiency to reduced the amount of ozone will have increased or decreased by 0.93% per intensity of ultraviolet light 0.5 mw/cm^2.

Keywords: Ozone, Ultraviolet, Intensity

Introduction

As it is well known, the ozone will be using as inhibitor of viral and bacterial infections with high efficiency and application of ozone significance, such asThe Mini Ozone System for Misting Fan [1]Ozone Generator Sizing Analysis for Cooling Tower System [2] Determination of Optimum Rating of an Ozone Generator for a Room in a Hospital [3]and etc.Therefore, it is high possibility to use ozone for cleaning air, water, and patient suite in hospitals with hygienic condition. However, due to infection in hospitals is increasingin each year with prevalence rated of respiratory tract infections in the hospital up to 43.2 percent [4] .That infection will be spreading widely via air directly and it leads to respiratory tract infections from Mycobacterium tuberculosis (MTB). The MTB is a major cause of pulmonary tuberculosis with high prevalence rate of the pathogenesis. It leads the patient infected other severe disease and high medical expenses. World Health Organization (WHO) has identified that Thailand is one of the top 22 countries with a rate of TB patients by the highest per capita in the world [5]. From medical research in inhibition of MTB by ozone concentration of 0.03 ppm to 0.05 ppm, it will be inhibiting MTB by 95% [6] and from ozone concentration of 25 ppm, it can be inhibit MTB by 99% [7] .However, ozoneconcentration emitted into the air must have been the level which is not harmful to humans according to the WHO standards. It is definedin the 0.1 ppm to 0.12 ppm. [8] or United State Environmental Protection Agency (EPA) standard [9] [10].

Therefore, an ozone generator with appropriate ozone concentration is one of necessary instruments to disinfection in hospitals. This paper emphasized on effect of ultraviolet light to reduce ozone concentrationpropose to used together with an ozone generator for inhibit virus and bacteria in hospitalprovide effective and more safety.

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Materials and Methods

1. Theory and related works

1.1 Ozone generate[11]

Ozone (O_3) is a gas consisting of three oxygen atoms in a combine molecule and it is not stable. The ozone generated by corona discharge is shown in (1) to (4)

$$O_2 + e \rightarrow O^+_2 + 2e \quad (1)$$

$$O^+_2 + 2 \rightarrow O^+ + O + 2e \quad (2)$$

$$O^+ + O + 2e \rightarrow O + O + e \quad (3)$$

$$2O_2 + 2O \rightarrow 2O_3 \quad (4)$$

1.2 Chemical decomposition

Chemical decomposition of ozone into Oxygen.That requires energy of ultraviolet light with 254 nm as shown in equation 5-6 [12]

$$O_3 + hv_{254\ nm} \rightarrow O_2 + O \quad (5)$$

$$O_3 + O \rightarrow 2O_2 \quad (6)$$

Wavelength inversely proportional to energywhen the wavelength is less due to extremely high energy of UV Therefore. Energy from wavelengths below 254 nm can be decomposition of ozone Bonds.

1.3 Ultraviolet Light

Electromagnetic waves. Caused by periodic oscillations of electrons with in atoms of matter due to induces the electricfield and magnetic fields, which is a wave radiates in all directions around the origin.It has been revealed the UVC wavelength 253.7 nm. That can be decompose ozone gas. [13]. and the spectrum of ultraviolet radiation can be classified according to the standard. ISO-DIS-21348 [14]. Presented in Table 1.

Table 1 spectrum of ultraviolet radiation (ISO-DIS-21348)

Name	Abbreviation	Wavelength range (nm)	Energy per photon (eV)
Before UV spectrum	Visible light	over 400	under 3.10
Ultraviolet A (long wave)	UVA	400 – 315	3.10 – 3.94
Near	NUV	400 – 300	3.10 – 4.13
Ultraviolet B (medium wave)	UVB	315 – 280	3.94 – 4.43
Middle	MUV	300 – 200	4.13 – 6.20
Ultraviolet C (short wave)	UVC	280 – 100	4.43 – 12.4

2. Experiments detail

In the experimental design,has selected 1) ultraviolet light source rated is 10 watt, diameter of 2 cm, length 36cm,Voltage: 220 volts 50Hzand wavelength 253.7 nm. Because ozone is gas absorption of light with maximum absorption at a wavelength of 253.7 nm.2) Ozonestorage equipment is acrylic with thickness 5 mm size 10cm x 15cm x 10cm. Steel frame for adjusting the distance ultraviolet light source size 40cm x 40cm x 1m and, 3) adjustable base for height level dimensions of 30cm x 30cmfor adjust small scale 1cm - 5 cm as shown in (Figure 1).

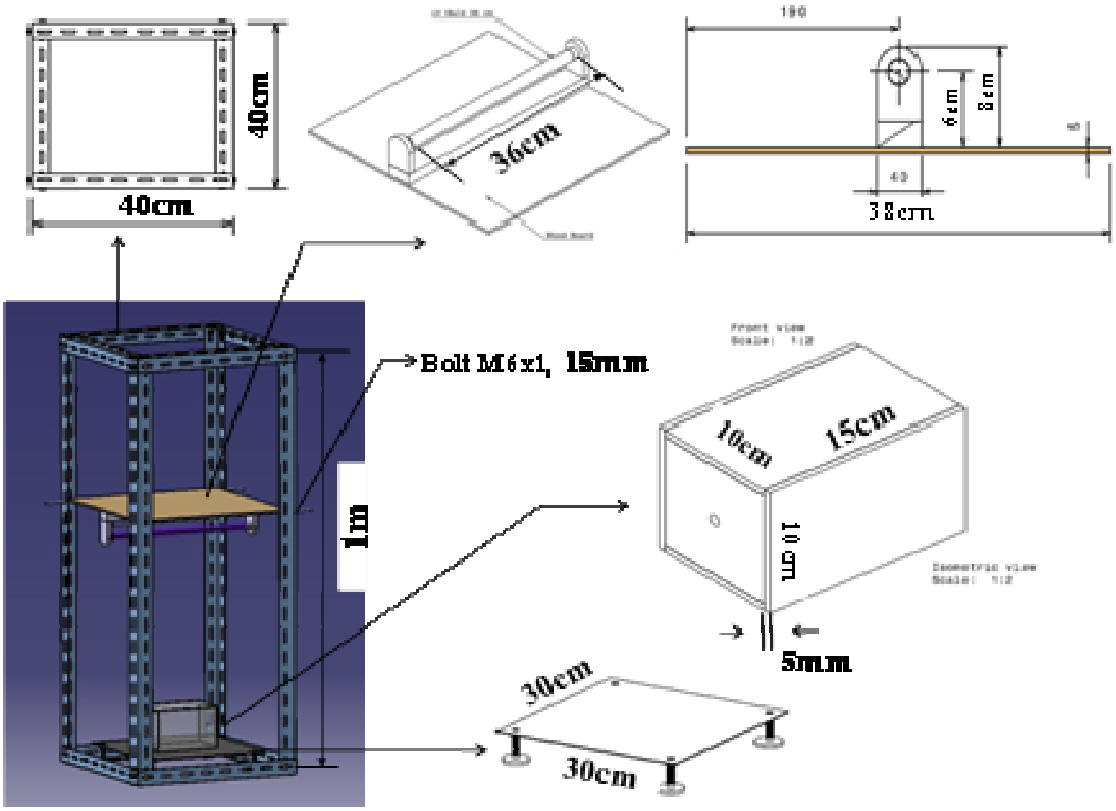


Figure 1 Experimental equipment

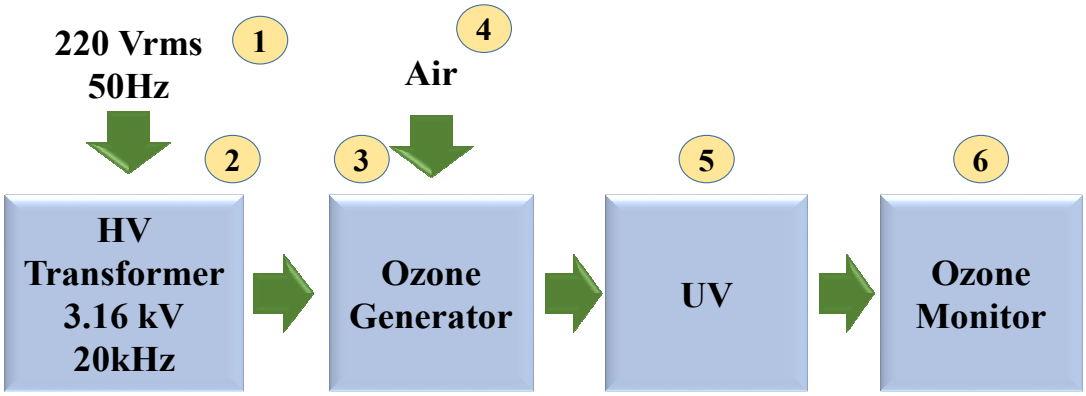


Figure 2 Flow diagramof experiment

(Figure 2) Show that the flow diagramof experiment. Number 1 is the supply voltage, 220Vac, 50 Hz connect to high voltage transformer in the number 2 which converts the voltage to 3.16 kV and frequency 20 kHz for supplied to the electrode in the ozone generator at number 3. That can generate electric field stress high enough for decomposition of oxygen in air. At number 4 when the air through an electric field the ozone gas isoccur. After that ozone gas had been generate is will be send to experimental equipment forstudy on the effect of ultraviolet light to reduce ozone concentration in number 5. The result can measure by ozone monitor in number 6.

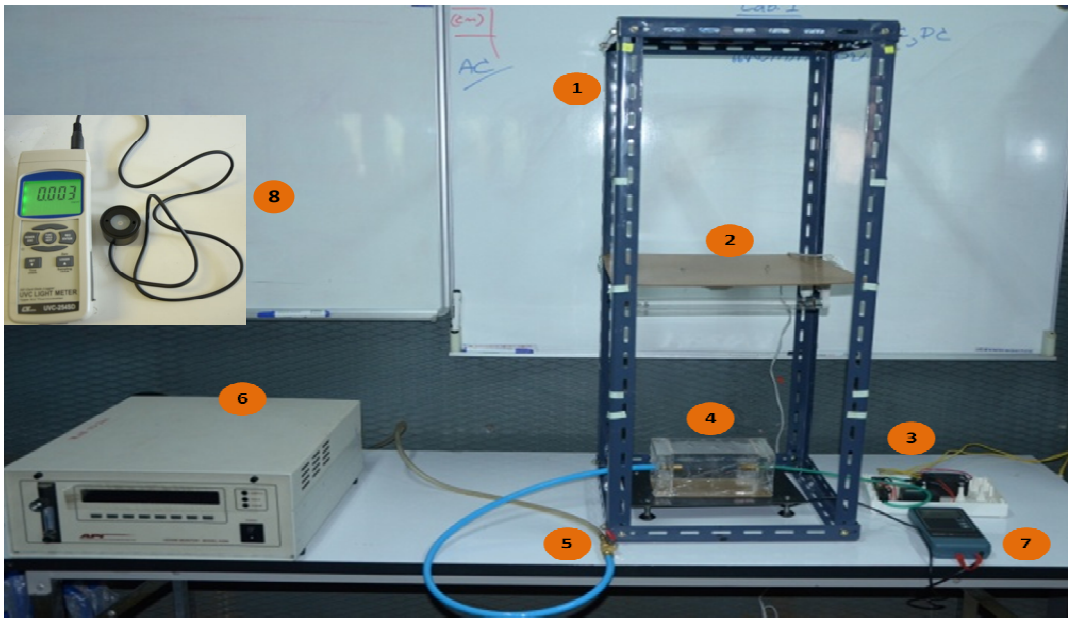
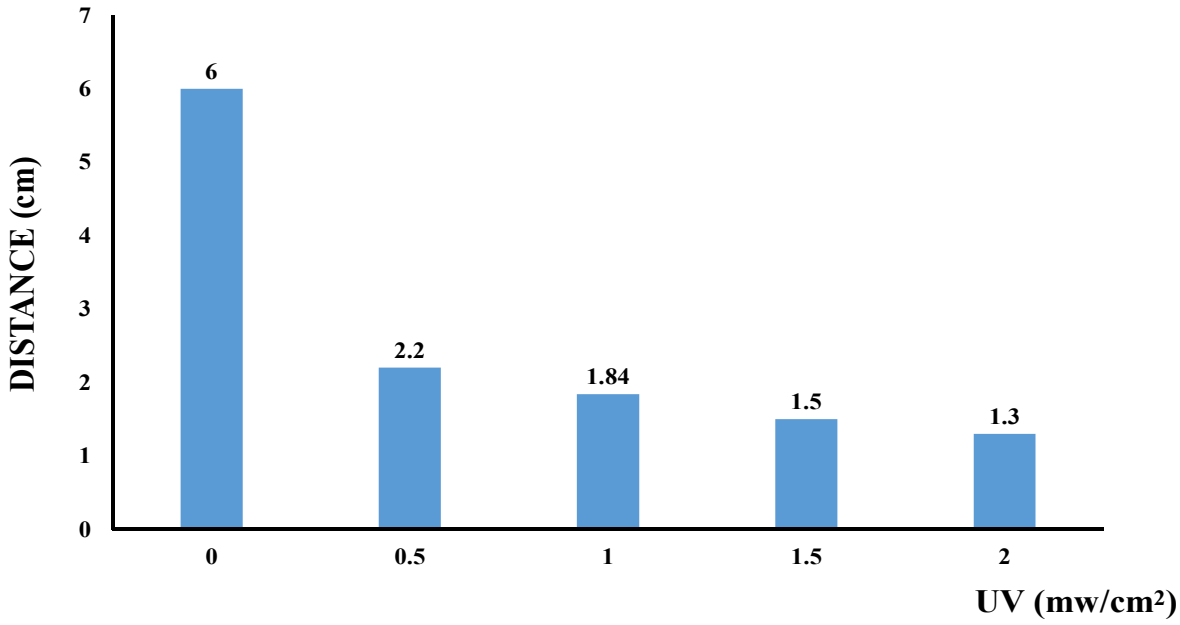


Figure 3 experimental setup

(Figure 3) show that the experimental setupnumber1 is the frame for adjustable high level of ultraviolet light source in number 2, Number 3 is the ozone generatorand number 4 isozonestorage equipment.Number 5 is a valve used to adjust the ozoneconcentration. Number 6 is ozone monitor, number 7 is flow meter and number 8 is UVC meter.

Results and Discussions

An experimental for study on the effect of ultraviolet light to reduce ozone concentration. Ozone concentration had been measuring by "OZONE MONITOR - MODEL 450M" at temperature condition is 25°C have a result below



(Figure 4), Show that the vertical axis is the distance from ultraviolet light source. The horizontal axis is the energy of ultraviolet light.It was found that the ultraviolet light energy decreased by distance from the source is increased.

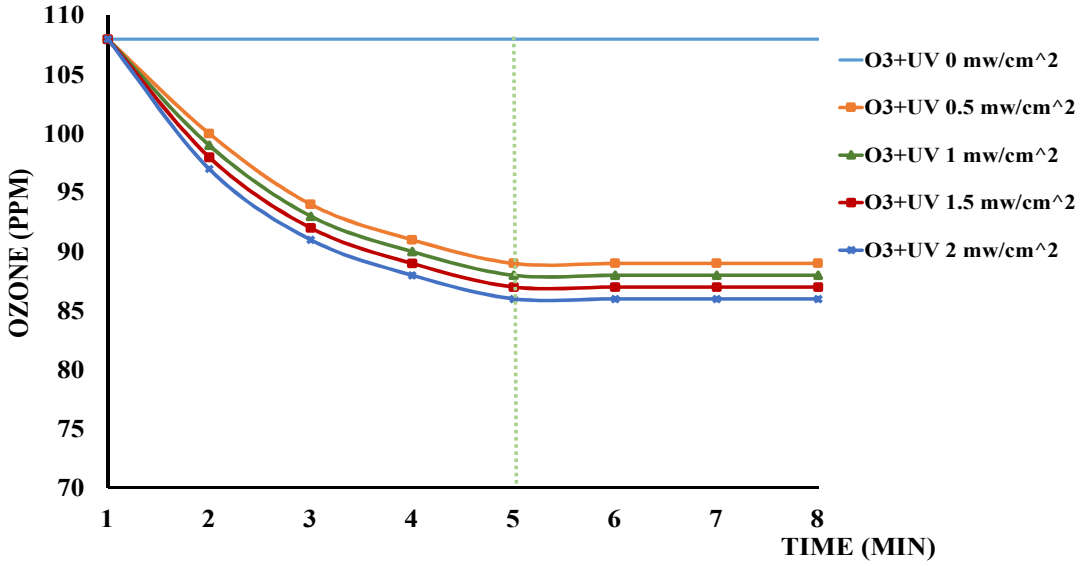


Figure 5 Relationship between the concentration of ozone per period and intensity of ultraviolet light

(Figure 5) Vertical axis is the amount of ozone concentration and horizontal axis represents time in experiment. Found that the ozone concentrations whichreceived intensity of ultraviolet light will be reducing and stable in approximate 5 minutes. Result of energy from ultraviolet light is increases due to reducing the amount of ozone can be increasing.

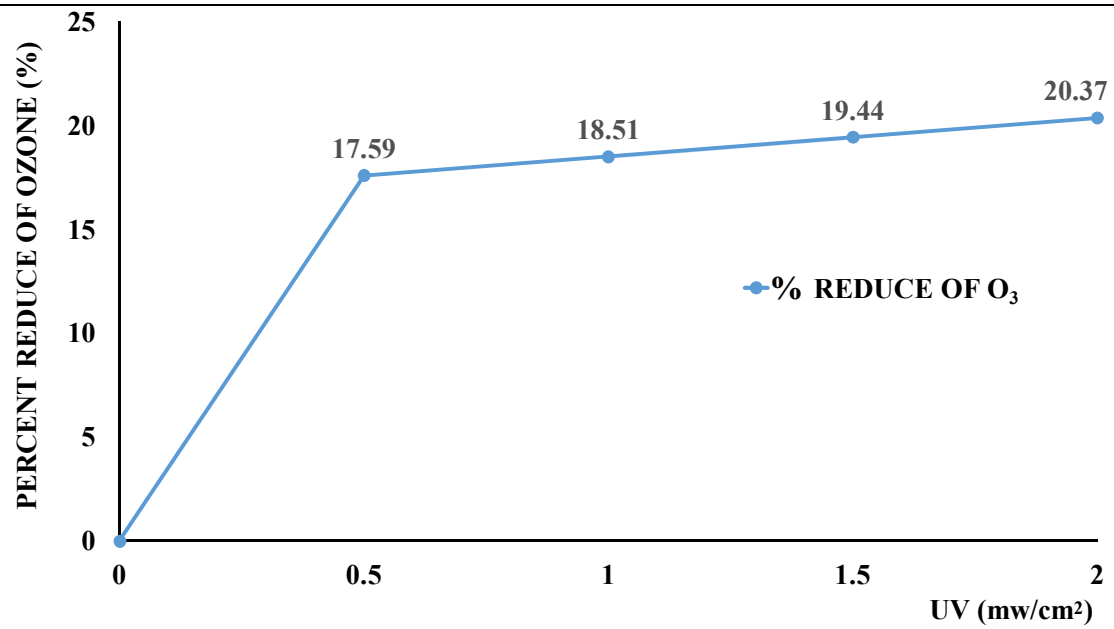


Figure 6 The relationship of performance to reduce ozone by intensity of ultraviolet light

(Figure 6) the vertical axis represents the percent reduction of ozone and the horizontal axis represents anintensity of ultraviolet light.This result found that the effective of reducing of ozone is increases as energy from ultraviolet light is increases but performance of reducing will be decreasing 0.93% byenergy from ultraviolet lightis decreased by 0.5 mw/cm^2.

Table 2 Effectively to reducing of ozone per intensity of ultraviolet lightby contrast ozone 108ppm concentration ultraviolet light before power constant. 108 ppmat temperature 25°C

UV (mw/cm^2)	Distance (cm)	Ozone + UV (ppm)	Deference of ozone (ppm)	% Reduce of Ozone by UV
0	6	108	0	0
0.5	2.2	89	-19	-17.59%
1	1.8	88	-20	-18.51%
1.5	1.5	87	-21	-19.44%
2	1.3	86	-22	-20.37%

Table 2 shows the result obtained in the experiment includeintensity of ultraviolet light, distance, amount of ozone concentration after pass ultraviolet light, and presented of reducing ozone by ultraviolet light.

Conclusion

Experimental to study on the effect of ultraviolet light to reduce ozone concentration found that the intensity of ultraviolet lightis directly affects to the efficiency of the reducing of ozone. The result show that the intensity of ultraviolet light by 2 mw/cm^2 at distance 1.3cm which is the most energy in this experiment can reduce ozone by 20.37%. Intensity of ultraviolet lightis decrease due to effective in reducing of ozone decreased. In this experimenta least of reducing ozone is 17.59% at intensity of ultraviolet lightby 0.5 mw/cm2. Effective for reducing ozone will decrease by approximately 0.93% fromintensity of ultraviolet lightis decreased by 0.5 mw/cm^2. It was concluding that intensity of ultraviolet lightis increase due to effectof the performance of reducing ozone is increase. The results will be using to design an ozone controller propose to use together with ozone generator for inhibitvirus and bacteria in hospital with provide effective and more safety.

Acknowledgement

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14.ISO 21348 Process for Determining Solar Irradiances.

Segregation of Pattavia Pineapple Juiciness by Microwave

Wanchai Khamsen,[1*] Chuthong Summatta,[1] Chiraphon Takeang[1]
and Eakkathas Pruksawan[2]

Abstract

The purpose of this research was to investigate the segregation of pattavia pineapple into different juicy levels. Microwave was used to analyze the frequency of fruit for sorting the lushness of pineapple. The horn antenna was designed the 5.8 GHz in microwave frequency for testing the transmission and reflection of waves in pineapple for classification into different maturity levels. The maturity of pineapple juicy high levels, the return loss of transmission was less than the pineapple non juicy. The results showed that the transmission of microwave was affected the maturity of pineapple juicy levels. It can be concluded that the transmission of microwave frequency was significant for segregation of pineapple juiciness.

Keywords : Segregation, Pineapple juicy, Microwave

Introduction

Pineapple (*Ananas comosus*) is the common name for an edible tropical plant and also its fruit [1]. The pineapple is eaten fresh or canned and available as a juice or juice mixed. It is native from Paraguay and the southern part of Brazil and nowadays also grown in several parts of Thailand. Thailand is one of the world's leading manufacturer and exporters of pineapples [1]. Pattavia variety of pineapples is generally used as raw materials in the production process of canned pineapples. Pineapple is exported in fresh or as processed products which the most critical factor is the quality of the raw material [2]. There are classification of grade fruits such as size, appearance and maturity index. Maturity index is the level of ripeness includes shape, color and texture. The conventional method for maturity inspection is used the human expert employee. This method will lead to some error due to human fault and take more time. However, several techniques exist for the grading of fruit. The acoustic impulses are used to evaluate a watermelon's internal quality [3]. This method analyzed the sound from vibration of the knocking fruit. This method applies to evaluate pineapple maturity [4]. Whereas, Chyung [5] uses the acoustics impulses to assess the internal quality of pineapple. The resonant frequencies obtained from acoustic impulse tests conducted on pineapple firmness and soluble solids have been used to develop an artificial neural network (ANN) model for ripeness prediction [6]. In addition, the X-ray images are used to detect pineapple translucency [7]. Near Infrared spectroscopy (NIR) has been used to accurately predict soluble solids content in pineapples [8] used multivariate data analysis for classification of pineapple maturity.

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In this paper, segregation of pattavia pineapple juiciness by microwave for prediction of pineapple maturity is proposed. Microwave is used to analyze the frequency of fruit for sorting the lushness of pineapple.

This paper is organized as follows. First section describes materials and methodology. Second section shows the results and discussions. And the last section concludes the paper.

Materials and Methods

1. Samoles

A sample of 200 fresh "Pattavia" cultivar pineapples was taken from the farms in the region of Lampang Province, Thailand. The samples were divided into two groups of maturity level according to their juiciness and non juicy. The samples were analyzed by using weight, diameter and the transmission and reflection of microwave frequency response measurements to obtain nondestructive parameters. The weight of pineapple must be in the range of 1-1.5 kilogram and a diameter of 10-15 centimeter. After that, the pineapples were cut-open along the longitudinal axis and photographed. All processes were managed within 2 day of the postharvest at room temperature approximately 25 °C.

2. Design horn antenna

The horn antenna was designed according to standard rectangular waveguide 5.8 GHz in frequency. The dimension of horn antenna is shown in (Figure 1-2).

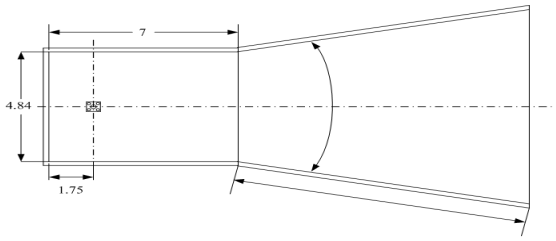


Figure 1 Top cross section of horn antenna.

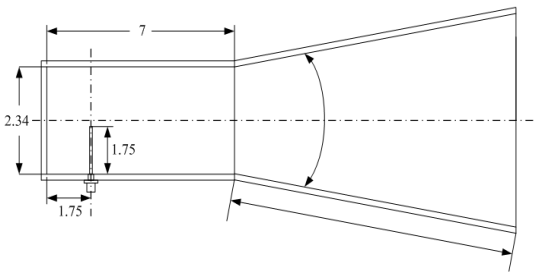


Figure 2 Lateral cross section of horn antenna

Form (Figure 1-2), the gain of a rectangular horn antenna can be obtained.

$$D = \frac{4\pi\varepsilon_{ap}A_p}{\lambda^2} = \frac{4\pi\varepsilon_{ap}(a_E a_H)}{\lambda^2} \quad (1)$$

Where D is gain of a rectangular horn antenna, ε_{ap} is effective aperture, A_p is cross-sectional area, a_E is the width of the cross-sectional area, a_H is the length of the cross-sectional area and λ is the wavelength. The gain of a rectangular horn antenna calculation is about 17.08 dBi.

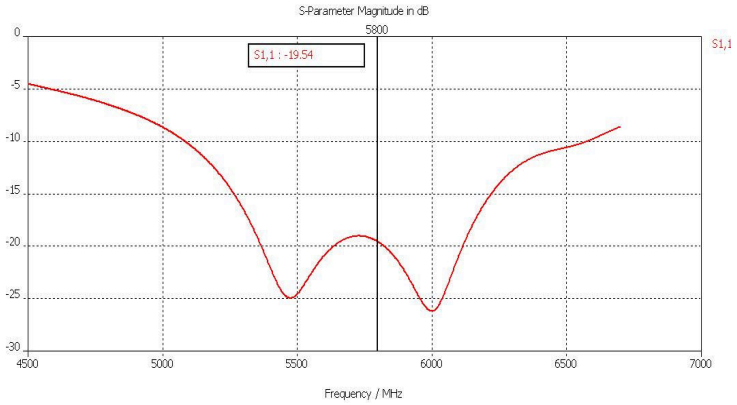


Figure 3 Simulation results of the return loss.

Results and Discussions

1. Simulation results

Horn antenna was designed and simulated using computer program. The results were compared with the calculated values. The return loss (S11) was the important parameter to consider as shown in (Figure 3). The results show that the return loss of 5.8 GHz in frequency is -19.54 dB which is negative above world standard (10 dB). Therefore, the antenna bandwidth has led to wider use of 1.4 GHz with frequencies between 5.1 GHz. to 6.5 GHz. The simulation results of propagation and gain of the antenna with computer program are shown in (Figure 4-5). The propagation is towards the front of the antenna with the gain of 15.4 dBi, which is close to the calculated values. The implemented prototype in the laboratory is shown in (Figure 6).

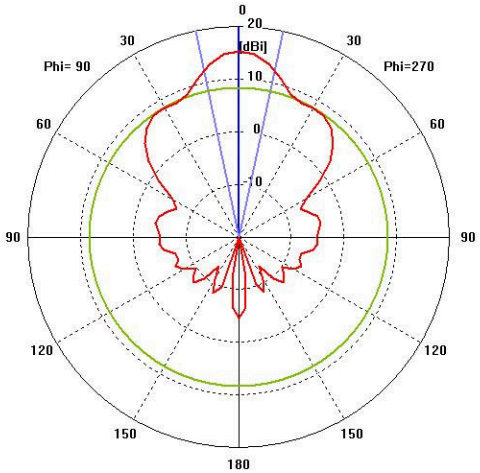


Figure 4 Simulation results of the propagation in 2D view.

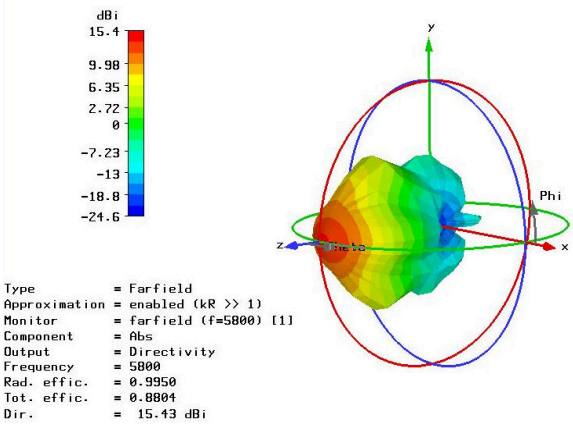


Figure 5 Simulation results of the propagation in 3D view.

2. Experimental results

The circuit configuration was used to measure the transmission and reflection of microwave frequency response as shown in (Figure 6). An experiment of the segregation of pattavia pineapple juiciness is used to confirm the performance of the proposed technique. The implemented prototype in the laboratory is shown in (Figure 7).

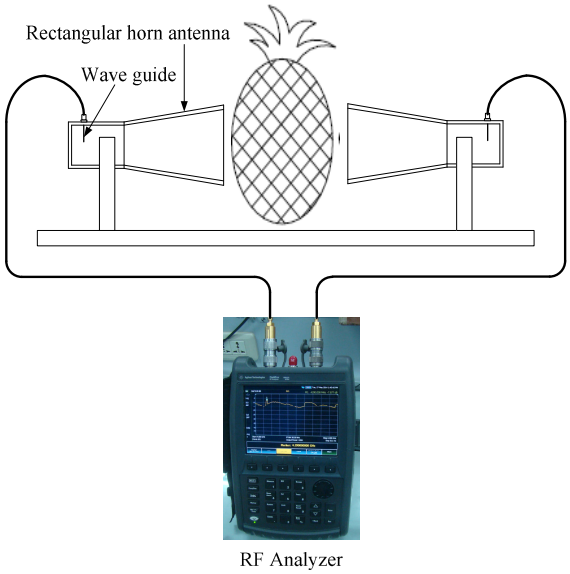


Figure 6 The circuit configuration

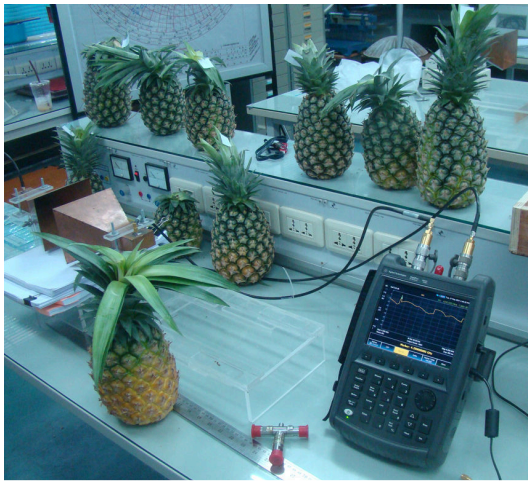
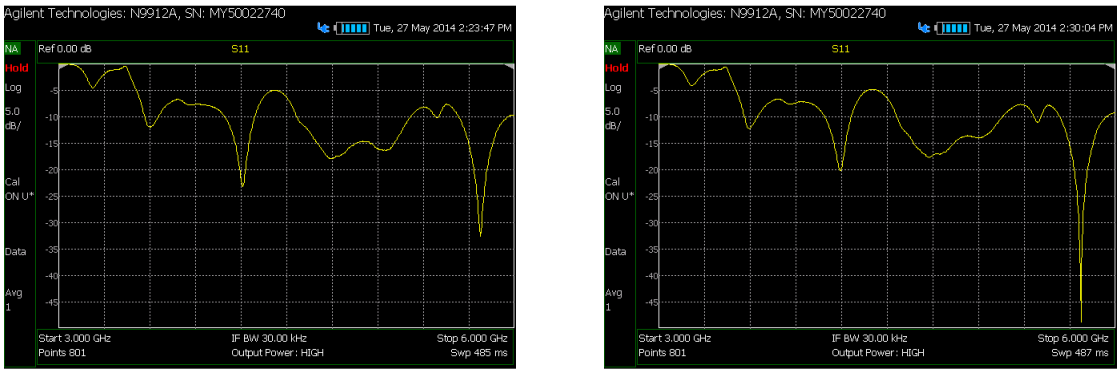


Figure 7 Experimental equipment.

The photographs in (Figure 8) show the internal appearance of pineapples graded into two maturity levels. (Figure 8 a) represents the non juicy pineapple and (Figure 8 b) for juiciness pineapple. The return loss (S11) responses of a pineapple sample with two waveforms are shown in (Figure 9). The results show that the format of the return loss is different. The return loss of transmission of juiciness pineapple was less than the pineapple non juicy at 5.8 GHz in frequency. It can be concluded that the transmission of microwave frequency was significant for segregation of pineapple juiciness.

a) b)

Figure 8 The internal appearance of pineapples: a) non juicy pineapple and b) juiciness pineapple.



a) b)

Figure 9 The return loss (S11) waveform of: a) general pineapple and b) juiciness pineapple.

Conclusion

In this paper, segregation of pattavia pineapple maturity into different juicy level with microwave is proposes. Microwave was used to analyze the frequency of fruit which used for sorting the juiciness of pineapple. The horn antenna was designed according to standard rectangular waveguide 5.8 GHz in frequency for transmission and reflection of microwave frequency response. Horn antenna was designed and simulated using computer program. The results were compared with the calculated values. In experimental, the pineapples were analyzed by using weight, diameter and the transmission and reflection of microwave frequency response measurements to obtain nondestructive parameters. The return loss of transmission of juiciness pineapple was less than the pineapple non juicy. It can be concluded that the transmission of microwave frequency response significantly influence segregation of pineapple juiciness. Therefore, microwave is used to analyze the frequency of fruit which used for segregation of pattavia pineapple into different juicy levels.

Acknowledgement

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Synthesis of biodiesel from Irvingiamalayana seed oil

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ABSTRACT

Because of the increasing of fossil oil prices, reducing petroleum reserves and the environmental concern of emission gases from fossil fueled engines, biodiesel has been used as a renewable energy source in recent years. In this research, the study of synthesis biodiesel from *Irvingiamalayana* seed oil (Krabok oil) by transesterification reaction with methanol and potassium hydroxide as catalyst were investigated. The parameters that effects on transesterification reaction consist of the ratio of methanol and krabok oil, the concentration of catalyst, reaction temperature and reaction time were studies. The preliminary results shown that the optimum conditions for the synthesis biodiesel from Krabok oil by transesterification reaction were the mole ratio of methanol and krabok oil 8:1, the concentration of catalyst 1%, reaction temperature of 60 °C and reaction time of 120 minutes. The content of methyl ester of Krabok biodiesel was determined by gas chromatography (GC) to be 98% under the optimum condition. The obtained biodiesel was then tested for its fuel properties. The result showed the feasibility of Krabok oil as a new suitable raw material for biodiesel preparation.

Keywords:Biodiesel,*Irvingiamalayana* seed oil, Transesterification reaction

Introduction

The attractive solution of biodiesel as a renewable transportation fuel in Thailand was increasing because it can be compensated fossil oil and produced from vegetable oils and fats that low cost. The advantages of biodiesel are its portability, ready availability, higher combustion efficiency, lower sulfur content, renewability and higher biodegradability[1].Biodiesel fuel can be produced by transesterification reaction of substantially any triglyceride feedstock. This consists of oil-bearing crops, animal fats, and algal lipids. Transesterification reaction can convert the triglycerides into smaller hydrocarbon. The alcohol catalyst mixtures with low molecular weight of alcohol such as methanol and ethanolwereadded into the reaction. For cost reasons, methanol is the alcohol most frequently used for triglyceride transesterification. Nevertheless, other alcohols arealso used.Various type of catalyst (acid, bases or enzyme) can be used in this reaction. However, transesterification reaction with homogeneous base catalysts requires a shorter reaction time and lower cost compared with enzyme catalysts[2].The reaction products are a mixture of desires esters, mono and diglycerides, glycerol, water and catalyst. Biodiesel is composed of mixture of fatty acid alkyl esters. The transesterification reaction using methyl alcohol is fatty acid methyl ester(FAME) which is called biodiesel [3].

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Various types of vegetable oil can be used for preparation of biodiesel such as soybean, rice bran, coconut, rapeseed, jatropha and sunflower [4,5]. The use of vegetable oil and triglyceride feedstock for biodiesel production depends on regional availability and economics.

*Irvingiamalayana*is a local tree that produced not only in north region but also in northeast region of Thailand. The Thai name of this tree is Krabok or Ka-bok.It is botanically classified in the family of *Irvingiamalayana*. Krabok tree produces a popular and inexpensive wood that can be used for made furniture. The nutritional value and physicochemical properties of Krabok fruit was evaluated by Sonwai[6]. The most important part of nut seems to be oil. The fatty acid composition of Krabok nut was found to contain primarily saturated fatty acids such as lauric acid and myristic acids. Therefore, the production of biodiesel fromThaiKrabokseed oilis very interesting research.

To our knowledge, no investigations have been conducted to optimize the parameters of transesterification reaction for biodiesel production from*Irvingiamalayana* seed oil. In this study, the synthesis biodiesel from Krabokseed oil by transesterification reaction was conducted. The parameters that effect on the content of fatty acid methyl ester including the ratio of methanol and Krabok oil, the concentration of catalyst, reaction temperature and reaction time are discuss

Materials and Methods

The *Irvingiamalayana* (Krabok) seed samples were taken from local market at Pitsanulok province in north region of Thailand. Reagents for biodiesel synthesis were methanol (99.8%, Ajax Chemical Co. Ltd.). FAME standard solution (Sulpelco FAME Mix 37 comp.) which contains 37 fatty acid methyl ester such as methyl myritate, methylpalmitate, methyl stearate, oleic methyl ester and methyl behenate was used for GC analysis. Methyl heptadecanoate was used as internal standard material for GC analysis. All reagents that used in reaction were analytical reagent grade.

The Krabokoilwas prepared by solvent extraction. Firstly, the seed were clean and sent to the de-hulling to remove the hulls from the kernel. The kernel of all samples were crushed and milled into fine particle. The small pieces of Krabok seed was extracted using hexane as a solvent. The compositions of fatty acid in Krabok oil were determined using gas chromatography. The extracted Krabok oil that used as raw material for biodiesel production was finally stored in the dark bottle until use.

In this work, we investigated the influence of each factor on transesterification to optimize the reaction condition. Methanol to oil molar ratio, potassium hydroxide concentration, reaction temperature and reaction time were each considered as single factor. Four levels of methanol to triglyceride molar ratio (4:1, 6:1, 8:1, 10:1), four levels of potassium hydroxide concentration base on the weight of Krabok oil (0.5, 1.0, 1.5, 2.0), three level of reaction temperature (40, 50, 60 $^{\circ}$C) and four level of reaction time(60, 90, 120, 180 minute) were chosen as variables. The transesterification reaction was conducted in 250 ml glass batch reactor, placed in a thermostatic water bath, using magnetic stirring at 500 rpm. The mixture was stirred at the same rate in all run. The excess amount of methanol in the product was recovered by rotary funnel and left overnight for phase separation into two layers. The upper oil layer was crude biodiesel that was collected and washed with warm deionized water (55-60 $^{\circ}$C). Excess water in products was recovered by heated at 120°C for 4 hours. The Krabok biodiesel was filtered. The content of fatty acid methyl ester in product was analyzed by gas chromatography (GC) using EN14103 method.

GC analysis for fatty acid methyl ester of Krabok biodiesel was performed using Agilent 6890N gas chromatography with capillary column (HP-INNoWax) 30 m x 0.32 mm inner diameter(ID) x 0.25 um film thickness, equipped with a flam ionization detector(FID) and Agilent7683 Autosampler. The initial temperature program was 50 $^{\circ}$C with 2 min hold, then raised to 200 $^{\circ}$C at 20 V/min with 10 min hold. Final temperature was 280 $^{\circ}$C at 5 $^{\circ}$C/min with 2 min hold. The carrier gas was nitrogen, and fatty acid analysis was performed by injection of 1 μL of each sample. The run time for a single sample was 38.5 min. Additionally, the Krabok biodiesel that obtained from optimum condition was

analyzed the percent methyl ester byquality analysis department (PTT public company limited) in order to certify the result of Krabok biodiesel.

Parameters	Level			
	1	2	3	4
Methanol to triglyceride molar ratio	4:1	6:1	8:1	10:1
Potassium hydroxide amount (wt %)	0.5	1.0	1.5	2.0
Reaction temperature (°C)	40	50	60	
Reaction time (minute)	30	60	120	180

Results and Discussions

Krabok oil characteristic

The characterization of Krabok oil that used as starting raw material for biodiesel production is important because vegetable oil properties influence the biodiesel properties significantly. The physicochemical characteristic of Krabok oil was shown in Table 1.The major fatty acid compositions ofKrabok oil were capric, lauric, myristic, palmiticand oleic. There are a significant proportion of short chain fatty acids, such as C10, C12 and C14, compare to other oils typically used for biodiesel production such as rapeseed soybean and sunflower oil. These short-chain acids were converted in to ester and introduced complications during the biodiesel production process[7].

Table 1 Physicochemical properties of Krabok oil

Characteristic	
Free fatty acid (% as oleic acid)	0.9
Saponification value	243
Iodine value	8.3
Fatty acid composition (wt%)	
Capric acid (C10:0)	1.7
Lauric acid (C12:0)	41.7
Myristicacid(C14:0)	54.6
Palmitic acid (C16:0)	1.4
Oleic acid (C18:2)	0.6

Table 2 Parameters and levels of experimental design scheme for transesterification reaction

Optimum parameter for biodiesel synthesis from Krabok oil

For the transesterification reaction of Krabok oil, we investigated several operating conditions: molar ratio of methanol to Krabokoil, catalyst concentration, reaction temperature and reaction time

Molar ratio of methanol to Krabokoil

The most important factor of alkali-catalyzed transesterification was the molar ratio of alcohol and oil. An excess of methanol is required in order to drive the reaction towards completion because transesterification is a

reversible reaction. The stoichiometry of this reaction require 3 mol of alcohol/ 1 mol of triglyceride to produce 3 mol of FAME and 1 mol of glycerol[8].The increase in molar ratio of methanol will result in high biodiesel yield. In this experiment, four different molar ratioswerestudies. The methanol to Krabok oil ratio was varied within the range of 4:1 to 10:1 with a reaction temperature of 60°C and 1%KOH on the basis of oil weight as catalyst for 60 min. The maximum fatty acid methyl ester was found at the methanol to oil molar ratio of 8:1. As shown in Fig. 1, with increase in methanol to Krabok oil molar ratio, the content of methylester was increase and reached a maximum at the methanol to oil ratio of 8:1. However, the furtherincrease in molar ratio beyond 8:1 resulted in a small decrease inthe percent of methyl ester. The yield remains the same with further increase in the methanol to Krabok oil molar ratio.

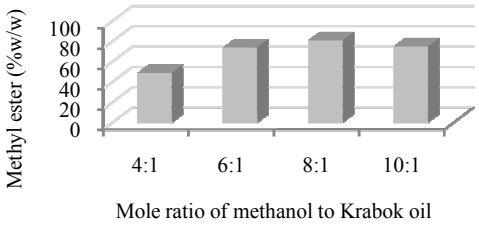

Figure 1 Effect of mole ratio of methanol to Krabok oil on fatty acid methyl ester. Experimental conditions: reaction temperature:60 °C; potassium hydroxide content: 1 wt%; reaction time: 60 min.; mixing speed: 500 rpm.

Catalyst concentration

Transesterification reaction of Krabok oil was performed using potassium hydroxide as catalyst. Potassium hydroxide has an advantage because it can serve as a fertilizer. Because potassium hydroxide can be convert into product which can serve as a fertilizer. Sine KOH is more economical than sodium hydroxide, it is the preferred choice for large-scale FAME production process[4,8]. The effect of potassium hydroxide content was studied in the range of 0.5 to 2% by weight. Figure 2 shows the influence of the amount of potassium hydroxide on biodiesel yield. The content of fatty acid methyl ester was quite low for small quantities of potassium hydroxide. The amount of potassium hydroxide depends on the amount of free fatty acid content. In this work, the optimum catalyst concentration of potassium hydroxide was 1 %. As shown in Figure 2, the content of fatty acid methyl ester was enhanced by increasing KOH concentration. Additionally, it was observed that the yield of biodiesel started to decline when the catalyst concentration was increased above 1.0%. There was a gradual increase in the content of methyl ester from 89 to 97 as the catalyst loading increased from 0.5 to 2 wt.%. However, the biodiesel from the reaction slightly increase with further increase in catalyst loading higher than 1wt.%. Therefore, the catalyst concentration of 1% was chosen for subsequent experiment.

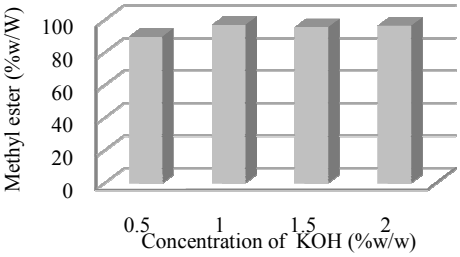

Figure 2 Effect of potassium hydroxide content on fatty acid methyl ester .Experimental conditions: reaction temperature:60 °C; reaction time: 2 h; methanol to Krabok oil mole ratio: 8:1; mixing speed: 500 rpm.

Reaction temperature

The effect of temperature on Krabok oil transesterification reaction was investigate at 40, 50 and 60 °C using potassium hydroxide concentration of 1 %(w/w) and molar ratio of methanol to oil of 8:1. As illustrated in Figure 3, the content of methyl ester was44, 70, and 95% at 40, 50 and 60 °Crespectively. The reaction temperature strongly affected the content of

methyl ester. In general, transesterification reaction is performed near the boiling point of the alcohol at atmospheric pressure. Further increase in temperature is reported to have a negative effect on the content of methyl ester[9]. In this work, the optimum temperature was 60°C because the maximum content of methyl ester was observed.

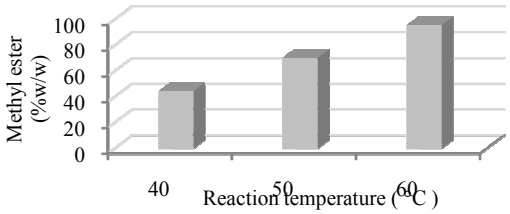

Figure 3 Effect of reaction temperature on fatty acid methyl ester .Experimental conditions: methanol to Krabok oil mole ratio: 8:1; potassium hydroxide content: 1%wt; mixing speed: 500 rpm; reaction time 120min.

Reaction time

Reaction time was significant operating parameters which are closely related to the energy costs of biodiesel production process. Different researchers have reported different reaction time for transesterification process[3].The effect of reaction time on the transesterification of Krabok oil at catalyst concentration of 2%, molar ratio of 8:1and 60°C were determined. In this work, the reaction times were determined at 30, 60, 120 and 180 minutes. The result shown that within 60 min, the reaction was rapid.The content of fatty acid methyl ester was enhanced by increasing the reaction time.However, it was observed that no significant increase in the content of methyl ester was observed with prolongation of the reaction beyond 120 minute. Therefore, the optimum reaction time in this study was 120minutes. Under optimum condition, the content of methyl ester in this study correlates well with the certificate of analysis byquality analysis department (PTT public company limited).

The physical and chemical properties of Krabok biodiesel were determined by standard method. The results were compared with those of Thai Biodiesel specification that shown in Table 3. It was found that Krabok biodiesel had some fuel properties correlated with Thai biodiesel specification.

Table 3 Properties of Krabok biodiesel in comparison with Thai biodiesel specification

Test item	Method	Limit	Result in this work
Density at 15 °C, kg/m^3	ASTM D 4052-96	860-900	871.7
Kinematic viscosity at 40°C, mm^2/s	ASTM D 445-06	3.5-5.0	3.753
Total acid number, mg KOH/g	ASTM D 664-01	Max.0.5	0.25
Water content, %wt	EN ISO12937	Report	0.03

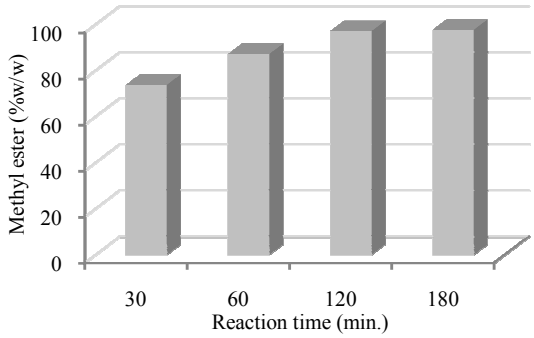

Figure 4 Effect reaction time on fatty acid methyl ester .Experimental conditions: reaction temperature:60 °C; methanol to Krabok oil mole ratio: 8:1; potassium hydroxide content: 1%wt; mixing speed: 500 rpm

Conclusion

This paper illustrated a new raw material and methods for sustainable biodiesel production from*Irvingiamalayana* seed oil. The synthesis of biodiesel fromKrabok oil by transesterification reaction with methanol and potassium hydroxide as catalyst was carried out. The experimental parameters that effect on the content of fatty acid methyl ester were investigated. Optimum parameters were 8:1 methanol to Krabok oil mole ratio, 1 wt. % of potassium hydroxide, 2 hours of reaction time, with mixing speed 500 rpm in this experiment range. Under optimum conditions, Krabok oil was converted into biodiesel with fatty acid methyl ester content reaching 98% which correlate the certificate of analysis from quality analysis department, PTT public company limited.Some fuel properties of Krabok biodiesel are agreement with Thai biodiesel specification. The result showed the feasibility of Krabok oil as a new suitable raw material for biodiesel production.

Acknowledgement

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Diversity of macroinvertebrates in the Wa River, Bo Klua, Nan Province, Thailand

Patchara Nithirojpakdee ,[1*] Chaowalee Jaisuk[2] And Tharatep Sukkong[1]

ABSTRACT

The research on diversity of macroinvertebrates in Wa River, Amphur Bo Klua, Nan Province, Thailand 15 research sampling sites along Wa River were investigated on September in 2013 (wet season) and February in 2014 (dry season). Macroinvertebrates were collected by Surber sample. Class Insecta was found, Order Trichoptera is highest diversity (9 families) including Fleptoceridae, Glossosomatidae, Helicopsychidae, Hydropsychidae, Hydroptilidae, epidostomatidae, Limnephilidae, Phryganeidae and Polycentropodidae. The average of species diversity index was 1.39 $\pm$ 0.61 in wet season and 1.44 $\pm$ 0.88 in dry season. Diversity of macroinvertebrates were changed by seasonal and geographic characteristics of the region. According, organism by species composition of macroinvertebrates and species diversity index (1.38), the water quality of Wa River is good quality for aquatic organism.

Keywords: macroinvertebrates, aquatic insect, species diversity, biodiversity

Introduction

In Thailand has undergone rapid social and economic changes in recent decades and with these has been a precipitous rise in the degradation of natural resources. Forest cover, coastal mangroves, coral reefs and many aquatic and terrestrial animals have declined in distribution and numbers, in some cases dramatically [1]. Threats of species and habitat as a consequence of human activities can lead to widespread environmental losses. For example, algaecides, pesticides and fertilizers to agriculture cropland can result in significant additions of contaminants to water resources. Anthropogenic activities can change biodiversity within aquatic ecosystems and effects on human health. Aquatic biodiversity can experience a decline due to loss or fragmentation of habitat and pollution. Changes in benthic invertebrate community structure and distribution are associated with changes in environmental factors [2].

Benthic invertebrates play an important role in transitional ecosystems, by filtering phytoplankton and then acting as a food source for larger organisms such as fish, thereby linking primary production with higher trophic levels. Aquatic macroinvertebrates are organisms for indicators of stream quality [3]. Moreover, benthic macroinvertebrates were used to achieve the above objectives in a variety of ways, including monitoring changes in genetic composition, bioaccumulation of toxicants, toxicological testing in the laboratory and field, and measurements of changes in population numbers, community composition, or ecosystem functioning [4].

Insects are among the most conspicuous inhabitants of streams and rivers. In most cases, it is the larval stages of these insects that are aquatic, whereas the adults are terrestrial. Immature aquatic insects abound in the benthos of riffle regions of headwater rivers [5] in Thailand, especially, Hydropsychidae, Baetidae and Leptophelidae [6].

The aims of this research were to present a preliminary assessment of the diversity and distribution of stream macroinvertebrates in the Wa River, Bo Klua, Northern of Thailand. The results of this research evaluate for environmental health of Wa River to generate information on stream conservation, especially management conservation area in future.

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Materials and Methods

This research was conducted Wa River, Amphur Bo Klua, Nan Province, during wet season (September in 2013) and dry season (February in 2014). The research area is approximately 746 (667-824) meters above sea level. Sampling sites (15 sites) were selected along Wa River. Macroinvertebrates were collected using Surber sample. All collected specimens were collected and preserved in 70% ethanol for subsequent counting and identified to the lowest practical taxonomic level in the laboratory by stereomicroscope. A variety of relevant keys were used for identifying specimens [7]; [8]; [9]; [10]; [11]; [12].Then, species diversity index (H) of macroinvertebrates community were described using the Shannon -Weiner diversity index (high values of H would be representative of more diverse communities).

Results and Discussions

In this study, all 3 Phylum of macroinvertebrates from Wa River sampling were found, consisting of Arthropoda, Mollusca and Annelida. Phylum Arthropoda and Phylum Mollusca were found in wet and dry season (Table 1 and 2). In contrast, Phylum Annelida (Class Oligochaeta) was found only in dry season at 3 sampling sites (site 10, 13 and 15) (Table 2). Class Insecta (Phylum Arthropoda) was highest taxa in all seasons [13]; [14]. Order Trichoptera was the most diverse groups [16], followed by Ephemeroptera and Diptera, respectively in this studied [15]; [16] see Table 1 and 2. Similarity with Dudgeon [11] reported naturally, the caddisflies (Trichoptera) are highly represented in the tropics.

Diversity of macroinvertebrates were changed between season and sampling sites. Changes in the species composition and the relative abundance of each species most commonly occur in response to environmental changes [17]. Similarity with Principe [18] suggested differences in the physical attributes of riffles and runs were clearly reflected in the taxonomic composition of aquatic macroinvertebrates assemblages of tropical stream. Hildrew [19] showed the distribution of organism changes in relation to hydrological and geomorphological conditions at different spatial scales: drainage, reach, and habitat. Aquatic insect emergence is strongly influenced by season. Most of Asian countries are effected by monsoon and seasonal rainfall, and monsoon behavior is nearly unpredictable [20]. Diptera (Chironomidae) was the most distribution in both seasons in Wa River. Simialrity, Principle [18] found chironomids were the main taxa in runs of streams. Chironomids taxa were reported to be the least affected by activities of fish and shrimp, suggesting that their ability to build retreats and bury themselves provides protection againts macroconsumers [21];[22]. The average of species diversity index (1.38) of macroinvertebrates in Wa River were demonstreated good water quality of organisms [23].

In wet season, Phylum Arthropoda was higher diverse groups (8 Orders) than Phylum Mollusca (1 Order). Phylum Mollusca was found in some sampling sites (site 10 and 12). Order Trichoptera is highly represented in this study (9 families), followed by Ephemeroptera (6 families) and Diptera (5 families and 1 group), respectively (Table 1). Site 6 was found highest number of taxa. Incontrast, site 3 and 15 were

found lowest number of taxa. The average of species diversity index was 1.39 ± 0.61. The highest species diversity index was site 9 (2.16), followed by site 6 (2.15) and site 7, 11 (2.02), respectively. In contrast, site 3 was found lowest diversity Index (0.27) (Table 1).

In dry season, Highest diverse of macroinvertebrate was Phylum Arthropoda (8 orders). Phylum Annelida was found in some sampling sites (site 10, 13 and 15) and Phylum Mollusca was found only in site 10. Moreover, Order trichoptera was highest diverse groups (7 families), followed by Ephemeroptera (6 families) and Diptera (4 families and 1 group), respectively (Table 2). Site 10 was found highest number of taxa. In contrast, site 9, 11and 12 were not found macroinvertebrates in this study. The average of species diversity index was 1.44 ± 0.88. The highest species diversity index was site 7(2.4), followed by site 10 (2.33) and site 8(2.3), respectively. In contrast, species diversity index was 0 at site 9, 11 and 12 (Table 2).

Table 1. Diversity of macroinvertebrates at 15 sites in wet season in Wa River, Bo Klua, Nan province.

Phylum/		Family/Group	Sites (September 2013)														
Class	Order		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Arthropoda/	Coleoptera	Elmidae				/		/	/	/	/	/	/	/	/	/	
Insecta		Psephenidae						/	/	/		/	/	/			
	Collembola	(unidentified)		/													
	Diptera	Chironomidae	/	/	/	/	/	/	/	/	/	/	/	/	/	/	
		Tabanidae					/										
		Thaumaleidae									/						
		Tipulidae		/	/					/	/	/	/	/	/	/	
		Pupae(unidentified)		/	/		/	/	/	/	/	/	/	/	/	/	
		Simulidae					/		/	/	/	/	/	/	/		
	Ephemeroptera	Baetidae	/	/		/	/	/	/	/	/	/	/	/	/	/	
		Caenidae	/				/	/		/	/	/	/	/	/	/	/
		Ephemerelidae											/			/	
		Heptageniidae				/	/	/	/	/	/					/	/
		Leptophlebiidae						/		/	/	/	/	/		/	/
		Tricorythidae					/		/	/	/		/	/	/		
	Hemiptera	Corixidae	/	/							/	/					
		Gerridae											/				
		Pleidae						/	/					/			
	Odonata	Coenagrionidae					/	/			/					/	
		Gomphidae					/	/	/		/	/	/	/		/	
	Trichoptera	Fleptoceridae						/									
		Glossosomatidae						/									
		Helicopsychidae						/									
		Hydropsychidae					/	/	/				/			/	
		Hydroptilidae						/	/	/	/		/				
		Lepidostomatidae						/									
		Limnephilidae						/	/								
		Phryganeidae						/									
		Polycentropodidae						/	/								
	Plecoptera	Chloroperlidae									/						
		Perlidae					/						/				
Mollusca/	Mesogastropoda	(unidentified)										/		/			
Gastropoda																	
H*			0.76	0.61	0.27	1.15	1.65	2.15	2.02	1.31	2.16	1.46	2.02	1.51	0.74	1.95	1.05
* Shannon – Weiner Diversity Index																	

Table 2. Diversity of macroinvertebrates at 15 sites in dry season in Wa River, Bo Klua, Nan Province.

Phylum/		Family/Group	Sites (February 2014)													
Class	Order		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Arthropoda/	Coleoptera	Elmidae				/		/		/		/			/		/
Insecta		Limnichidae							/								
		Psephenidae						/	/	/		/				/	/
	Collembola	(unidentified)					/		/								
	Ephemeroptera	Baetidae	/	/	/	/	/	/	/	/		/			/	/	/
		Caenidae	/		/	/	/	/	/	/					/	/	
		Ephemeridae													/	/	
		Heptageniidae					/	/	/						/	/	
		Leptophlebiidae				/	/	/		/		/			/	/	
		Tricorythidae					/	/				/			/		
	Diptera	Chironomidae	/	/	/	/	/	/	/	/		/			/	/	/
		Thaumaleidae					/		/								
		Tipulidae		/					/	/		/			/		
		Simulidae					/			/							
		Pupae(unidentified)		/	/			/	/	/		/			/	/	
	Hemiptera	Corixidae	/	/	/		/					/			/		/
		Pleidae						/	/			/					
		Veliidae							/								
	Lepidoptera	Pyralidae								/							
	Odonata	Coenagrionidae					/		/								
		Gomphidae					/	/	/			/				/	
	Trichoptera	Helicopsychidae						/				/			/		
		Hydropsychidae					/	/	/	/		/					
		Hydroptilidae					/	/	/	/		/			/	/	
		Leptoceridae															/
		Limnephilidae						/				/			/	/	
		Polycentropodidae								/		/					/
		Psychomyiidae								/		/					/
Annelida/	Oligochaeta	(unidentified)										/			/		/
Oligochaeta																	
Mollusca/																	
Gastropoda	Mesogastropoda	(unidentified)										/					
H*			1.17	1.08	0.83	1.55	1.92	1.98	2.40	2.30	0	2.33	0	0	2.22	2.00	1.87
* Shannon – Weiner Diversity Index																	

Conclusion

The present study showed diversity and distribution of macroinvertebrates were changed in season and location. Phylum Arthropoda, Class Insecta was most abundant taxa. Family Trichoptera was highest diversity taxa among the macroinvertebrates. Family Diptera (Chironomidae) was the most distribution in both seasons in Wa River. The average of species diversity index was 1.38. This study suggested water quality of Wa River was good water quality for organism by species composition of macroinvertebrates and species diversity index.

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Transmittance of Solar Radiation due to Absorption by Precipitable Water Vapor in the Atmosphere

Sayan Phokate[1*]

ABSTRACT

This research aims to calculate the transmittance of solar radiation due to absorption by precipitable water vapor in the atmosphere of Thailand and calculate the precipitable water vapor in the atmosphere. The precipitable water vapor in the atmosphere was calculated from upper air checking data (relative humidity and temperature). The data were collected at four meteorological monitoring station located in Chiang Mai, UbonRatchathani, Bangkok and Songkhla during the years 1992-2012. The precipitable water vapor obtained from this investigation were used to formulate a mathematical model relating to the precipitable water from four stations with surface climatological data (relative humidity and temperature) at the same stations. The result showed that the relationship has a relatively high level of reliability. The precipitable water vapor obtained from upper air nearly is equal to the value from the model. The difference in the Root Mean Square Error (RMSE) is equal to 0.259 cm. Then, the researcher used a model to calculate the amount of precipitable water vapor at 85 meteorology stations nationwide.The result showed that the precipitable water vapor was less in the dry season (November to March) and relative high in the rainy season (April to October).The average per year was found to be 4.559±0.213 cm.When analyzing the solar radiation absorption by water vapor in the atmosphere. Found that the absorption is more or less depending on the precipitable water vapor in the atmosphere, which has an average annual as 15.531 percent. The transmittance ofsolar radiation due to absorption averageperyear was found to be 84.508 percent.

Keywords:Solar Radiation, Transmittance, Absorption, Precipitable Water Vapor

Introduction

In solar energy education for design energy technology system has to know quantity solar radiation value divided by area at the station. Usually, solar radiationthatenter theearth's surfaceinto theatmospherewillhave changed. That isadecrease whencompared tosolar radiationoutsidethe atmosphere [1,2]. Solar radiation is one of the most important parameters that affect the heat balance of the atmosphere and form the basis of most of the studies on climate change[3,4]. Normally, the amount of solar radiation reaching the earth on a clear and cloudless day is about 75% of solar radiation, and on a totally cloudy day it is about 25% of solar radiation [5]. Because of worldly atmosphere has the absorb solar radiation. Moreover, the amount of water vapor in the atmosphere is an important influence in the solar radiation depletion that comes through the atmosphere to the earth [6,7]. The water vapor can absorb more than 10% of solar radiation traveling through the atmosphere [7].

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The amount of water vapor in the atmosphere indicates the change of weather, cloud formation, formation of rain, fog, snow, hail, etc. In addition, water vapor in the atmosphere can absorb solar radiation in broad band (0.25-4.0 μm) at 15% [8], which the amount of absorption depends on the water vapor in the atmosphere [9].Water vapor has an important role in the global climate change development, it is fundamental to the transfer of energy in the atmosphere [4]. Because it is essential to human life, many researchers proposed the estimation of atmospheric water vapor values such as for meteorological applications. Lacking of water vapor data in a certain area can not prediction of current climate change. It is a physical parameter that is difficult to measure with adequate spatial and time resolution under all weather conditions. Additionally, the vapor phase plays an important role in the hydrological cycle, and it affects the climate and weather systems [10]. Generally, the quantity of water vapor in the atmosphere is shown by precipitable water vapor. Precipitable water vapor value represents the total amount of water vapor content in the lower atmosphere that would result from condensing all the water vapor in an atmospheric column at a particular time and over a given location from the surface of Earth to the top of the atmosphere [9,11,12]. The amount of water vapor in the atmosphere, which is rare in Thailand has not been measured directly. From the investigation, it was found that water vapor quantity has the relation to the relative humidity and the temperature has of the air that from checking upper air data. In addition, water vapor is changed by time and geography. [13-15].

Usually, we are able to show the amount of the precipitable water vapor, which will be in a form of the total amount of water vapor in the zenith direction. Assuming that the water vapor was inserted in the column of the atmosphere condenses into water[6,9]. In this research,therelationship betweentheamount of water vapor fromrelative humidity and airtemperature of heupperair. InThailand, there is anupperair meteorologicaldepartment by radiosonde observation, which has onlyfourstations across thecountry. The data were collected at four meteorological monitoring stations located in Chiang Mai, UbonRatchathani, Bangkok, and Songkhla during the years 1992-2012. The objective isto finda mathematical modelforcalculating theamount ofwater vaporinthe atmosphere ofThailand.The research result will have that can reduce the expenses in measure the value of water vapor for the station where no checking upper air data and use base data in the education about incoming solar radiation in the Earth's surface including the ability to transmittance solar radiation due to absorption by precipitable water vapor in the atmosphere [8,16]. Additionally, detailed data of the water content are an important input data for hydrological, energetic and radiation models [17-19].

Experiments detail

Precipitable water vapor is obtained by integrating the water vapor density in the vertical direction. The realization of precipitable water vapor from upper air data by radiosonde observation is achieved

through numerical integration. Radiosonde observation includes pressure, temperature and relative humidity taken at different heights as the balloon rises. These discrete observation are converted into water vapor densities and integrating these along a height profile yields the value of precipitable water vapor [7,11]. At locations well away from an upper air station, atmospheric precipitable water is often predicted using the strong correlation between surface vapor density (or surface vapor pressure) and precipitable water (see for example Leckner [20],Gueymard[7],Gueymard and Garrison [6], Garrison and Adler [14], Garrison [21]).

This study calculated the precipitable water vapor from the relation between the relative humidity and temperature of the weather from upper air checking data at four meteorological monitoring stations, namely Chiang Mai (18.78 °N, 98.98 °E) in the North, UbonRatchathani (15.25 °N, 104.87 °E) in the North-east, Bangkok (13.73 °N, 100.57 °E) in the Central region and Songkla (7.20 °N, 100.60 °E) in the South during the years 1992-2012. Then the amount of water from upper air checking data were analysed to find the relation between temperature and relative humidity which is surface data from the same stations. Precipitable water vapor from surface data were determined using the following equation [22].

$$w = 0.90176 \exp\left(\frac{0.1738\,RHp_s}{T}\right) \quad (1)$$

Where w is precipitable water vapor in centimeters, RH is relative humidity(decimal), T is ambient temperature(K) and$p_s$is the partial pressure of water vapor(mbar).

The partial pressure of water vaporin saturated air is given by the following semiempirical equation [9,10].

$$p_s = \exp\left(26.23 - \frac{5416}{T}\right) \quad (2)$$

Result was used to formulate the precipitablewater vapor model, which was used for calculating precipitable water vapor in other meteorological stations located in all main regions of the country.

The transmittance ofsolar radiation due to absorption by precipitable water vapor is given by [9]

$$\tau_w = 1 - \frac{2.9\,U}{(1+141.5\,U)^{0.638} + 5.925\,U} \quad (3)$$

and $U = wm_r$ (4)

Where τ_w is the transmittance ofsolar radiation due to absorption by precipitable water vapor (decimal), U is the pressure-corrected relative optical path length of precipitable water vapor (cm) andm_r is the relative optical air mass (decimal). After that, find the transmission of solar radiation due to absorption by precipitable water vapor in the atmosphere from the relationship between τ_w and w.

Results and Discussions

The results of the modeling to calculate the precipitable water vapor for stations that do not have upper checking data.The relation between water vapor value from upper checking data (w) with surface data(temperature and relative humidity), which is surface data from the same station were calculated. The precipitable water vapor obtained from upper air is nearly equal to the value of the empirical equation.That is, the difference in the root mean square error(RMSE) is equal to 0.259 cm. According to Table1, shown models of this work, Leckner[20], Garrison [21], Atwater and Ball [23] and Excell[13] almost the same accuracy, based onthe relationship betweensurfacetemperature and relative humidity, which is the same data at the same time. Results areshown inTable 1.

Table 1 The averageannualamount of precipitable water vaporfromthe upperair data, with that calculated from the models of this work, Leckner, Garrison, Atwater and Ball, and Excell.

Method	$\overline{w}$ (cm)	Standard deviation	RMSE (cm)
This work	4.559±0.213	0.739	0.259
Leckner	4.548±0.287	0.638	0.334
Garrison	4.636±0.222	0.782	0.411
Atwater and Ball	4.284±0.207	0.589	0.561
Excell	4.974±0.318	0.721	0.629

This result was compared to that reported byLeckner[20]and Garrison [21]based onthe relationship betweensurfacetemperature and relative humidity, which is the same data at the same time. The standard error of the mean is equal to 0.056 and the pattern of changes in the corresponding period. Consistent withOkulov*et al*. [24], GueymardandGarrison [6] found that water vaporis changingthe location andmonths of the year, shown in thefollowing figure1.

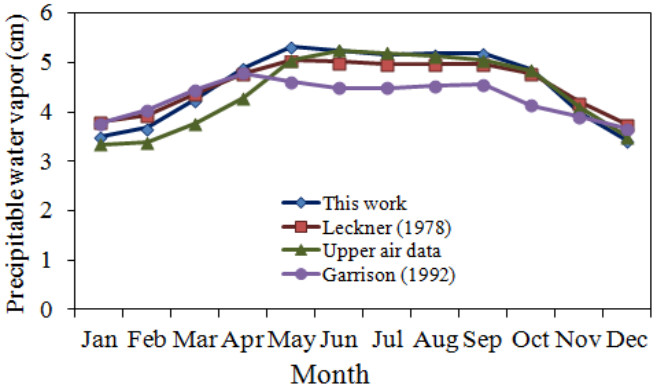

Figure 1 Comparative data of monthly average precipitable water vapor between this work,Leckner and Garrison.

We used the empirical equation to calculate the precipitable water vapor from monthly average of thesurface data (temperature and humidity)in during theyears 1992-2012 of 85nationwide stations. It was found that, amount of precipitable water vapor associated systematic with surface data. Moreover, the study showed that water vapor varies throughout the year from 2.431 to 6.146 centimeters, which is quite high in rainy season, andadecreasein the dry season. The average per year is equal to 4.559±0.213centimeters. Itwas also found that precipitable water vapor varies with latitudes of the stations systematically. In addition,amount of water vapor inthe rainy season (April to October) was the same for allstations around the country. However, precipitable water vapor slowly increases from the North to the South from November to March.According toZhaiand Eskridge[15]findsthat the amount ofwatervapor depends on thesurface data andtheseasonal changes. The absorptance by watervaporaverageperyear in round 20 years was analyzed. It was found thatthe amount ofsolar radiationabsorbed byprecipitablewatervapor ismore orless dependingon the amount ofprecipitablewatervaporinthe atmosphere. Theaveragevalue of theabsorptance by water vapor is equal to 0.155 or 15.531 percent. This is consistentwith theworkofNunez [8],the water vapor in the atmosphere absorb solar radiation more than 15 percent. On the other hand, when the precipitable water vapor is much, transmittance by water vapor is less. It was found that the transmittance by water vapor monthly averagein 20 yearsequal to 0.845.Transmission analysis of atmospheric water vapor using the monthly average in the past 20 years during 1992 to 2012 results are shown in Figure 2.

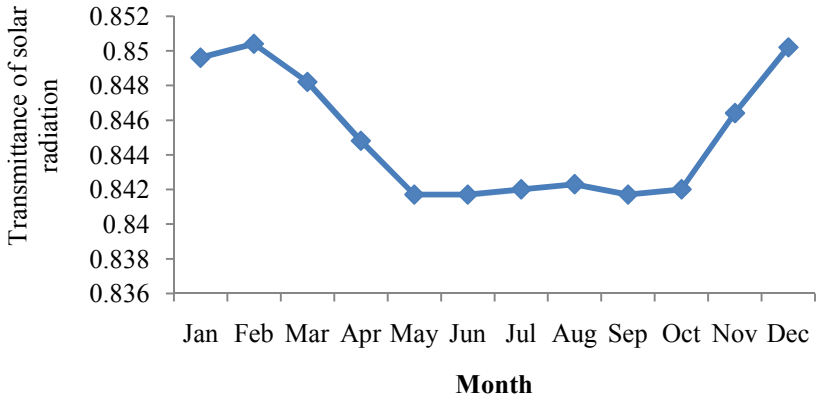

Figure 2 Show the transmittance of solar radiation is changed by the time of the year. (themonthly average from the twenty year period of eighty-fivenationwide stations).

When therelationship between transmittance of solar radiation (τ_w) and precipitable water wapor (w) in the followingFigure 3. The mathematicalrelationship can be expressed asequation(5), with thecorrelation coefficient (R^2) is equal to 0.932.

$$\tau_w = -0.012\,w + 0.8922 \qquad (5)$$

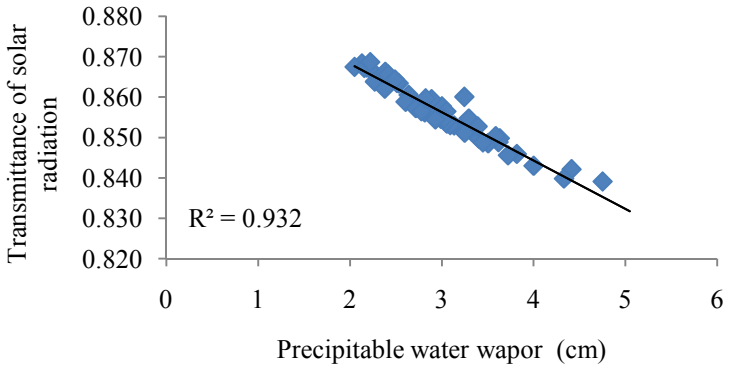

Figure 3 The relationship betweentransmittance of solar radiation(τ_w)andprecipitable water wapor(w) (using the annual average during 1992-2012 of eighty-five stations across the country)

Conclusion

This researchhas calculatedtheamount ofwater vaporfrom relative humidityand temperature fromupper air data ofthefourstations.The relationship between precipitable water vapor with the surface data (temperature and relative humidity), which is measuredat the same station. Results ofanalysis ofprecipitable water vaporhave a relationshipwiththe surface data, which can be writtenin termsof mathematical models. The researchers used surface data from85stations across thecountry, whichisapplied tothe model tocalculate the picipitable water vapor. The simulation results showedthattheprecipitablewater vapor changedby the timeof the year. Which is higherinthe rainy season from Aprilto Octoberand lessduringthedry seasonfrom November toMarch. Averagefor the yearwas4.559$\pm$0.213 cm. It is also found that the precipitable water varies with latitudes of the stations. That is, the precipitable water is high in the South and low in the North. Solar radiation absorption by precipitable water vapor is more or less depending on the amount of precipitable water vapor in the atmosphere.The result indicatethat the transmission is more orless dependingon the amount ofprecipitable water vaporinthe atmosphere. That is, when the precipitable water vapor is much, transmissionis less. The average annualtransmission ofsolarradiationdue to absorptionbyprecipitable water vaporis84.508percent. The relationship between the monthly average transmittance and monthly average precipitable water vapor at high reliability, the correlation coefficient (R^2) was 0.932.

The result of this study was indirectly obtained from upper checking data and theoretical calculation. In the future, it is advisable that the modern measuring instrument should be employed and distributed to meteorological stations around Thailand to achieve that accurate data. Data obtained will be useful for thestudy of weather change, weather forecast, solar radiation depletion and other related areas.

Acknowledgement

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Concentration Effect of Solution on ZnO Hexagonal Nanorods Synthesized by Aqueous Solution Process

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ABSTRACT

In this research, the ZnO hexagonal nanorods was synthesized by aqueous solution process on seed zinc oxide layer. Precursor solution consisted of zinc nitrate hexahydate and hexamethylenetetramine which diluted in deionized water. The various precursor concentrations in the range of 5 mM to 50 mM were used to studied the ZnO nanorods growth at 90^0C for 24 hours. We found that the precursor concentration is less than 20 mM, the nanowire with diameter size 23 to 40 nm was appeared, while the concentration is more than this the whisker was shown. Moreover, the ZnO nanorods was completely growth with diameter size 105 nm at precursor concentration 50 mM. The morphological was characterized by field-emission scanning electron microscopy (FE-SEM) and structural was characterized by X-ray diffractometry. The results indicated that c-plane was dramatically growth at low concentration and a-plane was occurred at high concentration.

Keywords: ZnO Nanorods , Aqueous Solution Process, Field-Emission Scanning Electron Microscopy, X-ray Diffractometry

Introduction

ZnO one dimensional has been extensively studied in the recent years for its potential applications in fabricating electronic, optoelectronic and electromechanical devices. ZnO is a semiconductor and has the direct wide band gap (E_g = 3.37 eV at room temperature). Thus, many researchers try to investigate and fabricate the several patterns of ZnO nanostructures. ZnO nanostructure including nanorods [1], nanowires [2],and nanowhiskers [3] have been reported. ZnO nanorods are one among the promising nanostructures because ZnO nanorods have a large surface area, a high aspect ratio, and a unique shape. A large surface area is important for high sensitivity sensors for gas detection [4]. The high aspect ratio of ZnO nanorods allows excellent field emission for a high-brightness electron source. More recently, ZnO nanorods provide possibilities for valuable applications such as light emitting diodes (LEDs) [5] and solar cells [6] owing to their structural advantages over thin films. The ZnO nanostructures have been prepared by pulsed laser deposition (PLD) [7], sol gel [8], sputtering deposition [9], and aqueous solution process [10]. Among the growth methods, the aqueous solution method shows many advantages over other deposition techniques, such as low temperatures, simple equipment, cheap and environmentally friendly chemicals, and large capacity of growth vessel.

Therefore, this research focused on the synthesis of ZnO nanorods by aqueous solution process at low temperature. To explore the relationship between the precursor concentration and the density of the ZnO nanorods, the influences of various precursor concentrations on physical morphologies and crystallographic structures were investigated and discussed.

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Experimental details

The details of experiment set-up have two steps consisted of substrate preparation and precursor preparation. Firstly, for substrate preparation, the silicon wafer with (100) orientation was used as the substrate. The seed ZnO with the thickness of 100 nm was deposited on top of the silicon wafer by reactive rf magnetron sputtering. The rf power of 80 Watt, argon flow rate of 10 sccm and oxygen flow rate of 15 sccm were used as the deposition condition. While the deposition is running, the pressure in vacuum chamber was kept constant at 5 mTorr with deposition time for 20 minutes. Secondly, the precursor for ZnO growth was prepared. The chemicals zinc nitrate hexahydrate ($Zn(NO_3)_2.6H_2O$) and hexamethylenetramine (HMTA;$C_6H_{12}N_4$) were used. Both of chemicals were analytical grade reagents and were used without further purification. The aqueous precursors of zinc nitrate hexahydrate and hexamethylenetramine (1:1 ratio) were dissolved in the deionized water (DI), then the concentration of 5, 10, 20, 30, 40 and 50 mM were prepared. All of these solutions were stirred on the hotplate with magnetic bar until complete dissolution.

In order to investigate the effect of various precursor concentration on ZnO nanorods growth, each seed ZnO layer substrate was put face down on the surface of each beaker of aqueous solution sample. Because of surface tension, the substrate could float at the top of the solution surface as seen in Fig.1. Then all samples were heated at 90°C for 24 hours in the oven. Subsequently, the final products were rinsed by DI water and dried at room temperature. Finally, the study of morphological of ZnO nanorods was provided by the field emission scanning electron microscopy (FE-SEM, Hitachi). Additionally, the crystal structure of ZnO was examined by using the grazing incidence X-ray diffraction (GIXRD, Rigaku) of 40kV, 30 mA in 2θ scanning range from 20° to 70° with 0.02 steps.

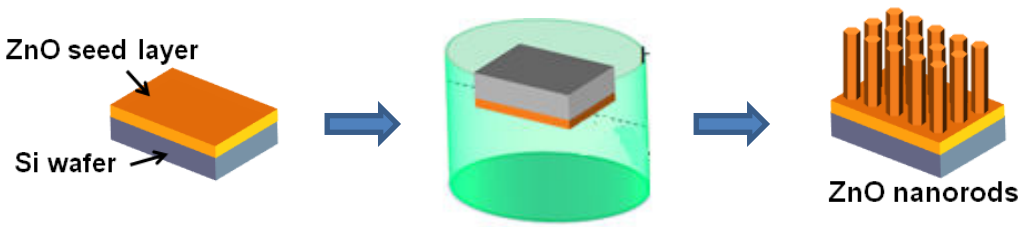


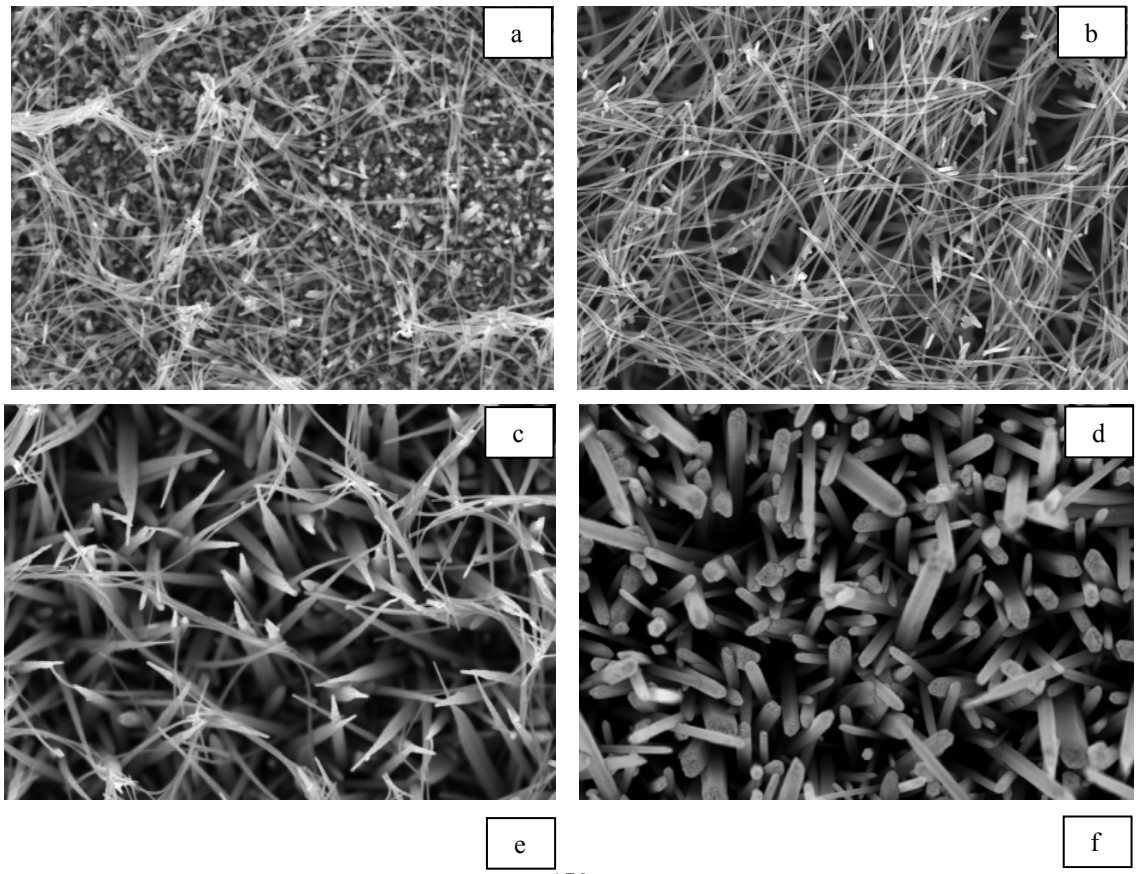
Figure 1 Schematics of ZnO growth in aqueous precursor solution at 90°C for 24 hours in the oven.

Results and Discussions

Fig. 2(a-b) show the SEM images of the morphological of ZnO with 5 mM and 10 mM concentration of $Zn(NO_3)_2.6H_2O$:HMTA. The results show the nanowire with diameter size of 2 various

concentrations are 23 and 40 nm, respectively. The ZnO NWs density, defined as number of NWs per 1 μm^2, increase as precursor concentration increase. The possible of this reason is the same as Xu S., et al [11]. Zinc chemical potential inside the solution body increases with zinc concentration is increased. To balance the increased zinc chemical potential in solution, more nucleation sites on the substrate surface will be generated, and therefore, the density of ZnO NWs will increase. While, the zinc concentration is further increased, the NWs density is decided by the number of nuclei formed at the beginning of the growth, which continue to grow and form nanorods (shorter NWs) as seen in Fig. 2(c-f). Fig.2(c) shows the tip whisker-like morphology of ZnO nanorods in the concentration 20 mM with diameter sizes are around 45 nm and a number of NRs per $1\mu m^2$ is 8.00. When the concentration is more than 20 mM, the hexagonal ZnO nanorods were shown. The diameter sizes of various concentration 30mM, 40 mM and 50 mM are 99 nm, 100 nm and 105 nm, respectively. The results indicated that at the beginning growth process, the arrival of more ions on the substrate may initiate new nuclei and growth on the lateral first as seen in Fig. 1c, then the axial growth and lateral growth seem to be equal significant, the hexagonal of ZnO NRs were shown in Fig. 2(d-f).

Fig. 3 shows schematic images presenting the ZnO nanostructures formation at different precursor concentrations. The formation of nanostructures from aqueous solution involves two steps, nucleation and growth.



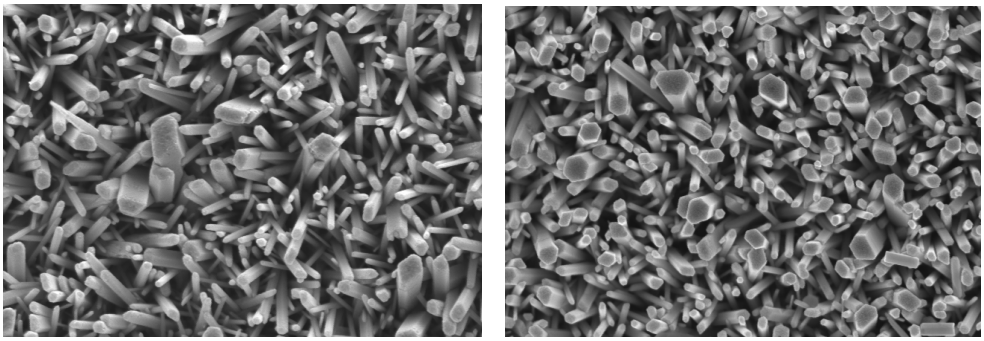


Figure 2 SEM images of ZnO crystals prepared with different precursor concentration: (a) 5 mM , (b) 10 mM, (c) 20 mM, (d) 30 mM, (e) 40 mM, (f) 50 mM.

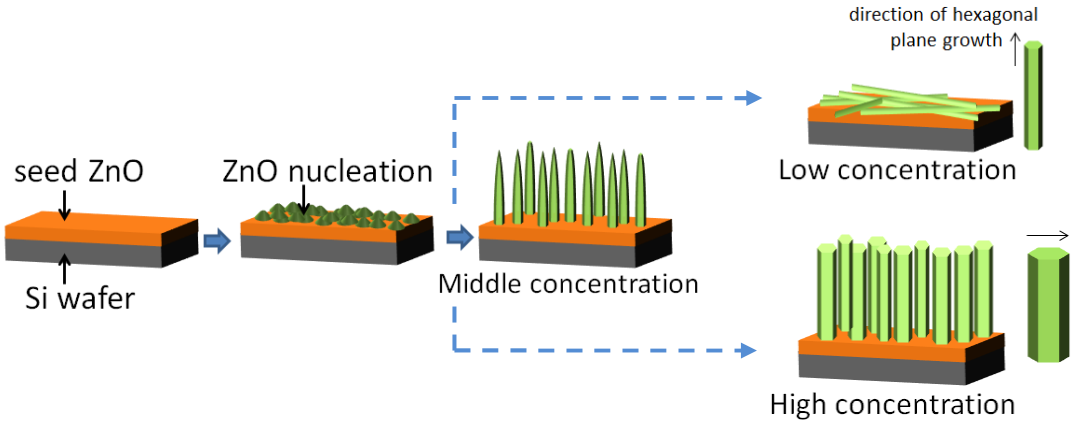


Figure 3 Schematic images presenting the ZnO nanostructures formation as a function of precursor concentration (low concentration is less than 10 mM, middle concentration is 20 mM and high concentration is more than 30 mM).

Fig. 4 shows the XRD patterns of ZnO NRs growth at different precursor concentrations. All of the diffraction peaks are indexed to the standard of hexagonal wurtzite zinc oxide, and no diffraction peaks of any other phases are detected. The XRD pattern shows the strong sharp reflection of (002) with other diffraction peaks, indicating the multi-orientation character of ZnO nanostructures. When the precursor concentration is increased, the plane of (100), (101) and (101) are decreased. It indicates that when the ZnO has NWs structure, the plane side of hexagonal was shown, until ZnO NWs become the NRs, the plane side was disappeared or decreased.

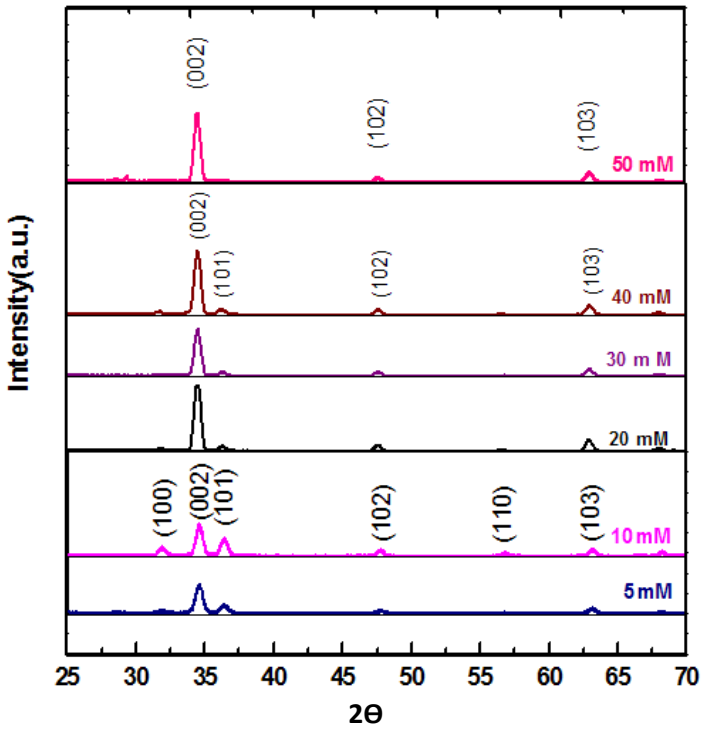


Figure 4 XRD patterns of the ZnO nanorods prepared with various concentration of 5 to 50 mM.

Conclusions

The experimental results reveal that the ZnO NRs can be synthesis by aqueous solution method and the influence of various precursor concentrations on the morphology of ZnO nanorods growth were studied. When the precursor concentration was increased, the ZnO nanowires become the nanorods and the diameter sizes of nanorods was increased. Moreover, the crystal structure of ZnO was confirmed by XRD pattern. Consequently, the optimizations of preparation parameters are the interesting topic for investigation in the next step.

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The Investigation of Four-Wave Mixing Correlation of Entangled Photon within a Fiber Ring Resonator by Using Squeezed State Representation

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ABSTRACT

The time correlation of entangled photon states generated by four-wave mixing process within a fiber ring resonator was given and analyzed. The pure four-wave mixing based Hamiltonian dependence of the fiber optic nonlinear strength coefficient $\chi^{(3)}$ was established. The squeezed state representation technique was applied to the system density operator of photons to be used in Heisenberg equation of motion. It was found that the corresponding stochastic equation of motion of photon states which reduced into the Fokker-Planck equation showed the validity oftheir dynamics lifetime via the second order correlation strength, inferred variance criteria, and can justify its application domain to quantum information processing.

Keywords: Four Wave Mixing, Entangled Photon, Quantum Correlation.

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INTRODUCTION

Entangled photon or EPR pair is a crucial key to quantum information processing such as quantum cryptography, quantum teleportation, and quantum lithography [1]. Its most two prominent properties are firstly, the simultaneous nature of transferring data in signal processing methodology via a long distance communication with the highest fidelity and secondly, the most perfect data security from any eavesdropper as a consequence of the no cloning theorem.

The most prominent of squeezed state of light is the principle of quadrature uncertainty. There was a nondemolition observation of such states perform successfully [2]. In quantum information, the squeezed coherent states of photon is used widely in a single qubit form. It responses as quantum gate operation [3].

Recently, there are many successful results from the four wave mixing process to generate an entangled photon pair such as in Rubidium vapor with electromagnetically induction [4] and using ultra-short laser pumping pulses launch into nonlinear crystal fiber optics [5, 6]. Squeezed states of entangled photon pair generated bythis process canalso be described for their validity in statistical language [7]. The extreme intensive laser pulses to be usedin a few mode fiber optic with the relationship of cross-mode modulation to be treated as classical picture generation gives a clear description of conversion efficiency [8].

Most of entangled photon generation occurs from the stimulated quantum mechanical cascading process via parametric down conversion process within nonlinear susceptibility $\chi^{(2)}$ and $\chi^{(3)}$ materials where the polarization's reaction equation that show a material responding to external electric field E appears as

$$P_i = P_0 + \varepsilon_0 \chi^{(1)}_{i,j} E_j + \varepsilon_0 \chi^{(2)}_{i,j,k} E_j E_k + \varepsilon_0 \chi^{(3)}_{i,j,k,l} E_j E_k E_l + \dots \,, \quad (1)$$

where P_0 is the built-in polarization, $\chi^{(m)}$ is them^{th} -order electric susceptibility and ε_0 is the permittivity of vacuum [9]. The generation process for a concerning entangled photon, in this equation, is exactly about the third or the fourth terms in the right hand side depend on a type of used materials. The most occurring quite frequently in a nonlinear optical fiber in this equation is the fourth term in a degenerated four-wave mixing process where two types of photons, i.e. the two pumping and a signal and an idler, are interacted under the quantum mechanically conservation principle of energy and momentum. The most sensitive optical fiber topology that subsidized the process validity must arrange itself in a ring resonator form for the reason of two type conservation tuning and seeking to be occurred [10]. It must again read

out for clearing understand about the two types of physically conservation, first, for the energy appearing in the frequency modes of photon, i.e. $2\omega_p = \omega_s + \omega_i$ and second, for the momentum or phase matching read as $2k_p = k_s + k_i$, where p, s and i stand for the pumping, the signal and the idler photon's mode, respectively. The focusing on optical fiber generation about the description of entangled photon in polarization modes of four-wave mixing was successfully and appeared in a nonlinear Schrödinger equation [11]. Then four types of fullentangled photon states can be written in a famous of Bell's form as [12]

$$\left|\psi\right\rangle^{(\pm)} = \frac{1}{\sqrt{2}}\left(\left|+\right\rangle_s \otimes \left|-\right\rangle_i \pm \left|-\right\rangle_s \otimes \left|+\right\rangle_i\right), \quad (2)$$

and

$$\left|\phi\right\rangle^{(\pm)} = \frac{1}{\sqrt{2}}\left(\left|+\right\rangle_s \otimes \left|+\right\rangle_i \pm \left|-\right\rangle_s \otimes \left|-\right\rangle_i\right), \quad (3)$$

where $\left|+\right\rangle$ and $\left|-\right\rangle$ represent the horizontal and vertical photon's polarization state, respectively. These states were determined a class of correlations for some continuous variable criteria, extended to get some corresponding observables from the composites n parties entanglement system appearing in the most famous another type of Bell's inequality as $\left\langle \tilde{X}_n \right\rangle^2 + \left\langle \tilde{Y}_n \right\rangle^2 \leq \left\langle \prod_{k=1}^{n} \left(X_k^2 + Y_k^2 \right) \right\rangle$, where X_k and Y_k are local real continuous observation variables of the *k*th-partite [13].

In this article, within a fiber optic ring resonator, the correlation between the signal and the idler modes of photon will be analyze by using the squeezed states representation. Because of there exist the quantum decoherence arisen from photon-phonon interaction between system, i.e. entangled photon, with an external heat reservoir, this mean that the correlation should be breakdown for any period of times.

Materials and Methods

It well known that photon states from the second quantizing to the classical electromagnetic Maxwell's equation can be decomposed into three different kinds of quantum states of photon: the number states, the coherence states and the squeezed state. A full description of the electromagnetic field requires a quantum statistics treatment because of they have an infinite of modes where each mode is described by independent Hilbert spaces. In this article, the suitable representation is in the coherent states invented by P. D. Drummond, positive *P* representation [14]. This will be applied with the squeezed state of entangled photon generated from the four-wave mixing process within a fiber optic ring resonator.

To give more details about the generation of entangled photon from the four-wave mixing process within a nonlinear fiber ring resonator, it deserves to talk about its mechanics. The pumping coherent photon state of frequency mode ω_p within the more strength discrete pulses of Gaussian soliton type is launched frequently into a fiber and induce stimulated parametric down conversion in the cascade process to be converted and finally emit a pair of entangled photon circling in the ring and ready to be used in quantum information processing. The establishing degenerated four-wave mixing Hamiltonian describing the entangled photon in the system is

$$\hat{H} = i\hbar\chi^{(3)}\left(\hat{a}_s^{\dagger}\hat{a}_i^{\dagger}\hat{a}_p^2 - \hat{a}_s\hat{a}_i\hat{a}_p^{\dagger 2}\right), \qquad (4)$$

where $\hat{a}_j$ and $\hat{a}_j^{\dagger}$ stand for the annihilation and creation operators of photon of modes $j = s, i, p$ respectively. Remind that this process is governed by the energy and momentum conservation laws as seen in the previous section.

To find two kinds of photon states evolving in time domain under quantum Markov process, let's start to analyze by using the master equation in Von Neumann equation for time evolution in Schrödinger picture, hence;

$$i\hbar\frac{d}{dt}\hat{\rho} = [\hat{H}, \hat{\rho}] \qquad (5)$$

This equation hard to solve analytically, so it can be transformed into the second order stochastic equation by using the most well-known powerful and trustable *+P* representation of density matrix operator $\hat{\rho}$ [15] where

$$\hat{\rho} = \int_{\mathrm{D}} \hat{\Lambda}(\boldsymbol{\alpha}, \boldsymbol{\alpha}^{+}) P(\boldsymbol{\alpha}, \boldsymbol{\alpha}^{+}) d\mu(\boldsymbol{\alpha}, \boldsymbol{\alpha}^{+}) \qquad (6)$$

where $\boldsymbol{\alpha} \equiv (\alpha_p, \alpha_s, \alpha_i)$ and $\boldsymbol{\alpha}^{+} \equiv (\alpha_p^{+}, \alpha_s^{+}, \alpha_i^{+})$ and a projection operator is

$$\hat{\Lambda}(\boldsymbol{\alpha}, \boldsymbol{\alpha}^{+}) = \frac{\left|\boldsymbol{\alpha}\right\rangle\left\langle(\boldsymbol{\alpha}^{+})^{*}\right|}{\left\langle(\boldsymbol{\alpha}^{+})^{*}\middle|\boldsymbol{\alpha}\right\rangle}. \qquad (7)$$

To examine the entanglement correlation from the results of eq. (5), the criteria for crossing variance of any two operators $\hat{X}_i$ and $\hat{Y}_i$, field quadrature operators, guarantee from Bell's inequality that

$$V^{\inf}(\hat{X}_i)V^{\inf}(\hat{Y}_i) < 1. \qquad (8)$$

In this equation the upper script inf refers to the inferred variance [16]. This will be used and showed for more details in the next section.

Results and Discussion

When the *+P* representation in eq. (6) was applied tothe squeezed state representation, it found that a well-defined probability density was validity as shown in Fig. 1. This make sure that its benefits can be used to determine all concerning physical observables.

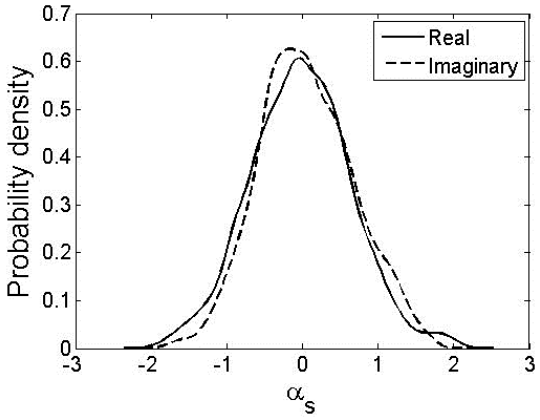

Fig.1: The signal photon annihilation operator $\hat{a}_s$ was transformed into a c-number in the equivalent form α_s by the *+P* representation. It was found that this representation has a well-define function to be used statistically for all observables.

To analyze the equation of motion satisfying eq. (5), let's make a change from the quantum operators to the new corresponding c-number variables by applying the *+P* representation to get the variables such as $\hat{a}_s \to \alpha_s$, $\hat{a}_i \to \alpha_i$, and $\hat{a}_p \to \alpha_p$. This operation will be achieved by substitute eq. (4) into eq. (5) and next using eq. (6), then the equivalent Fokker-Planck equation that describes the states evolution in a phase space or in a complex plane is arrived as

$$\frac{\partial}{\partial t}P(\boldsymbol{\alpha},\boldsymbol{\alpha}^{+},t)=\Bigg[-\frac{\partial}{\partial\alpha_s}(\chi^{(3)}\alpha_i^{+}\alpha_p^{2})$$

$$-\frac{\partial}{\partial\alpha_s^{+}}(\chi^{(3)}\alpha_i\alpha_p^{+2})-\frac{\partial}{\partial\alpha_i}(\chi^{(3)}\alpha_s^{+}\alpha_p^{2})$$

$$-\frac{\partial}{\partial\alpha_i^{+}}(\chi^{(3)}\alpha_s\alpha_p^{+2})+\frac{\partial}{\partial\alpha_p}(2\chi^{(3)}\alpha_s\alpha_i\alpha_p^{+})$$

$$+\frac{\partial}{\partial\alpha_p^{+}}(2\chi^{(3)}\alpha_s^{+}\alpha_i^{+}\alpha_p)-\frac{\partial^2}{\partial\alpha_p^{2}}(\chi^{(3)}\alpha_s\alpha_i)$$

$$+\frac{\partial}{\partial\alpha_s}\frac{\partial}{\partial\alpha_i}(\chi^{(3)}\alpha_p^{2})+\frac{\partial}{\partial\alpha_s^{+}}\frac{\partial}{\partial\alpha_i^{+}}(\chi^{(3)}\alpha_p^{+2})$$

$$-\frac{\partial^2}{\partial\alpha_p^{+2}}(\chi^{(3)}\alpha_s^+\alpha_i^+)\Bigg]P(\boldsymbol{\alpha},\boldsymbol{\alpha}^+,t) \qquad (9)$$

Consequently; this equation renders set of Langevin equations [17] :

$$\frac{\partial}{\partial t}\alpha_s = \chi^{(3)}\alpha_i^+\alpha_p^2 + \sqrt{\chi^{(3)}\alpha_p/2}\;\xi_1(t),$$

$$\frac{\partial}{\partial t}\alpha_s^+ = \chi^{(3)}\alpha_i\alpha_p^{+2} + \sqrt{\chi^{(3)}\alpha_p^+/2}\;\xi_2(t),$$

$$\frac{\partial}{\partial t}\alpha_i = \chi^{(3)}\alpha_s^+\alpha_p^2 + \sqrt{\chi^{(3)}\alpha_p/2}\;\xi_3(t),$$

$$\frac{\partial}{\partial t}\alpha_i^+ = \chi^{(3)}\alpha_s\alpha_p^{+2} + \sqrt{\chi^{(3)}\alpha_p^+/2}\;\xi_4(t),$$

$$\frac{\partial}{\partial t}\alpha_p = -\chi^{(3)}\alpha_s\alpha_i^2\alpha_p^+ + \sqrt{\chi^{(3)}\alpha_s\alpha_i}\;\xi_5(t),$$

$$\frac{\partial}{\partial t}\alpha_p^+ = -\chi^{(3)}\alpha_s^+\alpha_i^+\alpha_p + \sqrt{\chi^{(3)}\alpha_s^+\alpha_i^+}\;\xi_6(t),$$

(10)

where noise correlations satisfy the condition

$$\langle\xi_j\rangle = 0,\ \langle\xi_i(t)\xi_j(t')\rangle = \delta_{ij}\delta(t-t'), \qquad (11)$$

where $i, j = 1,2,...,6$.

The trajectoryin time evolution of entangled state α_s in complex plane, using the results of eq. (10), is shown as in Fig.2.

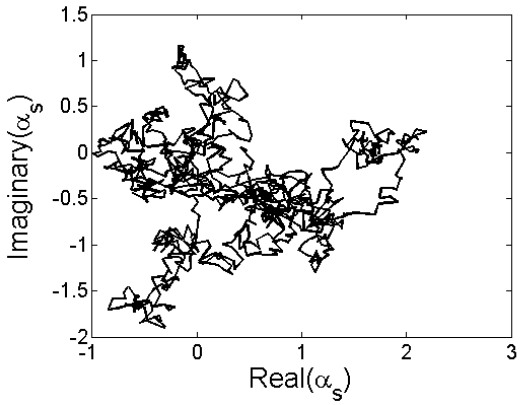

Fig. 2: The stochastic the trajectory of a real versus imagine part of signal state from the result of eq. (10).

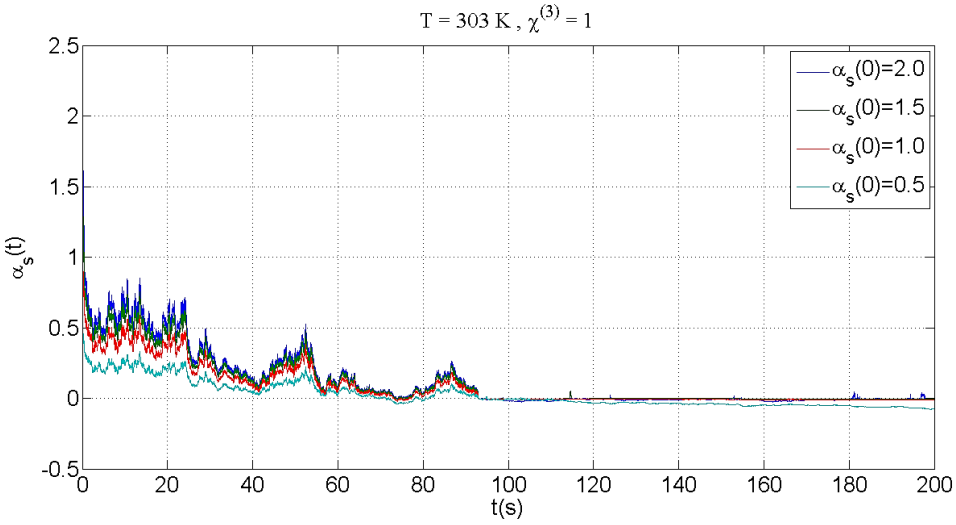

Fig.3: The correlation time of signal photon state, α_s ,at a given boundary conditions and finally their amplitudes are approximately ceased for the interacting with heat reservoir after the time beyond 60 seconds.

From eq. (10) it is useful to examine the correlation of entangled criteria of signal and idler photons by invoking of eq. (8). In the fiber ring resonator, assume that there are many signal photons occur for many times pumping, so the Bose-Einstein distribution function included the signal photon population n_s^{th} must be applied for all photonstates in a ring. Fig. 4 shows variance's acceptable according to Bell's inequality. This means that the hidden variables does not exist for quantum photon entanglement.

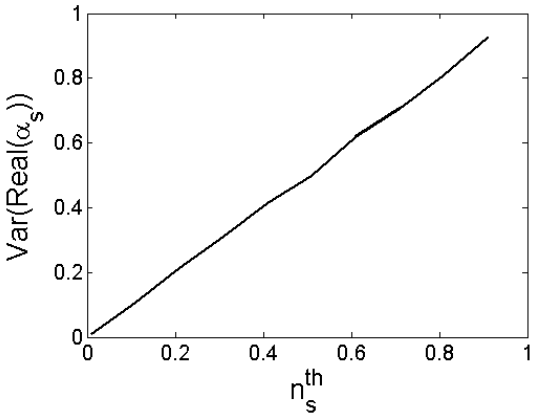

Fig. 4: Show the variance of the signal state evolution, its density of state is less than 1 and for the variance of so, correspond to Bell's inequality in eq. (8). This is true as well for the variance of its counterpart creation operator α_s^+.

Conclusion

The correlation relation between signal and idler photon, a pair of entangled photon, generated from the four-wave mixing process within a nonlinear fiber ring resonator was established and analyzed by using the squeezed state incorporated with the *+P* representation. The validity lifetime of an entangled photon pair was

shown and appropriate to apply in many concerning quantum information which used entangled photon in the process. From the inferring variance, it was found that there was a violation of Bell's inequality and guarantee the quantum nature of the entangled photon pair. The simulation of the evolution in time of entangled signal state was shown that it had enough lifetime but after that it ceased from the reservoir's absorption. This lifetime has significant figure to quantum information processing.

Acknowledgement

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Evaluation the physico-chemical properties of surface water and sediments: A case study of Klong Prem Prachakorn, Thailand

Varinthorn Boonyaroj [1*]

Abstract

Water demand in Thailand is increasing dramatically due to economics and population growth. At the same time the amount of wastewater generation from communities were also increased. Certain physico-chemical properties can cause water pollution. Common sources of water pollution in canals in Thailand especially at Klong Prem Prachakorn are untreated wastewater, improperly treated communities wastewater, and accumulated contaminants from the recurring flood situation in Bangkok. In this study, the physico-chemical properties of surface water and sediment in Klong Prem Prachakorn were investigated. The geographical information system (GIS) was applied in this research. The samples were collected from Klong Prem Prachakorn in a distance of 1.3 kilometers between Bang Khen train station intersection and Wat Samiannaree intersection. The physico-chemical properties were analyzed according to the standard methods for the examination of water and wastewater. The results show that the quality of the water samples being monitored were within the range of the surface water qualities standard in Thailand. The organic residue in terms of chemical oxygen demand (COD) in sediment was also investigated. This research provides physico-chemical properties of the contaminated surface water and offer the information for the selection of the appropriate campaign for Klong Prem Prachakorn conservation.

Keywords: surface water, water quality, sediment, physico-chemical properties, geographical information system (GIS)

Introduction

Water demand in Thailand is increasing dramatically due to the economic expansion and rapid population growth. Consequently, the amount of wastewater generation from the communities are also increased. Certain physico-chemical properties can cause water pollution. Common sources of water pollution in canals in Thailand especially Klong Prem Prachakorn include untreated wastewater discharged directly to the canal, improperly treated communities wastewater, and accumulated contaminants from the recurring flood situation in Bangkok. Natural sediment in canals contain nutrients, organic, inorganic compounds. However, in most cases, only contaminants that cause health risk are concerned.

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The geographical information system (GIS) is a very helpful tool for developing solutions for water resources problems. It can remotely assess water quality. The information provided by GIS is very useful for policy makers for determining remedial measures [4]. GIS was used for selected site location. This research was performed to investigate the physico-chemical properties of surface water and natural sediment in Klong Prem Prachakorn. Moreover, the COD reduction in batch experiment was also investigated.

Introduction

Water demand in Thailand is increasing dramatically due to the economic expansion and rapid population growth. Consequently, the amount of wastewater generation from the communities are also increased. Certain physico-chemical properties can cause water pollution. Common sources of water pollution in canals in Thailand especially Klong Prem Prachakorn include untreated wastewater discharged directly to the canal, improperly treated communities wastewater, and accumulated contaminants from the recurring flood situation in Bangkok. Natural sediment in canals contain nutrients, organic, inorganic compounds. However, in most cases, only contaminants that cause health risk are concerned. The geographical information system (GIS) is a very helpful tool for developing solutions for water resources problems. It can remotely assess water quality. The information provided by GIS is very useful for policy makers for determining remedial measures [4]. GIS was used for selected site location. This research was performed to investigate the physico-chemical properties of surface water and natural sediment in Klong Prem Prachakorn. Moreover, the COD reduction in batch experiment was also investigated.

Materials and Methods

Water qualities analyses were regularly monitored using the analytical procedures described in Standard Methods for the Examination of Water and Wastewater [1]. The wastewater were stored at a temperature of 4^{o}C. Wastewater used in the experiment was obtained from Klong Prem Prachakorn in Thailand. The geographical information system (GIS) was applied in this research. The samples were collected from Klong Prem Prachakorn in a distance of 1.3 kilometers between Bang Khen train station intersection and Wat Samiannaree intersection. The biochemical oxygen demand (BOD) and chemical oxygen demand (COD) were 98 mg/l and 194 mg/l, on average. The characteristics of leachate used in this study are shown in Table 1. All water quality parameters in the influent (wastewater) were regularly

analyzed every 7 days. The analyzed parameters included pH, Temperature, SS, TDS, Turbidity, DO, BOD, COD. Moreover, The COD and organic matter in natural sediment were also determined.

Table 1 Characteristics of wastewater used in experiment. (n=7)

Parameter	Unit	Range	Avg±SD
pH	-	7.12-8.40	7.89±0.30
Temperature	°C	25.0-26.9	27±0.7
Turbidity	NTU	115-368	275±55
DO	mg/l	0.12-3.64	0.82±0.90
BOD	mg/l	60-127	98±24
COD	mg/l	108-480	194±132
SS	mg/l	42-82	58±11
TDS	mg/l	1,075-1,380	1,265±101

Batch experiment was conducted in laboratory under room temperature (25–30 °C) where pH of mixed liquor was 7.0–8.0 and dissolved oxygen (DO) during the testing time was maintained at the level higher than 3 mg/l. The COD reduction during the experimental operation was also investigated as shown in **Figure1**.

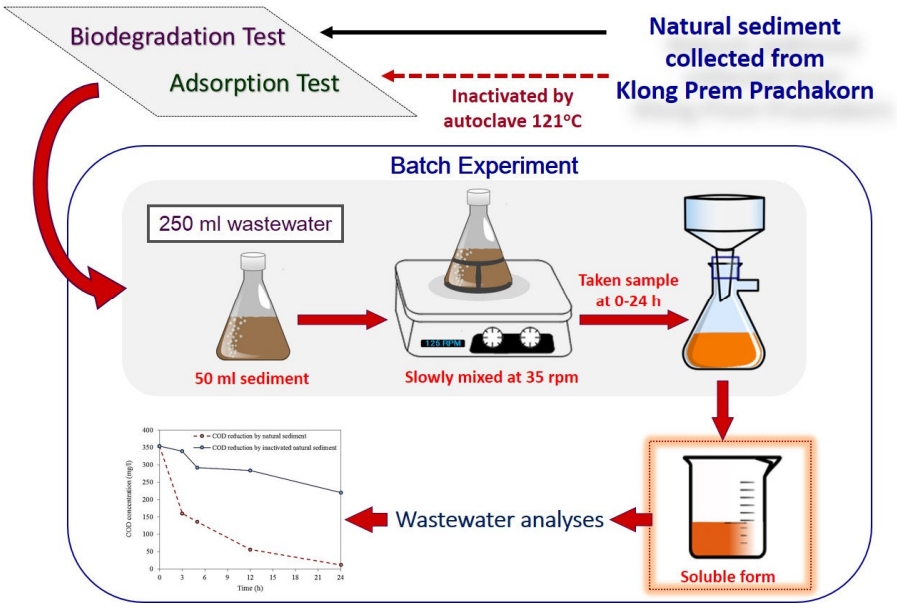

Figure 1 COD reduction in batch experiment.

Results and Discussions

The Physico-chemical properties of natural sediment used in the experiment are divided into 2 sampling points as shown in **Table 2**. pH value at each sampling points were neutral. The COD concentration contained in natural sediment at Bang Khen train station intersection, and Wat Samiannaree intersection were found 58 mg/l, and 64 mg/l, respectively. Moreover, the percentage of OM were present approximately 17%, and 10%, respectively as shown in **Figure 2**. The water qualities in Klong Prem Prachakorn were shown in **Table 3**. The organic compounds accumulated in surface water and natural sediment depends on size of the communities. Moreover, rapid expansion of community development near Klong Prem Prachakorn over the past decades considerably impact the quality of water in this canal.

Table 2 Physico-chemical properties of natural sediment used in experiment. (n=3)

Parameter	Unit	Sampling point	
		Bang Khen train station intersection	Wat Samiannaree intersection
pH	-	7.6	8.0
Temperature	^{o}C	26	29
EC	µs/cm	257	395
COD	mg/l	58	64
OM	%	17	10

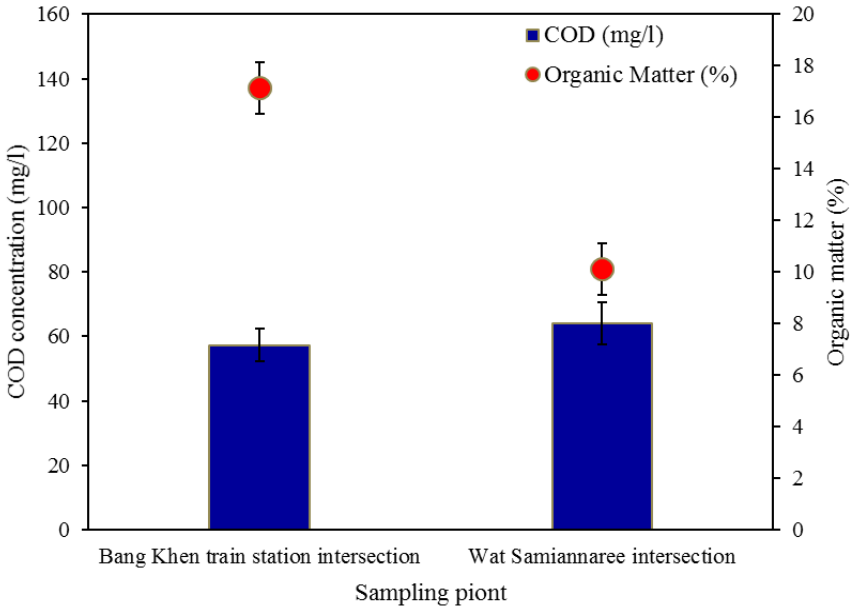

Figure 2 Organic matter COD concentration in natural sediment.

Table 3 Characteristics of water in Klong Prem Prachakorn. (n=5)

Parameter	Unit	Sampling point			
		Bang Khen train station intersection		Wat Samiannaree intersection	
		Range	Avg±SD	Range	Avg±SD
pH	-	7.11-7.51	7.29±0.16	7.06-7.55	7.34±0.22
Temperature	°C	20.8-27.6	25.9±2.9	21.3-27.9	26.0±2.8
Turbidity	NTU	16-47	32±13	18-60	37±17
DO	mg/l	1.34-4.70	3.50±1.59	2.36-4.84	3.32±0.97
BOD	mg/l	9-18	14±4	4-19	15±7
COD	mg/l	28-57	43±13	23-53	40±12
SS	mg/l	8-31	19±10	15-62	37±21
TDS	mg/l	175-340	233±74	212-480	356±107

The samples were taken at time intervals during 24 h period for the determination of COD concentrations in dissolved forms. For the adsorption experiment, inactivated natural sediment was used for determining adsorption capacity of sediment. The natural sediment samples obtained from Klong Prem Prachakorn were inactivated three times by pasteurization at 121 °C for 15 min in order to terminate microbial activities. Same procedures with those used in biodegradation experiment were performed using inactivated natural sediment. The initial concentrations of COD in wastewater in these batch experiments were controlled at 350 mg/l. **Figure 3** show the decrease of COD concentration in batch experiments using sediment. During 24 h, the concentrations of COD residue by natural sediment was found approximately 12 mg/l. It was found that the biological activity y microorganisms in natural sediment as an important role for COD reduction in wastewater.

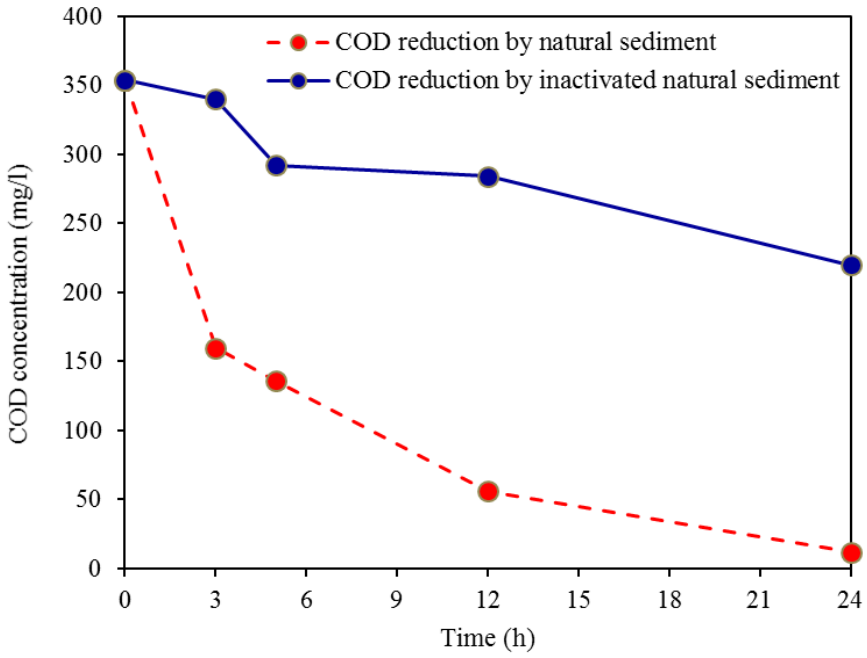

Figure 3 COD reduction in by natural sediment and inactivated natural sediment.

Conclusion

This research found physico-chemical properties of surface water and natural sediment collected from Klong Prem Prachakorn, Thailand. The capacity of natural sediment in batch experiment showed the

COD concentrations in water sample was decreased rapidly by natural sediment. For this case, biological activity by microorganisms in the natural sediment plays an important role in COD reduction in water sample. This research provided the water qualities situation of the canal, and offer the information for appropriate campaign of surface water conservation at Klong Prem Prachakorn.

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Community participation in the study of biodiversity of mosquitoes at Khuan Kreang peat lands, Kreang Sub-District, Cha-Uat District, Nakhon Si Thammarat, Thailand

Suppawan Promprao[1*]

ABSTRACT

The present study was conducted in 2011-2012 to provide community participation in the surveillance of mosquitoes breeding sites, identify the types of mosquitoes, estimate the risk of dengue haemorrhagic fever (DHF) transmission and perform the association between DHF patients and household's activities factors, in the household's residents and swamp area of Khuan Kreang Peat Lands, Kreang Sub-District, Cha-Uat District, Nakhon Si Thammarat, Thailand. Stratified random sampling technique was used to select the sample, 11 villages of Kreang sub-district was assigned to stratum. Three hundred households were assigned to sample units. Descriptive statistics were used to analyze the data and stepwise regression was used to form the model. The results showed that 2,124 containers were found and displayed some significant about this area. Out of 115 from 300 were *Aedes* positive households, 209 from 2,124 were *Aedes* positive containers. The collected mosquitoes' larvae were 6,501 which composed of *Aedes aegypti* (5.45%), *Aedes albopictus* (18.78%), *Culex* (49.08%), *Mansonia* (0.14%) and Pupae (26.55%), while no *Anopheles*. In the peat land region, adult mosquitoes were found but mosquito larvae were not. It may be the acidic of water (range of pH was 2.00 to 5.78), which was an unsuitable condition for the survival of mosquito larvae. Out of 11, 9 villages were DHF risk transmission (BI>50), include Village no 1 (Ban Khuan Pom), Village no 3 (Ban Khuan Yao), Village no 4 (Ban Khuan Kreang), Village no 5 (Ban Thung Kri), Village no 6 (Ban Khuan Raph), Village no 7 (Ban Yhan Dang), Village no 9 (Ban Khuan Ching), Village no 10 (Ban Bang Noi) and Village no 11 (Ban Sai Kanuun). Six predictor variables used to predict DHF patients, namely, animal pan, earthen jar, *Ae. aegypti* in drainage of refrigerators, pH in saucer planters, temperature in metal boxes and temperature in earthen jars. Since *Aedes* mosquitoes breed both inside and outside residential areas. To control these activities and mosquitoes, the elimination of natural and artificial containers or remodeling of those breeding sites should be taken into contemplation.

Keywords: Biodiversity, Swamp Area, Water Storage Container, Mosquito Breeding Site, Regression Model

Introduction

Controlling of mosquito-borne diseases effectively and successfully, having a good knowledge of the breeding ecology of mosquitoes include , the types and preferences for mosquitoes' larvae habitats, spatial and temporal distribution of breeding sites, the physical, biological and chemical characteristics of the habitat were required or necessary factors [1]. Previous findings of Adebote et al. (2008) [2] and Afolabi et al. (2010) [3] revealed that convenient aquatic breeding sites for some mosquito species may be inconvenient for other species. Some mosquitoes' species showed preference to water with suitable pH, optimum temperature, dissolved oxygen, concentration of ammonia, nitrate [4][5]. These parameters have been found to affect larval development and survival in breeding water storage containers. Mosquitoes were well known group of insects, which transmit many dreadful diseases causing serious health problems to human being [6].

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Biodiversity referred to the variability of both plants and animals. Widely, it was the richness of an ecological community. The diversity among insect has always been of keen interest, not only to entomologists dealing with structure and function, but also to those who were engaged in different environmental programs [7]. Khuan Kreang Peat Lands were located at Kreang Sub-District, Cha-Uat District, Nakhon Si Thammarat Province. Studies on the mosquitoes in the area has very little in spite of hearsay of the residents in the past have suffered with lymphatic filariasis from the bite throughout [8]. The study took place in similar areas at a peat swamp forest (Phru Toh Daeng Area), Su-ngai Kolok District, Narathiwat Province between years 2000-2002 by Aphiwathnasorn et al. [9]. They found 54 species 12 genera of mosquitoes, 60-70 % were of *Mansonia*. In the year 2003, Sujariyakul and [1]Faculty of Science and Technology, Nakhon Si Thammarat Rajabhat University, Nakhon Si Thammarat, Thailand.

Wonghiranrachata [10] have explored the mosquito vectors and mosquito larvae in Pak Panang Basin Project. They found that Cha-Uat District have a mosquito vector of malaria, lymphatic filariasis and dengue and village no 4 (Ban Khuan Kreang) was high DHF risk area (Breteau index: BI was the highest to 240). Last, in the year 2007, Promprao's studies in Kreang Sub-District. This study found 238 of water storage containers, mosquito larvae was not found but 418 of the others were not identified [11]. Moreover, the implementation of various development projects, the lack of participation from the public sector or local communities. Projects mainly affect the negative rather than the positive of Khun Kreang Peat land community. No storage of community database and use database. As a result, the public does not participate in management [12]. Therefore, a study of the biology of mosquito and environmental parameters of the breeding sites will be essential to determine their influence on mosquitoes' distribution and biodiversity. Hence, the goal of this study were to: For community involvement in education about the breeding of mosquitoes, study the type and abundance of mosquitoes, determine the abundance of mosquitoes and the risk of dengue fever and study the relationship between DHF patients and household's activities factors.

Materials and Methods

Study area: Kreang was one of Sub-District of Cha-Uat District, Nakhon Si Thammarat, Thailand. 70% of Kreang Sub-District was swamp forest. There was a forest in lowland flooding throughout the year. The natural river flow was Cha-Uat, flows into the sea at Pak Phanang River. Most people living along the flood plains, flat area without water flooding, and live in the hills known as "Khuan", which has a total area of 110,016 Rais (hectares). The area was divided into 11 villages with a local population 84,227 and a density of 101.1 /km^2 (Figure 1-3).

Data collection: A questionnaire survey was conducted in Khuan Kreang Peat Lands, in May-June 2011, covering 11 villages of Kreang Sub-District. Three hundred households in these 11 villages were sampled by a systematic stratified random sampling technique. By a proportional allocation method, these 300 sample units were assigned to 11 villages that assigned as stratums. One person in the collected household was identified as a sample unit. Breeding places [13] were sampled both indoors and outdoors within 15 meters of the houses. Temperature and pH of water in all breeding places were measured.

Mosquito Larval studies: Larval surveys were conducted in the study area using fishnets by teachers and students in Kreang Sub-District. All live mosquito larvae were collected in plastic bags, taken to the biological laboratory, preserved in 70% ethyl alcohol and identified up to species level. In this study, the 1st, 2nd instars and pupae were discarded because mosquitoes at these stages could not be identified. Types and numbers of mosquito larvae in water containers at each household were classified. Mosquito's larvae were identified as *Aedes aegypti*, *Ae. albopictus*, *Culex, Mansonia* or others from the biological laboratory [14](Figure 4).

Statistical Analysis: The data were computerized and validated using SPSS for Windows. Percentage, mean, standard deviation and Pearson's correlation coefficient were used to analyze the data. Entomological indices, such as House Index (HI; percentage of number of *Aedes* positive households), Container Index (CI; percentage of number of *Aedes* positive containers), and Breteau Index (BI; number of *Aedes* positive containers in 100 households), were executed [15][16][17]. The multiple regression was based on the general formula: $Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k + \varepsilon$, where Y was the DHF patients in household, $\beta_1, \beta_2, \ldots \beta_k$ were the regression coefficient of household's activities variables of $X_1, X_2, \ldots X_k$ and ε was the error term. In the multiple regression analysis, the fifteen variables that were significantly correlated to DHF patients were included in the tentative model. Stepwise regression technique was algorithm for including and excluding independent variables, used to select adequate model with the highest coefficient of determination (R^2). The selected model identified the multicollinearity by examining the variance inflation factor (VIF), i.e. a VIF value less than 5 indicated absence of multicollinearity. Durbin–Watson Test was used to explore the independent of error term. DHF risks in this area were evaluated by criteria[16][17].

DHF risk level	HI	BI
Low	HI < 0.1 %	BI < 5
Medium	0.1 % ≤ HI ≤ 5%	5 ≤ BI ≤ 50
High	HI>5%	BI>50

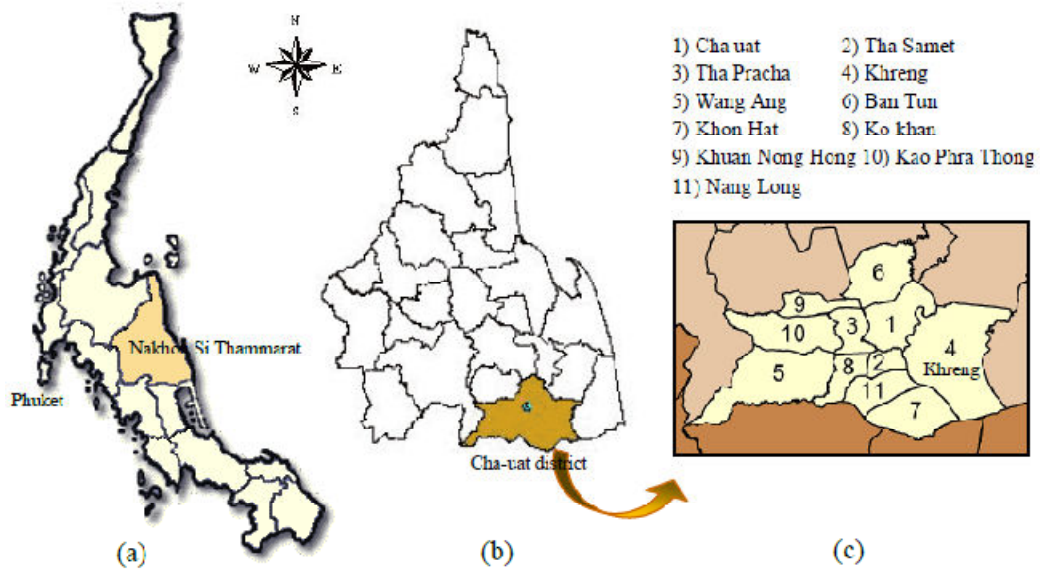

Figure 1 a) Map of Southern Thailand b) Map of Nakhon Si Thammarat province c) Map of Cha-uat District

(a)

(b)

Figure 2 The examples of study area, (a) in household (b) Kreang peat land, Kreang Sub-District, Cha-Uat District, Nakhon Si Thammarat, Thailand

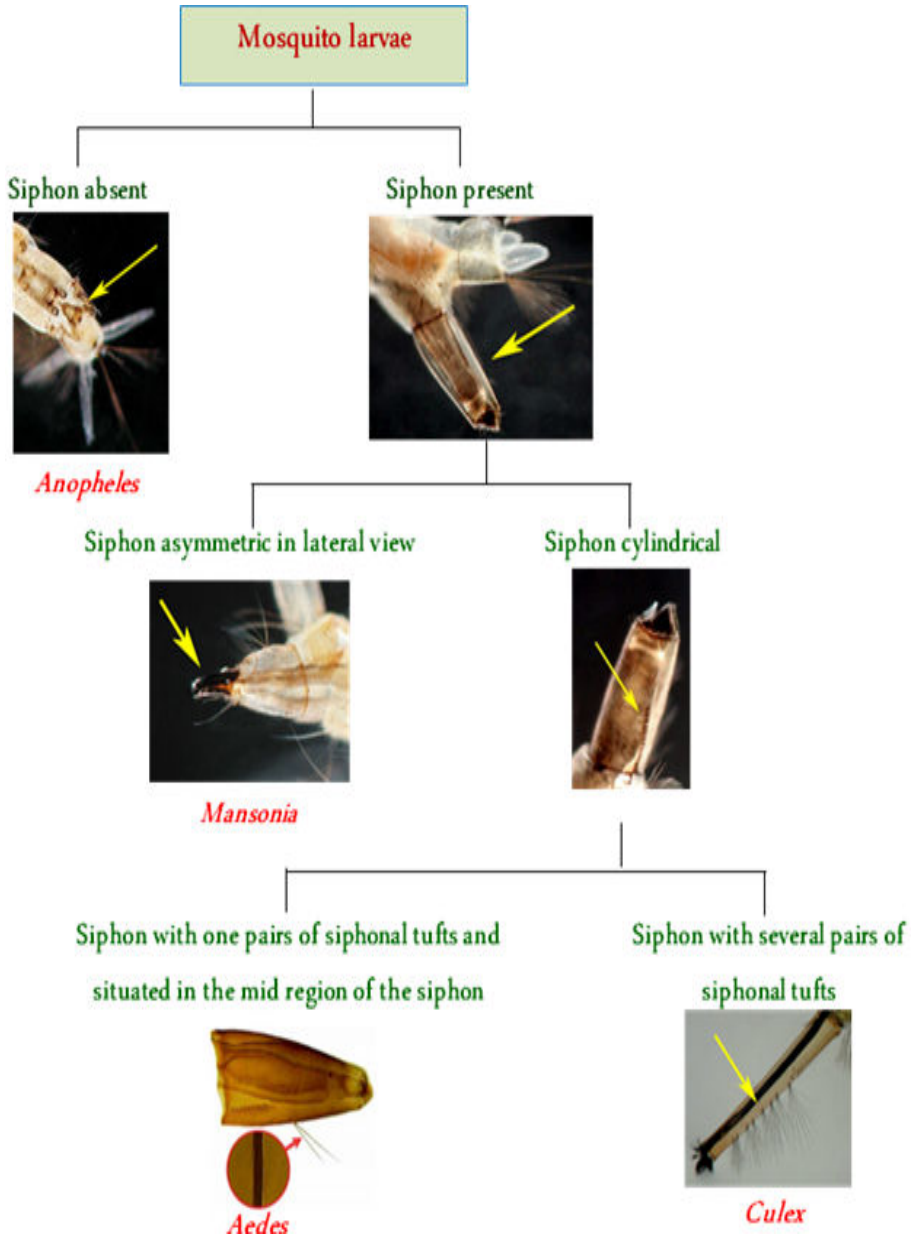

Figure 4 Process and identification of mosquitoes from mosquito larvae

Results and Discussion

Containers were found, displayed some household's activities. The total of 13 types of indoor water storage containers and 19 types of outdoor containers were found. Two types of indoor containers (i.e., plastic bucket and cement tanks) were found in all villages and only one type of outdoor containers (i.e., jar>100 liters) was found in all villages (Table 1).

A total of 6,501 mosquito larvae from 300 households in Kreang Sub-District were collected from all water storage containers. Three hundred and fifty four mosquito larvae were *Ae. aegypti*, 1,221 mosquito larvae were *Ae. albopictus*, 3,191 mosquito larvae were *Culex*, only 9 mosquito larvae were *Mansonia* and 1,726 were pupae but *Anopheles* was not found in this study (Table 2).

Table 1 Number of water storage containers, classified as a village

Name of containers	No. of Village											
	1	2	3	4	5	6	7	8	9	10	11	Total
Indoor												
Plastic buckets	58	61	62	74	53	18	15	22	23	22	24	432
Cement tanks	24	25	17	12	22	11	13	11	5	12	20	172
Other containers	20	21	11	22	22	7	16	14	0	5	12	150
Ant guards	12	7	8	0	4	4	0	4	0	4	16	59
Jar < 100 liters	6	4	8	15	8	3	0	1	0	1	2	48
Coolers	5	2	7	3	4	0	0	0	0	0	3	24
Jar > 100 liters	0	3	7	4	0	4	0	0	1	0	4	23
Wastewater boxes Fridge	0	2	2	6	4	0	2	0	0	1	0	17
Vase	1	1	1	1	2	1	0	0	0	0	1	8
Wastewater boxes cooler	2	2	0	0	0	0	0	0	0	0	0	4
Saucer planters	1	0	1	1	0	0	0	0	0	0	0	3
Indoor basins	1	1	0	1	0	0	0	0	0	0	0	3
Spotted betel containers	0	0	0	0	1	0	0	0	1	0	0	2
Total (Indoor)	130	129	124	139	120	48	46	52	30	45	82	945
Outdoor												
Jar > 100 liters	61	125	77	65	36	66	63	90	69	64	114	830
Plastic buckets	10	2	21	9	6	2	2	0	5	7	14	78
Cement tanks	4	10	0	6	3	2	3	1	3	1	9	42
Water tree containers	5	3	1	2	1	5	1	3	1	5	5	32
Used tires	4	4	2	1	2	4	1	1	5	0	6	30
Holes	0	9	2	3	3	5	4	1	0	1	0	28
Metal boxes	1	2	6	2	0	0	0	1	1	0	5	18
Animal pans	0	7	2	6	1	0	0	0	0	1	0	17
Coconut shells	0	1	4	7	0	0	0	2	3	0	0	17
Preserves areca jars	0	0	8	1	1	0	1	0	6	0	0	17
Rainy tanks	0	0	3	5	1	0	1	1	0	0	5	16

Earthen jars	2	2	3	1	0	2	0	1	0	1	3	15
Lotus basins	2	1	2	0	0	0	0	0	0	0	7	12
Water basins	3	0	0	1	2	0	1	0	2	0	2	11
Saucer planters	3	0	0	0	0	1	0	0	0	0	1	5
Other containers	1	1	0	3	0	0	0	0	0	0	0	5
Banana bracts	0	0	0	4	0	0	0	0	0	0	0	4
Ceramic containers	0	0	0	0	0	1	0	0	0	0	0	1
Old cars	0	0	0	1	0	0	0	0	0	0	0	1
Total (outdoor)	96	167	131	117	56	88	77	101	95	80	171	1179
Total	226	296	255	256	176	136	123	153	125	125	253	**2124**

Table2 Number of mosquitoes' larvae and pupae at Khuan Kreang peat land, classified as a village

No. of Village	Mosquitoes species				
	Aedes aegypti	*Aedes albopictus*	*Culex*	*Mansonia*	pupae
1	64	159	541	6	62
2	0	73	420	1	24
3	40	194	203	1	708
4	33	118	210	0	180
5	112	210	99	0	40
6	0	130	40	0	33
7	0	6	262	0	43
8	1	5	54	0	12
9	1	51	403	0	492
10	0	79	156	1	7
11	103	196	803	0	125
Total	354 (7.41%)	1,221 (25.57%)	3,191 (66.83%)	9 (0.19%)	1,726
Total of larvae and pupae	354 (5.45%)	1,221 (18.78%) 9(0.14%)	3,191 (49.08%)		6,501

The totals of 2,124 water storage containers were inspected for *Ae. aegypti*, *Ae. albopictus*, *Culex*, *Mansonia* and *Anopheles*. Of these containers, 945 containers located indoor were found 273 of *Ae. aegypti*, 594 of *Ae. albopictus*, 1,886 were *Culex*, only 6 were of *Mansonia*. A total of 1,179 containers located outdoor were found 81 of *Ae. aegypti*, 627 of *Ae. albopictus*, 1,305 were *Culex*, only 3 were of *Mansonia*. *Anopheles* were not found indoor and outdoor in this study. All types of mosquitoes larvae was

identified that not found indoor containers including: cooler, jar>100 liters, wastewater boxes cooler, indoor basins and spotted betel containers, while outdoor containers include lotus basins, banana bracts, old cars, ceramic container and other containers, were not found all types of mosquitoes larvae. Most number of larvae was found indoor containers, was jar< 100 liters and mosquito larvae was found most in the outdoor was plastic buckets. The results were in line with the study of Wongkoon et al. [18], they found that three types of indoor containers (i.e., small jars, cement tanks, and plastic tanks) were infested with *Aedes* larvae and 10 types of outdoor containers (i.e., small jar, cement tanks, plastic tanks, used cans, tires, plastic bottles, discarded objects, pot saucers plant pots and areca husks) were infested with *Aedes* larvae.

For indoor containers, most number of *Ae. aegypti* larvae, *Ae. albopictus* larvae, were found in cement tanks and wastewater boxes fridge, respectively. While most number of *Culex* larvae and *Mansonia* larvae were found most in jar< 100 liters. For outdoor containers, most number of *Ae. aegypti* larvae and *Ae. albopictus* larvae were found most in plastic buckets but *Culex* larvae were found most in jar>100 liters and the *Mansonia* larvae found just 1 percent in the plastic buckets, holes and metal boxes (Table 3). The study about *Aedes laval* occurrence in Vietnam of Phong and Nam (1999) found that *Ae. aegypti* and *Ae. albopictus* larvae were mostly found in artificial containers. *Ae.aegypti* larvae were found in drums, jars, concrete tanks and discarded objects. On the other hand, *Ae.albopictus* larvae were mainly found in jars, discarded objects, drums and aquariums [19]. Wongkoon et al. studied *Aedes* larval occurrence in Nakhon Si Thammarat, Thailand and found *Ae. aegypti* and *Ae. albopictus* larvae in six water storage containers including plant pots, animal pans, tires, small jars, water containers in bathroom and concrete tanks. They found that from these six containers, there were a higher number of *Ae. Aegypti* larvae in artificial containers (i.e., water containers in bathroom and concrete tanks) than *Ae. albopictus* [20]. Number of *Culex* larvae were most found in this study, 1,208 of *Culex* larvae were found indoor jars and 477 of them were found outdoor jar. The high occurrence of *Culex* in jars could probably be due to its adaptable life to this habitat. The results of this study was corresponding with previous findings and showing that indoor important breeding site of *Ae. aegypti* were cement tank, for *Ae. albopictus* were wastewater boxes fridge, for *Culex* and for *Mansonia* were jar<100 liters, while outdoor important breeding site of *Ae. aegypti* and *Ae. albopictus* were plastic buckets, for *Culex* were jar>100 liters and for *Mansonia* were jar<100 liters, holes and metal boxes(Table 3).

Table 3 Number of mosquito larvae indoor and outdoor water storage containers

Name of containers	Number	Mosquitoes species				Total
		Ae. aegypti	*Ae. albopictus*	*Culex*	*Mansonia*	
Indoor	945		594	1886	6	2758
Plastic buckets	432	7	109	342	0	458
Cement tanks	172	115	86	94	0	295
Other containers	150	2	14	3	0	19
Ant guards	59	31	32	0	0	63
Jar <100liters	48	97	151	1208	6	1462
Coolers	24	0	0	0	0	0
Jar >100liters	23	0	0	0	0	0
Wastewater boxes Fridge	17	20	196	240	0	456
Vase	8	0	2	0	0	2
Wastewater boxes cooler	4	0	0	0	0	0
Saucer planters	3	0	3	0	0	3
Indoor basins	3	0	0	0	0	0
Spotted betel containers	2	0	0	0	0	0
Outdoor	1179	81	627	1305	3	2017
Jar >100 liters	830	6	0	477	0	483
Plastic buckets	78	63	262	296	1	622
Cement tanks	42	0	1	46	0	47
Water tree containers	32	0	0	71	0	71
Used tires	30	0	156	164	0	320
Holes	28	0	0	3	1	4
Metal boxes	18	4	60	0	1	65
Animal pans	17	0	0	2	0	2
Preserves areca jars	17	0	59	144	0	203
Coconut shells	17	0	12	44	0	56
Rainy tanks	16	8	2	0	0	10
Earthen jars	15	0	47	3	0	50
Lotus basins	12	0	0	0	0	0
Water basins	11	0	0	56	0	56
Saucer planters	5	0	28	0	0	28
Other containers	5	0	0	0	0	0
Banana bracts	4	0	0	0	0	0
Old cars	1	0	0	0	0	0
Ceramic containers	1	0	0	0	0	0
Total	2124	354	1221	3191	9	4775

Entomological Indices: Kreang Sub-District was identified to high DHF risk area in this study (mean HI=36.80>5, mean BI=70.37>50). In village level showed that 39.02<BI<151.72, there were 9 villages of 11 villages was a risk of dengue haemorrhagic fever transmission (BI>50), include Village no 1 (Ban

Khuan Pom), Village no 3 (Ban Khuan Yao), Village no 4 (Ban Khuan Kreang), Village no 5 (Ban Thung Kri), Village no 6 (Ban Khuan Raph), Village no 7 (Ban Yhan Dang), Village no 9 (Ban Khuan Ching), Village no 10 (Ban Bang Noi) and Village no 11 (Ban Sai Kanuun) (Table 4-5).

Table 4 Number of households, mosquito larvae, water storage containers and entomological indices at Khuan Kreang peat land, classified as a village

No. of Village	Number				Indices		
	Surveyed households	*Aedes* positive households	Surveyed containers	*Aedes* positive containers	HI	CI	BI
1	39	19	226	23	48.72	10.18	58.97
2	41	7	296	16	17.07	5.41	39.02
3	41	15	255	27	36.59	10.59	65.85
4	34	14	256	19	41.18	7.42	55.88
5	37	13	176	21	35.14	11.93	56.76
6	17	8	136	11	47.06	8.09	64.71
7	14	2	123	12	14.29	9.76	85.71
8	13	2	153	6	15.38	3.92	46.15
9	15	7	125	20	46.67	16.00	133.33
10	20	3	125	10	15.00	8.00	50.00
11	29	25	253	44	68.97	17.39	151.72
Total	300	115	2124	209	38.33	9.84	69.67

Table 5 Entomological Indices calculation in Khuan Kreang Peat Land, average all Sub-District in case of stratified random sampling and a village was assigned to a stratum (W_i= surveyed household/300)

No. of Village	Number of Household		W_i	Indices			Multiple W_i*Indices		
	Surveyed	Total		HI	CI	BI	W_i*HI	W_i*CI	W_i*BI
1	39	172	0.12	48.72	10.18	58.97	6.02	1.26	7.28
2	41	194	0.14	17.07	5.41	39.02	2.38	0.75	5.43
3	41	195	0.14	36.59	10.59	65.85	5.12	1.48	9.22
4	34	151	0.11	41.18	7.42	55.88	4.46	0.80	6.06
5	37	173	0.12	35.14	11.93	56.76	4.36	1.48	7.05
6	17	77	0.06	47.06	8.09	64.71	2.60	0.45	3.58
7	14	63	0.05	14.29	9.76	85.71	0.65	0.44	3.88
8	13	59	0.04	15.38	3.92	46.15	0.65	0.17	1.95
9	15	71	0.05	46.67	16.00	133.33	2.38	0.82	6.80

10	20	93	0.07	15.00	8.00	50.00	1.00	0.53	3.34
11	29	145	0.10	68.97	17.39	151.72	7.18	1.81	15.79
Total	300	1393	1.00	38.33	9.84	69.67	36.80	9.99	70.37

Temperature and pH: The average temperature and pH parameters in which breeding was observed in the study area include: indoor mean temperature range of 27.75 °C -32.66°C, outdoor mean temperature range of 27.48 °C -31.43°C, indoor mean pH range of 7.52-8.95, and outdoor mean pH range of 5.21-8.46. The maximum indoor temperature (38.50°C) was found in wastewater boxes fridge but the minimum (24.90°C) was found in other containers (i.e. broken glass, damaged chairs) while the maximum (41.20°C) and minimum (24.90°C) outdoor temperature were found in the same type of containers (jar > 100 liters). The maximum indoor pH (10.56) was found in wastewater boxes fridge but the minimum (5.57) was found in jar <100 liters while the maximum outdoor pH (10.30) was found in used tires but minimum outdoor pH (3.60) was found in holes (Table 6).

Table 6 Mean, Standard deviation (SD), Minimum and Maximum of pH and Temperature of indoor and outdoor water storage containers

Name of containers	number	pH				Temperature (°C)			
		mean	SD	min	max	mean	SD	min	max
Indoor Plastic buckets	432	8.07	0.62	6.32	9.35	29.66	2.23	25.40	36.50
Cement tanks	172	7.79	0.67	5.84	9.33	**27.75**	1.28	25.20	32.30
Other containers	150	8.03	0.63	7.56	9.79	28.34	1.57	**24.90**	31.80
Ant guards	59	7.56	0.74	6.46	8.94	29.37	1.13	27.90	32.10
Jar <100 liters	48	**7.52**	1.10	**5.57**	9.83	28.39	0.97	25.20	30.40
Coolers	24	7.97	0.69	6.44	9.34	29.05	1.22	27.20	30.80
Jar >100 liters	23	7.49	0.99	5.98	8.82	28.08	0.98	26.80	29.80
Wastewater boxes Fridge	17	7.79	1.32	5.24	**10.56**	**32.66**	3.46	27.40	**38.50**
Vase	8	7.78	0.47	7.05	8.23	29.40	0.67	28.70	30.50
Wastewater boxes cooler	4	8.52	0.47	7.83	8.87	31.05	2.69	27.20	33.10
Saucer planters	3	7.92	0.42	7.65	8.40	29.40	0.46	28.90	29.80
Indoor basins	3	**8.95**	0.84	8.25	9.88	29.00	1.22	27.60	29.80
Spotted betel containers	2	7.90	0.00	7.90	7.90	29.30	0.00	29.30	29.30
Outdoor Jar >100 liters	830	8.05	0.61	5.82	9.71	28.97	2.28	**24.90**	**41.20**
Plastic buckets	78	7.55	1.11	5.74	9.98	30.05	2.34	26.90	37.10
Cement tanks	42	8.20	0.66	7.12	9.55	28.88	1.49	26.50	32.40
Water tree containers	32	8.16	0.54	7.30	9.55	28.68	2.07	25.30	32.20
Used tires	30	8.38	0.88	6.51	**10.30**	29.08	2.23	25.90	34.00
Holes	28	7.38	1.74	**3.60**	8.99	30.41	1.69	28.20	34.50
Metal boxes	18	7.25	0.89	5.57	8.20	**31.43**	2.35	27.80	35.10
Animal pans	17	7.90	0.66	5.92	8.60	30.02	1.96	26.70	33.70
Preserves areca jars	17	7.51	0.70	5.57	8.00	30.48	2.44	25.50	34.00
Coconut shells	17	6.81	1.11	5.47	8.08	30.74	1.97	28.60	35.90

Rainy tanks	16	8.30	0.35	7.81	9.01	29.27	1.65	26.90	32.00
Earthen jars	15	7.57	0.76	6.17	9.08	29.86	1.71	27.70	33.10
Lotus basins	12	7.90	0.68	7.04	9.27	28.78	1.74	27.00	31.60
Water basins	11	8.46	0.34	8.12	8.94	29.32	3.15	25.70	33.90
Saucer planters	5	8.03	0.78	6.92	8.75	27.48	0.65	26.90	28.40
Other containers	5	7.65	0.66	6.39	8.69	29.47	1.65	27.08	31.80
Banana bracts	4	5.21	0.00	5.21	5.21	29.80	0.00	29.80	29.80
Old cars	1	7.92	0.00	7.92	7.92	27.70	0.00	27.70	27.70
Ceramic containers	1	7.20	0.00	7.20	7.20	29.50	0.00	29.50	29.50
Total	2124								

Water temperatures in mosquito breeding observed in the study suggested that mosquitoes procreate at water temperature mean of 27.75°C -32.66°C. This finding was supported by the study of Afolabi Olajide et al. [3] and Afolabi and Ndams [6], they confounded that mosquitoes breed at water temperature of 26.5 to 29.3°C and female mosquitoes preferred water temperature range of 24.7 to 28.3°C. Temperature and pH of water in water storage container were negative relation in low level (r=-0.2262). It showed that temperature increased of the pH decreased and temperature decreased the pH increased (Figure 5).

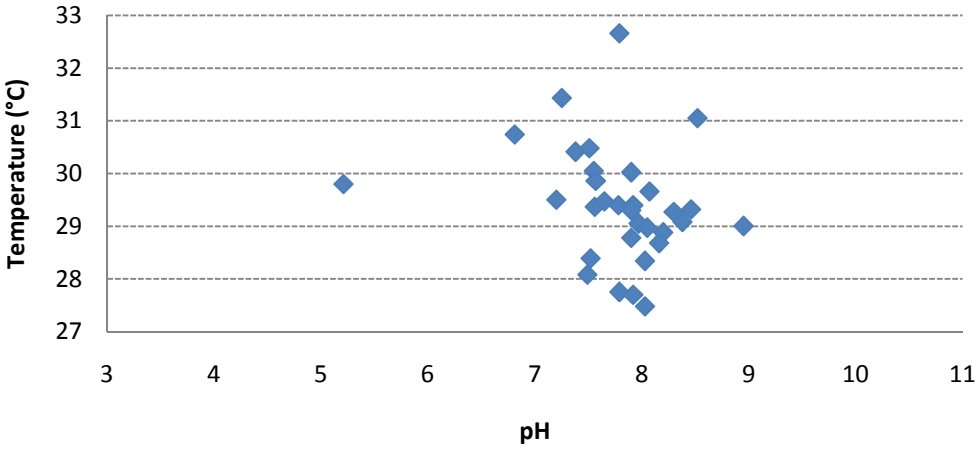

Figure 5 Relationship between temperature and pH of water in water storage containers

These findings was corresponded with the study of Apiwathnasorn (2012) was concluded that temperature, which directly affects the growth rate. An increase in temperature will change pH levels and concentration of ions, impact of large molecules such as proteins, fats, carbohydrates, DNA and RNA within the cell, membrane nucleus, mitochondria and ribosome. Higher temperatures are higher in acidity, rate of 0.015-0.200 pH units per degree Celsius [21]. This will impact compounding the function of

proteins, nucleic acids, and membrane [22]. So when the temperature warms up, the insects will grow faster. Additionally, moisture will affect the lifespan of insects (longevity). Mosquitoes were susceptible to temperature changes in a narrow range 2°C [23]. Mosquitoes grow from egg to adult usually take from 7-14 days at a temperature of 31°C and at 28°C the life cycle of the mosquito be 10-12 days and may last up to 20 days when temperatures drop to 20°C.

Regression analysis: Correlation and regression analysis were a major statistical tool used in this study. For investing the relationship between household's activities and DHF patients. The results revealed that out of 167 variables, 15 variables that were correlated with the number of cases of DHF patients. Pearson's correlation coefficient of 15 variables showed positive significantly correlation between household's activities and DHF patients. It found that 6 out of 15 variables in this study showed significant correlated with DHF patients. The residuals correspond with the assumptions of regression analysis ($E[e_i] = 0$, $Var[e_i]$ approximate 1, independent of e_i and e_j; Durbin-Watson = 1.819>1.5). Interval of VIF of all significant variables were 1.003-1.038 which less than 5. Results of residual analysis were then used for the verification of the applicability of assembled regression model. The existences of influential and outlier observations were checked but not found in the model (maximum of standard error was not more than 3).

An analysis of variance (ANOVA) indicated that data fit the model well ($F_{6,\ 293,\ 0.01}$ = 18.009, p=0.000). 26.9% of the variation of DHF patients were explained by 6 independent variables (Adjusted R^2 = 0.25). Since, it was not significant of constant term (t=1.249, p=0.213). The updated regression model without constant term or the multiple linear regression through the origin, composed of six predictors to predict DHF patients, namely; animal pan (X1); (t=3.411, p=0.001), earthen jar (X3); (t=2.445, p=0.015), number of *Ae. aegypti* in wastewater boxes fridge (X5); (t=7.391, p=0.000), pH of water in saucer planters (X8); (t=2.390, p=0.017), temperature of water in metal boxes (X13); (t=2.646, p=0.009) and temperature of water in earthen jars (X14); (t=3.871, p=0.000), with R^2=26.9% (adjust R^2 =25.4%, Durbin-Watson = 1.819). Thus, the appropriate regression model was based on the following:

$$Y = 0.167\ (X1) + 0.120\ (X2) + 0.362\ (X3) + 0.116\ (X4) + 0.128\ (X5) + 0.195\ (X6)$$

Household's activities about *Aedes* mosquitoes contribute to breeding place. All of predictors had positive impact on DHF patients. In the other words, DHF patients would be expected to increase as all of them increase. The possible of DHF patient's prediction occurred, when you can estimate the number of positive containers, the number of *Aedes* larvae in the positive containers, temperature and pH of water in positive containers. Opened water-filled containers (animal pans, earthen jars, wastewater boxes fridge) provided breeding sites for *Ae.aegypti* mosquitoes. All of them were found around the houses during the survey. This result was corresponded with the studies of Koopam et al. [24]. Khera and Sharma [25] and Bhandari et al. [26], indicated that uncovered water containers and pitchers were significantly associated with dengue infection. The number of *Aedes* larvae in wastewater boxes fridge displayed the association with DHF patients. It reflected some cultural practices of the people in this area. Our results from this work seemed to support with the study of Barrera et al. [27] which reported that mosquito productivity was associated with ornamental containers, miscellaneous containers, metal drums, tires and animal pans. The number of *Aedes* larvae showed the entomological risk because adult *Aedes* larvae abundance was correlated with diagnosed dengue cases [28]. Temperature of water in earthen jars and metal boxes associated with DHF patients in this study. The result corresponded with a research of Wongkoon et al. [18] and Lester et al. [29]. They founded that the mean temperatures, container surface area and water depth influenced the population dynamics of the mosquito and the transmission of dengue disease. As the mean temperature increased, the DHF case also increased. It was possible that most of the physiological functions of vectors in this area were subject to optimal mean temperature.

Opened water-filled containers and number of *Aedes* larvae, temperature of water in earthen jar and metal boxes displayed the association with DHF patients in Kreang sub district. If we can estimate the number of *Aedes* positive containers or *Aedes* larvae, we can predict the DHF patients each household. Provincial Health Office may have to design a campaign for DHF prevention more specifically in each locality. Moreover, *Aedes* mosquitoes breed both inside and outside residential areas. To control these activities and mosquitoes, the elimination of natural and artificial containers or remodeling of those breeding sites should be taken into contemplation.

Conclusion

This study was a process that allowed the teachers, students and community members took part through activities, including community participation. It focused on community learning through participation in order to strengthen the community's capability in planning, carrying out, monitoring and evaluating the project from start to finish by adaptive management approach. Cognitive activity and all activities with students, teachers and public education in the district were returned to the community to participate in joint activities dialogue and knowledge sharing. The debate for comments and suggestions on the implementation and results of operations was to ascertain the facts in the community with the findings and conclusions together. The results of the exchange of learning and knowledge on a variety of mosquito showed explicitly that mosquitoes variations observed in different villages might be as a result of differences in physic-chemical and environmental factors. As combination of factors such as pH and temperature contribute to the increasing abundance of mosquitoes in the breeding places. The occurrence of *Aedes, Culex* and *Mansonia* were suggestive of the prevalence of vector borne diseases such as malaria, yellow fever, dengue fever and filariasis in the area. Therefore precise vector control programs and public enlightenment especially on human activities that encourage mosquito breeding were recommended.

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Increasing of sperm viability of Thai medicinal plant recipes from “Pet Nam Eak” Thai traditional medicinal book for male infertility

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Abstract

Five Thai medicinal plant recipes (INF01, INF02, INF03, INF04 andINF05) indicated for analeptic and restorative from “Phet Nam Eak”, a Thai medicinal plant recipes Book were collected and extracted following the instruction of the recipes. It was found that the yields of the recipe extracts were ranged from 31.9 to 46.5%, respectively. For phytochemical analysissuch as alkaloids, saponins, flavonoids, anthocyanins, glycosides and tannins, all extracts composed tannins and xanthones. In addition, the INF02 extract demonstrated the highest free radical scavenging activity with SC_{50} of 0.63 ± 0.02 mg/ml. For sperm viability test by Rezasurin assay, the INF04 extract exhibited the highest sperm viability of about 20% at 1 hr. Therefore, the INF04 extract which contained *Cyperusrotundus* L., *Boesenbergia rotunda* (L.) Manf.and*Streblus asper*Lour. etc, has a potential to further develop as a natural product for male infertility.

Keywords :Thai medicinal plant recipe, Phytochemicals, Free radical scavenging, Sperm viability

Introduction

In recent years, several studies have demonstrated a worldwide decreasing trend of male fertility, especially in developed countries (Shena*et al*., 2000). Male infertility is the inability of a couple to achieve a pregnancy with unprotected intercourse. There are many factors that can lead to male infertility such assexual problems, poor timing of intercourse, medical conditions, prior surgery, infections, exposure to chemicals, genetic diseases, infection, hormones andcancer treatment. Sperm defects and dysfunction are discovered from one of the significant developments of reactive oxygen species (ROS) and oxidative stress that candamage the sperm membrane, decreasing sperm motility and its ability to fuse with the oocyte, and alter the sperm DNA, resulting in the passage of defective paternal DNA on to the conceptus (Tremellen, 2008). The resuting lead tothe commonest defined cause of infertility (24%) and led to a poor chance of pregnancy (0-27%) without donor insemination (Hull *et al*., 1985; Shena*et al*., 2000).

Natural products are one of the most successful sources of pharmacologically active compounds for male infertility treatment due to the evidences of long traditional use for many generations in many countries especially in China. Wei-na*et al* (2008) reported that the traditional Chinese medicine, Shengjingsan Recipe (SJSR) significantly increased the sperm motion velocity (VAP,VCL,VSL),the amplitude of lateral head movement(ALH), the beat frequency of flagellum(BCF), and stimulated sperm binding zona pellucida($p < 0.05$).The Shouwu-Huanjing Recipe (SWHJR) significantly increased the sperm motion velocity (VAP, VCL, VSL), the amplitude of lateral head movement (ALH) and the beat frequency of flagellum(BCF), the density of progressive motility sperms ($p < 0.05$), the acrosome reaction rate ($p< 0.001$); and the fertilization rate(FR) and the fertilization index (FI) in sperm penetration assay(SPA) test($p< 0.01$) by dose-dependent manner (Zeng*et al*., 2003). In Thailand, there is also a lot of medicinal recipes in many regions with its own folklore wisdoms for treatment of male infertility.

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Only the effective recipes were recorded in mulberry pulp paper, palm leaves or *Streblus asper*, Loir papers. “Pet Nam Eak” Thai traditional medicinal book(ISSBN: 9748265714)contains a large number of medicinal recipes in Thailand for treating of several diseases and symptoms such as cancer, hypertension, diabetes, fever, pain, wound and abscess including male infertility. Thus, this book is a convenient source for searching and ranking of the potential recipes and medicinal plants for further studies on male infertility, low cost, and practicality of application. However, the partial pharmacologic actions of the traditional Thai medicine in the “Pet Nam Eak” bookfor male infertility are still unclear or undiscovered. This present study, the increasing of sperm viability of Thai medicinal plant recipes from “Pet Nam Eak” Thai traditional medicinal book for male infertilitywas investigated to evaluatefor their potential to develop as a natural product for male infertility patients.

Materials and Methods

Collection, preparation and extraction of the medicinal recipes

The fivemedicinal recipes (INF01, INF02, INF03, INF04 andINF05) were collected from the “Pet Nam Eak” Thai traditional medicinal book which indicating for improvement of male infertility (**Table 1**). The medicinal plants in those recipes were authenticatedby a botanist at Thai Traditional Medicine College (TMC), Rajamangala University of Technology Thanyaburi (RMUTT), Thailand during June - November, 2013. All medicinal plantswere died at 60°C, ground to powder and kept at dry place. The ratio of the plant powder wereprepared and extracted following the direction. Briefly, the mixed powderwasboiled with the controlled temperature at 85-90°C for 1 hr. The extract was filtered through Whatman no.1 filter paper connected with a vacuum pump. The filtrates were concentrated by a rotary evaporator (R-205, Buchi, England) at 40°C and 80 psi, and then lyophilized by a freeze dryer. The dried extracts were kept in an amber vial until use. The percentage yields were calculated on the dry weight basis.

Phytochemical analysis

Phytochemicals contents in the INF extracts such as alkaloids, saponins, flavonoids, anthocyanins, glycosides and tannins, were investigated. Phytochemical tests of the extracts were assayed as previously described (Boonpisuttinant*et al.*, 2014).

Free radical scavenging activity by DPPH assay

Free radical scavenging activity of the INF extracts was determined by DPPH assay as previously described (Manosroi*et al.*, 2012). Briefly, 50 µl of the samples at the various concentrations and 50 µl of DPPH (Sigma-Aldrich, USA) solution (0.5 mg/ml in ethanol) were put into each well of a 96-well microplate. The absorbances were measured by a microplate reader at 515 nm after 30 min of the reaction at 25ºC. Vitamin C (Sigma-Aldrich, USA) was used as a standard. The percentages of the DPPH radical scavenging activity were calculated as the following:

$$\% \ Scavenging = [(A_0 - A_1)/A_o] \times 100$$

Where, A_0 was the absorbance of the control and A_1 was the absorbance of the treated sample. The concentrations providing 50% scavenging (SC_{50}) were calculated from the graph plotted between the free radical scavenging percentages and the sample concentrations.

Semen collection

Nine healthy fertile men with the age range of 30 years old were recruited as donorsbetween December, 2013 – February, 2014. Semen samples were collected by masturbation in sterile glass cups after 3 to 5 d of abstinence and analyzed on-site within 1 h for both macroscopic and microscopic characteristics. All samples were allowed to liquefy for at least 30 min. This study was was carried out according to WHOstandards, and approved by the Ethical Committees of the Sanpathong Hospital, Thailand.

Sperm viability by resazurinassay

Sperm viability from donorsafter treatment with the INF extracts was investigated by resazurinassay with some modifications (Glass*et al.*, 1991). Briefly, 20 µl of the semen (20 x 10^6 cell/ml), 150 µl of Tris buffer (pH 7.5) and20 µl of the samples at the various concentrations (0.1, 1.0 and 10 mg/ml) were put into each well of a 96-well microplate.Then,10 µl of resazurin dye (Invitrogen, USA)was immediately added. After incubation at 37ºC for 60 min,the absorbances were measured by a microplate reader at 515 nm. Distilled water was used as control. The percentage of sperm viability was calculated by comparison to 100% viability of control.

Statistical analysis

The results were presented as the mean ± SD of three independent experiments (n = 3). ANOVA was used for the analysis of the test results (LSD test) at the significance level of *p*-value <0.05.

Results and Discussion

The yields and characteristics of theINF extracts

The medicinal plant recipes (INF01, INF02, INF 03, INF04 and INF05) from “Pet Nam Eak” Thai traditional medicinal book, have been treated to improve male infertilityin Thailand long times ago. The yields and characteristics of the INF extracts were showed in **Table 1**. The yields of the INF extracts by boiling with distilled water were ranged of 31.9 to 46.5%. The best yield (46.5%) was found in the INF03 extract.

Phytochemical contents and free radical scavenging activity of the INF extracts

Table 2 showed the phytochemicals and free radical scavenging activity of the INF extracts.It was found that all extracts represented tannins and xanthones, whereas INF02 and INF03 extracts showed flavonoids and glycosides (deoxysugar). Phytochemicals found in the extracts depend on kinds of plants, solvent and; temperature and time used in the extraction process (Manosroi*et al.*, 2012). The presence of these phytochemicals might affect with several biological activity of the extracts including anti-oxidation and sperm viability.

The free radical scavenging by DPPH assay of the INF extracts were represented in the SC_{50} values (mg/ml). All extracts gave the free radical scavenging activity by DPPH assay (**Table 2**). The SC_{50} values of the extracts were 6.33 ± 0.03, 0.63 ± 0.02, 19.31 ± 5.58, 6.81 ± 1.70 and 9.27 ± 3.96mg/ml, respectively.The lower SC50 value means higher free radical savenging activity. The INF002 extract exhibited the highest free radical scavenging activity, but it was lower than that of vitamin C of 9 folds ($p<0.05$). It has been reported that xanthones, flavonoids, tannins and glycosides, is an antioxidant which is the same with vitamin C (Khan*et al*., 2006; Kondo *et al*., 2009; Pietta*et al*, 2000; Pujimulyani*et al*., 2012;Zulkifli*et al*., 2012). Thus, the INF02 extract which showed the highest free radical activity might be due to the synergistic effect of these phytochemicals.

Sperm viabilityimprovement of the INF extracts

Resazurin (7-hydroxy-3H-phenoxazin-3-one 10-oxide) is a redox dye used as an indicator of dehydrogenaseactivity. The diaphorase enzyme transfers electrons such as NADH+ which from themetabolic processes of glycolysis and the citric acidcycle in sperm, tothe resazurin dye, which becomes reduced toresorufin and then to dihydroresorufin and manifestsas a visual colour change from blue to pink andthen to white (Zulkifli*et al*., 2005).**Figure 2**showed that the percentage (%) of Sperm viability after treatment with the INF extracts. All extracts showed no cytotoxicity on human sperm when compared with the control ($p< 0.05$). In addition, the INF04 extract at all concentrations (0.1and 10 mg/ml) demonstrated the highest sperm viability after treatment for 1 hr ($p< 0.05$).It has been previous reported that the single plantextract,*Boesenbergia rotunda* (L.) can improve the movement of spermsand enhanced the number of normal sperms at all doses in the mature rats(Yotarlai*et al*., 2011).This might be due to the synergistic effect of the plant compositions and phytochemical constituents especially the INF04 extract.

Conclusion

In this study, we have carried out an investigationto evaluate the improvement of sperm viability of the crude extract from medicinal recipes from “Pet Nam Eak” Thai traditional medicinal book. It has been suggestedthat the INF04 extracts exhibited the fair free radical scavenging, and the highest sperm viability of about 20% for 1 hr when compared with the control, which has a potential to further develop as a natural product for male infertility.

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Table 1 Medicinal plant compositions in the five INF recipes collected from the "Pet Nam Eak" Thai traditional medicinal book

Table 1 Medicinal plant compositions in the five INF recipes collected from the "Pet Nam Eak" Thai traditional medicinal book

Recipes	Medicinal plants	Parts used	Amount used according to the instruction in the recipes	%Yields	Characteristics
INF01	*Tinosporacrispa* (L.) Miers ex Hook.f.& Thomson	Stem	Equal amount of each plant	34.8	Sticky Brown-black Specific odor
	*Piper sarmentosum*Roxb.	Root			
	Solanumindicum L.	Root			
	Solanumaculeatissimum Jacq.	Root			
	Plumbagoindica L.	Root			
INF02	*Anaxagorealuzonensis*A. Gray	Wood	Equal amount of each plant	42.7	Sticky Deeply Brown Specific odor
	*Elephantopusscaber*L.	Wood			
	Mallotusrepandus (Willd.)*Muell. Arg.*	Wood			
	Zingiberofficinale Roscoe.	Rhizome			
	*Glycyrrhizaglabra*L.	Rhizome			
	Aegle marmelos(L.) *Correa ex*Roxb.	Fruit			
	Diospyrosrhodcalyx Kurz	Wood			
	Ficusfoveolata Wall.	Wood			
	Cyperusrotundus Linn.	Rhizome			
	Albiziaprocera(Roxb.) Benth	Bark			
	Tinosporacrispa (L.) Miers ex Hook.f. &	Stem			

	Thomson				
	Piper nigrum L.	Fruit			
	*Acanthus ebracteatus*Vahl.	Stem			
	*Derris scandens*Benth.	Stem			
	*Cryptolepisbuchanani*Roem.&Schult.	Stem			
	Boesenbergia rotunda (L.)Mansf.	Rhizome			
INF03	*Cyperusrotundus* L.	Rhizome	Equal amount of each plant	46.5	Powder Brown Specific odor
	Piper nigrum L.	Fruit			
	Boesenbergia rotunda (L.)Mansf.	Rhizome			
	Tinosporacrispa (L.) Miers ex Hook.f.& Thomson	Stem			
	Aegle marmelos(L.) Correa exRoxb.	Fruit			
	*Acanthus ebracteatus*Vahl	Stem			
INF04	*Cyperusrotundus* L.	Rhizome	Equal amount of each plant	39.2	Powder Brown-black Specific odor
	Piper nigrum L.	Fruit			
	Tinosporacrispa (L.) Miers ex Hook.f.& Thomson	Stem			
	Diospyrosrhodcalyx Kurz	Wood			
	Albiziaprocera (Roxb.) Benth	Bark			
	Streblus asper Lour.	Seed			

	Boesenbergia rotunda (L.) Mansf.	Rhizome			
INF05	*Cyperusrotundus* L.	Rhizome	Equal amount of each plant	31.9	Sticky Deeply Brown Specific odor
	Curcuma zedoariaZberg. Roscoe	Rhizome			
	Cleome viscose L.	Leave			
	Tribuluscistoides L.	Wood			
	AnaxagorealuzonensisA.Gray	Wood			

Table 2 Phytochemical contents and free radical scavenging of the INF extracts

Extracts	Phytochemical contents						Free radical scavenging activity (SC_{50} mg/ml)
	Alkaloids	Xanthones	Flavonoids	Anthraquinones	Glycosides	Tannins	
INF01	-	+	-	-	-	+	6.33 ± 0.03^{a}
INF02	-	+	+	-	+	+	0.63 ± 0.02^{e}
INF03	-	+	+	-	+	+	19.31 ± 5.58^{c}
INF04	-	+	-	-	-	+	6.81 ± 1.70^{a}
INF05	-	+	-	-	+	+	9.27 ± 3.96^{d}
Vitamin C							0.07 ± 0.01^{e}

Note: The symbols - was negative test; and + was positive test. Superscript letters (a, b and c) in the columns indicate significant differences ($p < 0.05$).

Figure legends

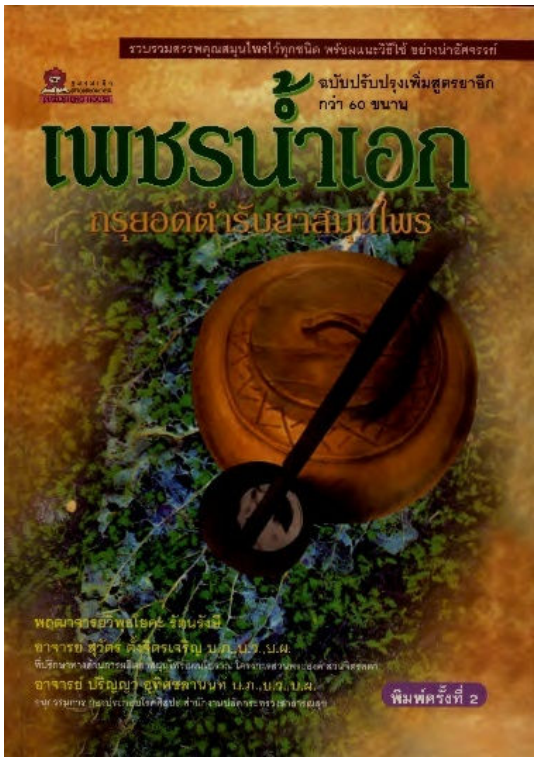

Figure 1"Pet Nam Eak" Thai traditional medicinal book

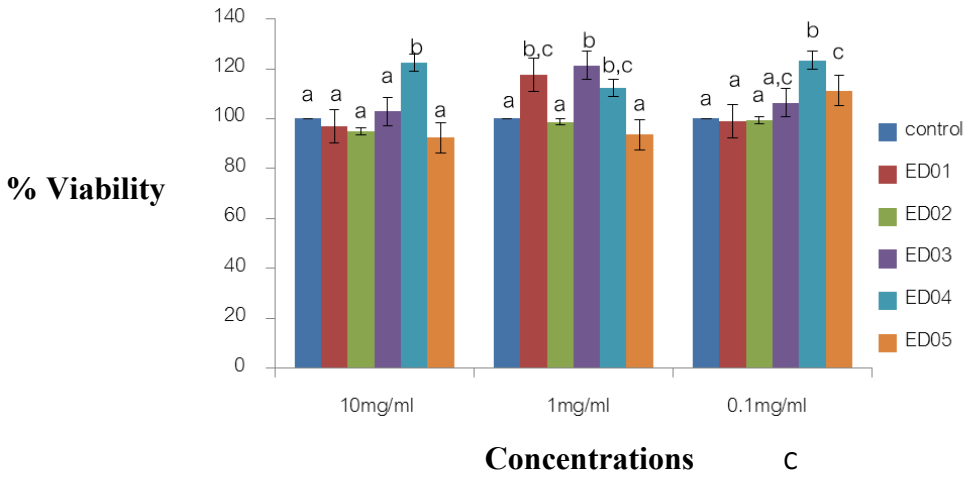

Figure 2 The percentage (%) of Sperm viability after treatment with the INF extracts. Superscript letters (a, b and c) in the columns indicate significant differences at $p < 0.05$.

Awareness and Behavior on Mobile Phone Hazardous Waste Management : A Case Study among Youth in Bangkok Metropolitan

Prayuth Suwansri[1*] And Radchanee Piwthong[2]

Abstract

The purposes of this research were to examine the students' Awareness and Behavior on Mobile Phone Hazardous Waste Management(ABMPWM) comparative studies of dependent variables among the levels of independent variables and their Corresponding correlation's between their exposure to information and ABMPWM and to yield the appropriate means for managing mobile phone waste. The survey research using self-administered questionnaires was conducted on 450 random samples from 264,027 students with study standing at junior and senior high school in Bangkok. The analytical statistical methods used were percentage, mode, mean, S.D. (Standard Deviation), T-Test, F-Test, One-way ANOVA Analysis, Correlation Analysis and Regression Analysis & Prediction Model.

The level of the Awareness on Mobile Phone Hazardous Waste Management index (AMPHWM index) was high. The AMPHWM index of men was higher than women and significance difference ($p<.05$). The group of 13-14years of age had AMPHWM index at the highest level. The samples of junior high school students had higher AMPHWMindex than the group of senior high school students. The group of students who bought the mobile phone themselves had higher AMPHWM index than the others. The group of students belonging the mobile phone with 15,000 baht had higher AMPHWM index than the low price. The group of students paying service charge monthly about 301-500 had higher AMPHWM index than the group paying more or less. The group of exposure to information had higher AMPHWM than no exposure to information group. Most of students received information from T.V.. The Awareness on Management of Mobile Phone Waste of the group of exposure to information and the group did not expose to information had correlation to the Behavior on Management of Mobile Phone Waste. The level of the Behavior on Mobile Phone Hazardous Waste Management index (BMPHWM index) was average. The BMPHWM index of men was higher than women. The group of 13-14 years of age had higher than the others. The samples of junior high school students had higher BMPHWM index than the group of senior high school students. The group of students who bought the mobile phone themselves had higher BMPHWM index than the others. The group of students belonging the mobile phone with more 8,001-15,000 baht had higher BMPHWM index than the lower and higher price. The group of students paying service charge monthly about 301-500 had higher BMPHWM than the group paying more or less. The group of exposure to information had higher BMPHWM index than no exposure to information group. The group of students received information from internet or electric media had higher BMPHWM index than the group students who received the information from the others.

Keyword : Hazardous Waste, Awareness, Behavior.

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Introduction

The current situations ofMobile Phone Hazardous Waste Management were of critical problems. The waste amount is quite rapidly escalated. The trash was disposed with full neglecting in conjunction with other non-toxic waste. When these wastes were separated and eradicated in usual manner (e.g. Landfill or Burning and etc.), the heavy and toxic metals were still leaking and well spread all over.The consequences of these hazardous contaminations would yield vital effects on human and living creature health. As the sequel, it was quite necessity for all of the mobile phone users (especially the youth which is the majority group) should payfull attention to overcome these problem via proper introducing of the **"Mobile Phone Hazardous Waste Management Action Program"**. These were the reasons and justification standing behind this valuable research.

Objectives

The main objectives of this study were listed as :

1. To study the "Awareness's" and "Personal Behavior"in Mobile Phone Hazardous Waste Management,Among the youth residing in Bangkok Metropolitan (A Comparative Study between the independentVariables of various levels),

2. To study the Relationship (Cause and Consequences) between "Personal Behavior" in Mobile Phone Hazardous Waste Management, with all other precedent factors (variables), and

3.To seek and appropriate proposes the effective strategic actions (combined options) for overcoming the Mobile Phone HazardousWaste Management, (among the youth in Bangkok Metropolitan).

Methodology

This action study is categorized as "A Survey Research" for which the sampling survey was adopted to be the information collection procedures. The field operation was employed by an appropriate question form for data collecting. The proper sample size for the survey was 450 youth from Bangkok Metropolitan. Those samples were randomly selected from the universal population of all high school students attached with the Office of Compulsory Education, (Bangkok Metropolitan) – Ministry of Education. The global size of population was 264,027 students.

The data and information management was processed and statistically analyzed with the auspices and privileges of software SPSS/FW. The obtained results and findings were proposed in to three portions, e.g. (1) the preliminary profiles of the respondents, (2) the comparative results of all dependent variables by their corresponding independent variables. The essential statistical tests were also induced by employing T-test, F-test and the Analysis of Variance – ANOVA. And (3) The relational or effect and causal analysis were finally applied with the statistical capabilities of the conservative Multi-Varieties Statistical Features. They were, the Simple Correlation Analysis, the

Multiple Correlation Analysis, and the Regression Analysis & Prediction Modeling.

.The Summarized Results

The research results were summarized and presented in all effects of "Key Indicators or "Indices". They were comprised into six global indices, e.g.

(1) Index of Knowledge and Understanding on "Mobile Phone Hazardous Waste Management"

(2) Index of Awareness's on "Mobile Phone

Hazardous Waste Management"

(3) Index of Personal Behavior on

"Procession and Utilization of Mobile Phones"

(4) Index of Personal Behavior on "Mobile Phone Hazardous Waste Management"

(5) Index of Attitude and Perception on "Procession and Utilization of Mobile Phones"

(6) Index of Attitude and Perception on "Mobile Phone Hazardous Waste Management"

The essential results were presented in condensed manner in the tabulation format for 7 tables. These were to communicate at the full and complete pictures in the comparative features of all six " Key Indicators" above. The five independent variables were selected to be involved in this presentation : "Informational Status" [two groups], "Age-Groups" [three levels], "Gender" [two levels], "Education" [two levels], and "Monthly Expenditure Spending" [three levels]. The results were proposed in Table 1 through Table 4.

Table 1 had expressed and logical confirmed that all of the respondents who belong to the "Informing" Group had shown **HIGHER** values of all six indices than those of the "Non-Informing" Group across the board at some significant levels. This had re-iterated that the exposing to information on "Mobile Phone HazardousWaste Management"do have direct effects on the key indices of the study. This evidence would suggest that the input of spreading of the proper knowledge andthe disseminating of information pertainingto the proper

"HazardousWaste Management" are highly advisable among the teenagers (residing in Bangkok Metropolitan Area – and hopefully in the other areas also, as well).

Table 2 had yielded comparable figures of these indices among the different age-groups of the teenager respondents. However, the younger groups may tend to have slightly higher index values for the first five indices and the sixth index had shown compatibility values at the three age-groups. The explanation would be that the elder teenagers could pay more attention and much care for on other interested engagements other than the environmental matters of environmental issues, especially, the "Mobile Phone HazardousWaste Management" concerns.

Table 1 The average values of "Study Indicators", the comparison between the two groups of "Non-Informing" vs. "Informing" onMobile Phone Hazardous Waste Management.

The Key Indices	Informational Status		Total
	Non-informing	Informing	
1. Index of Knowledge and Understanding on "Mobile Phone Hazardous Waste Management"	75.454	78.488	**76.98**
2. Index of Awareness's on "Mobile Phone Hazardous Waste Management"	76.150	78.009	**77.08**
3. Index of Personal Behavior on "Procession and Utilization of Mobile Phones"	58.232	59.938	**59.09**
4. Index of Personal Behavior on "Mobile Phone HazardousWaste Management"	59.777	60.280	**60.03**
5. Index of Attitude and Perception on "Procession And Utilization of Mobile Phones"	75.268	76.217	**75.74**
6. Index of Attitude and Perception on "Mobile Phone HazardousWaste Management"	75.873	76.863	**76.37**

Table 2 The comparison of average values of "Study Indicators" among the three age-groups of respondents, e.g. "13-14 yrs.", "15-16 yrs." and "17-18 yrs.".

The Key Indices	Age-Groups		
	13 – 14 yrs.	15 – 16 yrs.	17 – 18 yrs.
1. Index of Knowledge and Understanding on "Mobile Phone Hazardous Waste Management"	79.847	76.575	76.279
2. Index of Awareness's on "Mobile Phone Hazardous Waste Management"	77.895	76.884	76.941
3. Index of Personal Behavior on "Procession and Utilization of Mobile Phones"	60.790	58.761	58.728
4. Index of Personal Behavior on "Mobile Phone HazardousWaste Management"	60.965	60.422	59.466
5. Index of Attitude and Perception on "Procession And Utilization of Mobile Phones"	77.500	74.760	75.790
6. Index of Attitude and Perception on "Mobile Phone HazardousWaste Management"	76.754	75.586	76.745

Table 3 had shown the figures of all six indices among the "Males" gender well dominate over those of the "Females" respondents quite significantly. This would suggest that those males were well cared or more seriously attention to the natural environment than the female teenagers. Furthermore, if any promotional input were to gear into the system, the male teenagers should be put in front lineswith a higher priority. Also, on the other side of the coin, one should accelerate in motivation with the environmental cares into the females, at least on the conceptual planning stages.

Likewise the younger teenagers, the "Secondary Education" group tend to bear higher index results than those of the higher education group, i.e. "the High School". This would also imply that the younger group (Lower Education Group) were well aware (at high significant level) of the forth coming critical issues of "Environmental Hazard", especially caused by the "Mobile Phones". Detailed description was fully shown on Table 3 also.

Table3 The comparison of average values of "Study Indicators" between the two groups of gender, "Male" vs. "Female"

The Key Indices	Gender		Education	
	Male	Female	Secondary	High School
1. Index of Knowledge and Understanding on "Mobile Phone Hazardous Waste Management"	78.001	75.898	80.028	75.894
2. Index of Awareness's on "Mobile Phone Hazardous WasteManagement"	78.593	75.491	78.411	76.611
3. Index of Personal Behavior on "Procession and Utilization of Mobile Phones"	59.238	58.932	60.390	58.627
4. Index of Personal Behavior on "Mobile Phone Hazardous Waste Management"	60.736	59.285	61.130	59.639
5. Index of Attitude and Perception on "Procession and Utilization of Mobile Phones"	76.557	74.886	76.950	75.316
6. Index of Attitude and Perception on "Mobile Phone Hazardous Waste Management"	77.537	75.140	77.533	75.957

Table 4 The comparison of average values of "Study Key Indicators" among the three groups of monthly spending on Mobile Phone Charges.

The Key Indices	Average Expenses spending on Mobile Phone Monthly Charges		
	Not exceed 300 baht	301–500 baht	501 baht or over
1. Index of Knowledge and Understanding on "Mobile Phone Hazardous Waste Management"	76.863	77.599	76.500
2. Index of Awareness's on "Mobile Phone Hazardous Waste Management"	75.559	78.007	77.860
3. Index of Personal Behavior on "Procession and Utilization of Mobile Phones"	59.528	58.629	59.050

4. Index of Personal Behavior on "Mobile Phone HazardousWaste Management"	60.280	60.326	59.460
5. Index of Attitude and Perception on "Procession And Utilization of Mobile Phones"	74.100	76.259	77.050
6. Index of Attitude and Perception on "Mobile Phone HazardousWaste Management"	75.859	76.814	76.500

The last story of this study were concerning of "Level of Monthly Expenditures" that teenagers had spent on the uses of Mobile Phones. The figures had shown that there were comparable results (not significant different) for the four indices, namely, (1) Knowledge, (3) Behavior on Procession of the Phones, (4) Behavior on the Waste Management and (6) Attitudinal and Perception on "Mobile Phone HazardousWaste Management". Whereas the other two categories of index, had indicated that those teenagers with higher monthly spender stakes, would pay more attention to the current hazardous situation at some significant features. That was, the rest of the indices are : (2) the Awareness, (5) Attitudinal and Perception on "Procession and Utilization of Mobile Phones". This would imply that the more they had spent the higher intention on care and aware are evitable consequences. The complete and full results were shown on Table 4, above.

Table 5 The frequency and percentage distribution of respondents classified by "Sources of Information" on"Mobile Phone Hazardous Waste Management" that they had indicated of being exposed to.

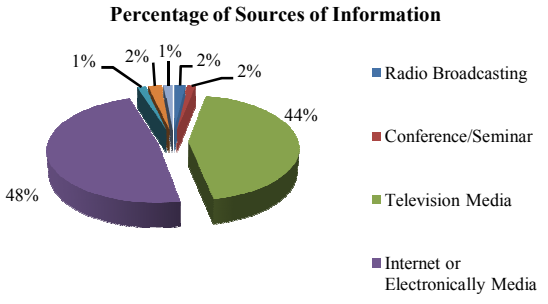
Sources of Information	Number	Percentage	Pie Chart Displaying
Radio Broadcasting	4	1.77	
Conference/Seminar	3	1.33	
Television Media	99	43.80	
Internet or Electronically Media	109	48.23	
Publication Media	3	1.33	
Retailer or Kiosk	5	2.21	
Mobile Phone Center	3	1.33	
Total	**226**	**100.00**	

Table 6 The frequency and percentage distribution of respondents classified by their "Means for obtaining ofMobile Phones in Procession".

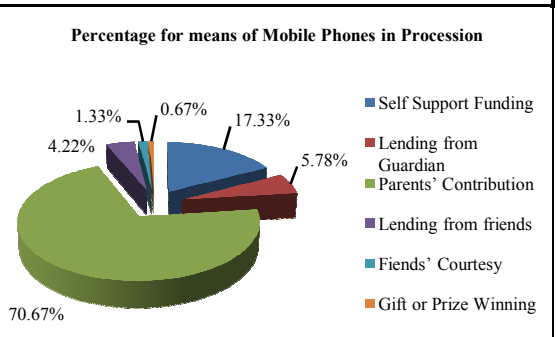
Means of Procession	Number	Percentage	Pie Chart Displaying
Self Support Funding	78	17.33	
Lending from Guardian	26	5.78	
Parents' Contribution	318	70.67	
Lending from friends	19	4.22	
Fiends' Courtesy	6	1.33	
Gift or Prize Winning	3	0.67	
Total	**450**	**100.00**	

Table 5 and Table 6 displayed both in tabular form and Pie Charts. The summarized statistical profile of two Key Variables was tabulated to cover both the frequencies and their respective percentage distributions. The sources of information were in Table 5. The information on "Mobile Phone Hazardous Waste Management" were referred by 226 out of 450 respondents from the survey. The main information sources that had had referred to were "Internet or Electronically Media" at 109 respondents or 48.23 %, and "Television Media" at 99 respondents or as much as 43.80 %, respectively. The other sources of information were rarely mentioned, there were five varieties of sources, e.g. Radio Broadcasting, Conference/Seminar /Meeting, Publication Media, Retailer or Kiosk, and Mobile Phone (Sales & Services) Center. All five sources combined to only 18 counts out of 226, or only less than 8 %.

The "Means for Obtaining Mobile Phones in Procession" among 450 respondents were majorly distributed on the three alternates.They were: Parents Contribution, Self -Support, and by Lending from Guardian at 70.67 %, 17.33 %, and 5.78 %, respectively. The global detail was supplemented and posted on the Table 6.

Table 7 Displaying of the Correlation Coefficients between the Indices (Six Key Dependent Variables) and the two Targeted Indices.

The Key Indices	Targeted Indices	
	Awareness on MPHWM	Personal Behavior on MPHWM
1. Index of Knowledge and Understanding on "Mobile Phone Hazardous Waste Management"	0.251	0.075
2. Index of Awareness's on "Mobile Phone Hazardous Waste Management"	N/A	0.329
3. Index of Personal Behavior on "Procession And Utilization of Mobile Phones"	0.145	0.257
4. Index of Personal Behavior on "Mobile Phone HazardousWaste Management"	0.294	N/A
5. Index of Attitude and Perception on "Procession And Utilization of Mobile Phones"	0.628	0.264
6. Index of Attitude and Perception on "Mobile Phone HazardousWaste Management"	0.758	0.328

The last Table presented here, was Table 7. This Table gave quite quantifiable and understandable amount of figures, sufficed for the directional and promising trend of the MPHWM program. This table shownthe relational facts among the six key indices with the two targeted indices. However, these numerical figures would embroil the confirmation of legitimate current situations.

Besides these two packages of condensed information, one may expose via the results of statistical analysis in managing of the techniques of Regression Analysis and the Prediction Equation approaches. The end analytical results were display into two equations. They were Equation 1 (the group of respondents whom had been informed with the Hazardous Waste Management Information) and Equation 2 (among the respondent without exposed to the Hazardous Waste Management matters).

[Index Value of Personal Behavior on "Mobile Phone Hazardous Waste Management"] = 42.913 +
+ 0.006*[Index Value on Knowledge and Understanding]
+ 0.228* [Index Value on Awareness of Hazardous Waste Management]

(Equation #1)

[Index Value of Personal Behavior on "Mobile Phone Hazardous Waste Management"] = 32.898 +
+ 0.089*[Index Value on Knowledge and Understanding]
+ 0.264* [Index Value on Awareness of Hazardous Waste Management]

(Equation #2)

Conclusion

The conclusive findings were highlighted and proposed into four main issues, they were,

(1) The youth of Bangkok Metropolitan were well perceived in the "Awareness of Mobile Phone Hazardous Waste Management". The indicated figure had confirmed the index of its category at 77.08,for which it had shown the competency in the future development of the relevant program.

(2) Besides the said "Awareness Index", the youth respondent had also released the perceived respective and corresponding index values of other five categories at the acceptable high level as well. They values were climbing up from 59.09 to77.08respectively.This atmospheric situationwould strongly support the forth coming program activities on these crucial issues.

(3) The indication on effects of exposing to relevant information would escalate all of the six index values, should give us valuable clues to design the essential contents of any future prominent program.

(4) This research would be of quite valuable to the promotion of physical program with expectation of proper preservation of our environment. There will be three portions of concerns, they are :

4.1 There should have up to six bodies and components involve, e.g. (1) the youth who are current mobile phone users, (2) the family or the guardian of the related youth, (3) the educational institutes and their responding communities, (4) the mobile phone retailers, (5) the mobile phone sale agents or the corresponding producers, and (6) the other related public and private sectors.

4.2 There should arrange or organize the action program on awareness building throughthe existing public mass media. Also, there should emphasize on implanting of public image and values on environmental

preservation. In the final effect, the program should induce a “Social Sanction” measures for those who do abuse or misbehave.

4.3 The promotion and formally support in conducting of related and further research programwould be of strongly advised

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Antiviral properties of extracts from Abutilon indicium (Linn.) Sweet

Niramon Worasith[1]*And Bernard A Goodman[2]

ABSTRACT

Leaves of *Abutilon indicum* (Linn.) Sweet from Ratchaburi Province in the Central region of Thailand were extracted by maceration and sonication using five solvent systems, water, 50%, 70%, 95% aqueous ethanol, and ethyl acetate. These crude extracts were then each evaluated for *in vitro* activity against the herpes simplex virus type 1 (HSV-1) using the green fluorescent protein (GFP) method. The 70% ethanol extract showed the strongest activity, and the minimum concentration for anti-HSV-1 activity was 0.21 µg/ml. For comparison, the commercial product, acyclovir, required a concentration of 5.0 µg/ml to achieve the same anti-HSV-1 activity. Anti-HSV-1 activities were also found in the 95% and 50% ethanol extracts, but were lower than that of the 70% ethanol extract. Cytotoxicity assays gave an IC_{50} value of 48.52 µl/ml for the 70% ethanol extract prepared by maceration and IC_{50} values of 18.81 µl/ml and 47.77 µl/ml for the 95% ethanol extracts prepared by maceration and sonication, respectively. The results from this study demonstrate that extracts of the leaves of the plant *Abutilon indicium* (Linn.) Sweet have good antiviral activity when tested against HSV-1, and at the same time show negligible cytotoxicity. Thus, they demonstrate potential for the development of new and effective anti-herpes virus agents.

Keywords: Antiviral activity, Anti-herpes simplex virus type 1, *Abutilon indicum* (Linn.) Sweet

Introduction

Viral diseases are a serious health problem for humans and mammals in general, and represent a growing concern in the 21st century as improvements in the quality of life lead to decreases in the incidences of diseases from other sources. Viruses reproduce inside the cells of their hosts, and infected cells produce large numbers of copies of the original virus. Usually, viruses are eliminated by the immune system, although in addition antiviral drugs have been developed to interfere with virus replication, or to strengthen the immune system. However, there is growing evidence for the development of resistance of various types of viruses to antiviral drugs that are currently in use (de Clercq, 2004). Indeed, the relatively simple structure of virus particles means that their evolution is rapid compared to other organisms, and as a result it is necessary to apply continuous efforts to identify and develop new antiviral agents. In this respect there are two parallel strategies available, namely the development of novel chemical pharmaceutical products, and the extraction and concentration of natural products with antiviral activity. It is the latter strategy that is the subject of this paper. For this exploratory project, the herpes simplex virus Type 1 was chosen for use as the test virus. It is a DNA virus, which belongs to the family *Herpes viridae*, and is responsible for a variety of diseases with symptoms ranging

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from mild to severe, and on occasion life threatening (e.g. Snoeck, 2000, Fatahzadeh and Schwartz, 2007). Furthermore, it has been used recently by several research groups for investigating the antiviral activity of various types of medicinal plant (e.g. Bag et al., 2012; Tan et al., 2013; Visintini Jaime et al., 2013; Anjana et al., 2014). The medicinal plant evaluated in this study was *Abutilon indicum* (Linn.), a member of the *Abutilon* species that has various uses in traditional medicines. For example, *Abutilon indicum* has been reported to possess antioxidant (Srividya et al., 2012), anti-inflammatory (Rajurkar et al., 2009), anti-arthritic (Vallabh et al., 2009), analgesic (Ahmed et al., 2000; Rajakaruna *et al*. 2002; Khadabadi and Bhajipale, 2010), hepatoprotective (Porchezhian and Ansari, 2005), immunomodulatory (Dashputre and Naikwade, 2010), and wound healing (Roshan et al., 2006) properties. Its ethnobotanical uses reviewed by Kaushik et al. (2009) include treatments for leprosy, headaches, gonorrhea, snake bites, and bladder infections. In addition, it has been used in the treatment of ulcers (Dashputre and Naikwade, 2011) and diarrhoea (Chandrashekhar et al., 2004), and is claimed to be both an aphrodisiac and laxative (Singh et al., 2002) as well as an effective mosquito larvicidal agent (Rahuman et al., 2008), although as pointed out by Kaushik et al. (2009), there has until recently been very little effort to verify its efficacy through scientific screening in animal models and clinical trials.

Materials and Methods

1. Source of materials

Abutilon indicum (Linn.) Sweet leaves were collected in Ratchaburi Province, Central Thailand. Fresh leaves were washed and dried in air at room temperature. The dried leaves were then ground and extracted by both maceration and sonication methods as described below.

2. Preparation of plant extracts

2.1 Maceration extraction method

Maceration was carried out using fifty grams of ground leaves soaked in 300 ml of one of the following solvents: 50%, 70% or 95% aqueous ethanol or ethyl acetate for 72 hours at room temperature. In addition, dried leaves were extracted with water using gentle heat at 60°C for 3 hours. The extracts were collected and filtered through muslin cloth following by Whatman No.1 filter paper.

2.2 Sonication extraction method

Fifty gram samples of ground leaves were also extracted by sonication using the same solvents and plant: solvent ratios as in the maceration method. Mixtures were placed in an ultrasonic bath at room temperature for 30 min, and the extracts collected and filtered through muslin cloth followed by Whatman No.1 filter paper.

With both extraction methods, solvents were evaporated under reduced pressure at 40-45°C using a Buchi rotary evaporator, and the concentrated extracts were kept in Amber-coloured bottles at 4°C until subsequent investigation.

3. Testing cytotoxicity against a primate cell line (Vero)

The green fluorescent protein (GFP)-expressing Vero cell line was generated in-house by stably transfecting the African green monkey kidney cell line (Vero, ATCC CCL-81), with pEGFP-N1 plasmid (Clontech). The cell line was maintained at 37°C in a humidified incubator with 5% CO_2 and minimal essential medium supplemented with 10% heat-inactivated fetal bovine serum, 2 mM L-glutamine, 1 mM sodium pyruvate, 1.5 g/L sodium bicarbonate and 0.8 mg/ml geneticin.

The cytotoxicity experiment was performed by adding 45 µl of cell suspension at 3.3×10^4 cells/ml to each well of 384-well plates containing 5 µl of test compounds previously diluted in 0.5% CO_2. Fluorescence signals were measured using a SpectraMax M5 multi-detection microplate reader (Molecular Devices, USA) in the bottom reading mode with excitation and emission wavelengths of 485 and 535 nm. The difference in the fluorescence signal between day 0 and day 4 was measured, and the cytotoxicity percentage was calculated as

$$\% \text{ Cytotoxicity } = [1-(FU_T/FU_C)]\times 100$$

where FU_T and FU_C represent the fluorescence units of cells treated with test compound and untreated cells, respectively. IC_{50} values were derived from dose-response curves, using 6 concentrations of 3-fold serially diluted samples, by the SOFTMax Pro software (Molecular device). Ellipticine and 0.5% DMSO were used as positive and negative controls, respectively.

4. Testing antiviral activity using herpes simplex virus type-1 (HSV-1)

Before performing the anti-viral assay, each crude extract was tested at a range of non-cytotoxic concentrations to evaluate their cytotoxicity effects on host cells. For this test using green fluorescent protein (GFP) detection, 10 µl of samples in 10% DMSO were added to 96-well plates, then 190 µl of GFP-expressing Vero cell suspension at 1×10^5 cells/ml premixed with 5×10^5 PFU/ml of HSV-1(ATCC VR260) inoculum were added to each well. The plates were incubated in a 37°C humidified incubator with 5% CO_2 for 4 days. Differences between the fluorescence signals at day 0 and at day 4 were measured using a SpectraMax M5 as described in the previous section, and the percentage of viral inhibition was calculated using the following equation:

$$\% \text{ viral inhibition} = \{1-[FU_C-FU_{VT})/(FU_C-FU_{VC})]\} \times 100$$

where FU_C, FU_{VT} and FU_{VC} are average fluorescence units of non-infected cells, virus-infected cells treated with *A. indicum* extract, and virus-infected cells untreated, respectively. Acyclovir and 0.5% DMSO were used as positive and negative controls, respectively.

Results

Cytotoxicity test against primate cell lines (Vero)

In order to study the tolerance limits for these extracts, cytotoxicity assays were performed on Vero cells using the green fluorescent protein (GFP) method. Concentrations of the various extracts required to reduce the viability of cells by 50% (IC_{50}) were measured. Ellipticine and 0.5% DMSO were used as positive and negative controls, respectively. The results show that there was no cytoxicity (IC_{50} >50 µl/ml) in the water and 50% aqueous ethanol extracts, whereas the 70% aqueous ethanol, 95% ethanol and ethyl acetate extracts were cytotoxic. The IC_{50} value for the 70% ethanol extract prepared by maceration was 48.52 µl/ml, and for the 95% ethanol extracts, IC_{50} values were 18.81 µl/ml and 47.77 µl/ml for the samples prepared by maceration and sonication, respectively; for the positive control, ellipticine, IC_{50} was 1.14 µl/ml (Table 1).

Table 1 IC_{50} values for the crude extracts of *Abutilon indicum* (Linn.) Sweet.

Crude extracts	IC_{50}	Cytotoxicity	IC_{50}
Maceration			
Water (60°C)	>50 µl/ml	non-cytotoxic	-
50% aqueous ethanol	>50 µl/ml	non-cytotoxic	-
70% aqueous ethanol	<50 µl/ml	cytotoxic	48.52
95% ethanol	<50 µl/ml	cytotoxic	18.81
Ethyl acetate	<50 µl/ml	cytotoxic	16.43
Sonication			
Water (room temperature)	>50 µl/ml	non-cytotoxic	-
50% aqueous ethanol	>50 µl/ml	non-cytotoxic	-
70% aqueous ethanol	>50 µl/ml	non-cytotoxic	-
95% ethanol	<50 µl/ml	cytotoxic	47.77
Ethyl acetate	<50 µl/ml	cytotoxic	46.79
Ellipticine (positive control)	<50 µl/ml	cytotoxic	1.14

Cell/DMSO (negative control)	0.5% DMSO	-	-

Anti-herpes simplex virus type-1 (HSV-1)

Inhibition of the herpes simplex virus type-1 by the various extracts was also evaluated by the green fluorescent protein (GFP) method, using acyclovir 5 µg/ml and 0.5% DMSO as positive and negative controls, respectively. The crude extracts of the *A. indicum* Sweet leaves all showed anti-HSV-1 activity, and the minimum concentration of all crude extracts to reveal this activity was 0.21 µg/ml. In a comparative study between extraction methods, it was found that all of the crude extracts prepared using sonication had better anti-HSV-1 activity than those prepared by maceration.

The 70% ethanol extract showed the strongest activity, and the concentration for anti-HSV-1 activity was 0.21 µg/ml, much lower than the value of 5.0 µg/ml required for the commercial product, acyclovir, to achieve the same level of anti HSV-1 activity. Anti-HSV-1 activity was also found in the 95% and 50% ethanol extracts (Table 2).

Discussion

In the past few years there have been several reports describing antiviral properties of extracts of plant species from various parts of the World (e.g. Müller et al., 2007; Bag et al., 2012; Mukherjee et al., 2012; Tan et al., 2013; Visintini Jaime et al., 2013; Anjana et al., 2014). Thus, these results suggest that such natural products could form the basis for the preparation of new families of medicinal products.

Table 2 Herpes simplex virus inhibition (%) by crude extracts of *Abutilon indicum* Linn. Sweet at 0.21 µg/ml compared with 5 µg/ml acyclovir

crude extracts	concentration (µg/ml)	% inhibition	
		maceration	sonication
Water	0.21	2.48	10.00
50% aqueous ethanol	0.21	8.16	14.02
70% aqueous ethanol	0.21	11.02	18.40
95% ethanol	0.21	9.06	16.29
Ethyl acetate	0.21	12.04	12.75
Acyclovir (positive control)	5.00	12.22	

There are, for example, several reports of medicinal properties associated with the leaves of *A. indicum*. Thus *A. indicum* leaf extracts may have potential use in the management of *diabetes milletus*, since Seetharam et al. (2000) found hypoglycemic activity in alcohol and water extracts, and Krisanapun et al. (2009) have shown that an aqueous extract inhibits glucose absorption and stimulates insulin secretion in rodents. These results are further supported by the work of Pant et al. (2013), who subsequently reported α-amylase and α-glucosidase inhibitor activities in methanol extracts of pulverized *A. indicum* leaves. Other examples of medicinal properties associated with extracts of *A. indicum* leaves include anti-diarrhoeal activity (Chandrashekhar et al. 2004) and anti-ulcer activity of methanolic extracts (Dashputre and Naikwade 2011), anti-inflammatory activity of various extracts (Rajurkar et al. 2009), and immunomodulatory activity of aqueous and ethanolic extracts (Dashputre and Naikwade 2010). However, to the best of our knowledge, the present work represents the first report of antiviral activity associated with extracts of *A. indicum*, and is in contrast to results of Kumar et al. (2006), who found no evidence for antimicrobial properties in extracts of the fruit, root or leaf of *A. indicum*.

The highest antiviral activity was found with the 70% ethanol extract, and considering the discussion in the previous paragraph, it would appear that such extracts may possess a broad range of medicinal properties that have not been fully evaluated. The *Abutilon* species are rich in potentially active components such as alkaloids, flavonoids, steroids, terpenoids and saponins (Khadabadi. and Bhajipale 2010), and there are reports of steroids, sapogenins. carbohydrates and oavonoids (Lakshmayya et al 2003), sesquiterpene lactones, gallic acid, β-sitosterol, geraniol and caryophylline in *A. indicum* (Pengelly 2004). The diversity in properties of *A. indicum* leaves is illustrated by the work of Lakshmayya et al (2003) who observed that the aqueous extract was most potent in reducing blood glucose levels, whereas petroleum ether and benzene extracts had good analgesic properties. Furthermore, the flavonoid component may be responsible for immunostimulation (Dashputre and Naikwade 2010), since *A. indicum* leaves can contain appreciable quantities of quercetin Rajalakshmi and Kalaiselvi Senthil 2009) and gallic acid (Pengelly 2004). Overall, it seems likely that different types of phytochemicals are responsible for different pharmacological properties, and measurements to characterize the active components in the most promising products from the current project will be the subject of future investigations.

Conclusions

The results from this project demonstrated that extracts of the leaves of the plant *Abutilon indicium* (Linn.) had antiviral activity when tested against the herpes simplex virus Type 1, and at the same time had negligible cytotoxicity. The highest activity was observed with the 70% ethanol extract, and this is now

being investigated in a new project for its antioxidant activity and polyphenol content along with other active extracts.

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The development of products which made from Fiber-Herb paper

Nadda Angsuwotai[1*]

ABSTRACT

This research is to study the process of making 7 fiber-herb paper which are lemon grass leaf, pineapple leaf, vetiver grass, leaf sheaf of banana tree, bagasse, rind of dragon fruit and rind of mangosteen; and to test properties of the paper and develop the products which made from the paper. The process of making papers from these 7 herbal plant fiber was different in proportion, weight of herbal plants, concentration of caustic soda, quantity of water, and time for boiling paper fibers. The properties of the papers were found that paper from the bagasse has toughness and damp which was suitable for good paper product designing. The second, third, fourth were paper from leaf sheaf of banana tree, pineapple leaf and vetiver grass. For the colors of the paper, the paper from the bagasse fiber, and the banana fiber were yellow and black respectively, the others were light brown. We also found that the fiber of dragon fruit was clear thin film but fragile-like. For the rinds of mangosteen, they could not be made papers because they were not joint. From this research, we designed products from the papers and made boxes, bags, and envelops in original color of the paper. The paper didn't have their odors. In this way, we create value from the waste, increase the value from the agricultural product, generate income to the farmers, and decrease the warm earth condition.

Key words : paper fiber, herb , product

Introduction

Wood has been a main raw material for making paper. Some parts of wood (such as leaves, barks, part of stems, shells of fruits, twigs, and roots) are proceeded to become fibers which can be made paper.[1][2] Mostly we use Eucalyptus which gives short fibers; however, long fibers are imported. Tensile strength and tearing resistance of papers are the effort of proper proportions of short and long fibers. Moreover, some materials are added for required properties of papers. This is a process of making papers in industry for a large number of quantity; however, in home-made papers making, the process are simple for making handcraft such as greeting card, wrapping paper, book marks, and artificial flowers. Mostly, the raw material for making the home-made papers is paper mulberry. Nowadays, there are a lot of methods to make paper from agricultural waste such as weeds and elephant excrement. These raw materials are called non-wood fibers which can be made non-industrial papers, but the papers will not be as strong as
the industrial ones. The raw materials which are usually used to make home-made paper are made from rice straw, pineapple leaves, banana leave, bagasse, and palm leaves which are agricultural wastes. Moreover, the raw materials from weeds are water hyacinth, lesser reedmace, and unwanted grasses. Furthermore, people who love paper-making art still discover many other raw materials such as jicama shell, pandanus leaves, selected leaves, vegetable leaves, useless parts of asparagus, and pomelo shell. The leaves and leaf sheaves of banana can also be made paper.[3] We can think that paper making is an art creation and it will be very valuable if we use the shell of fruits, which is left after eating fruits, to make paper fiber and develop to create things from these papers.[4]

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In the process of making paper, we may expect that the value of herbal plants will raise the quality of paper from colors, odors, and chemical substances in herbal plants (such as mangosteen has antiseptic substances). Corrugated paper has tensile strength and tearing resistance that can be made desks and chairs, but the design of paper product is still limited. The study and experiment of making paper fibers from herbal plants will make money to community because the raw material can be found in the community. Moreover, it promotes sufficient economy and it is environmental friendly by using resources economically. This research is also developed to make paper by using scientific methods and local wisdom to make models for further application.

Objective

1. study the process of making fiber-herb paper
2. study chemical and physical property of papers which are made from herbal fiber
3. develop paper product from fiber-herb paper

Materials

Figure 1 raw material of making paper from herbal plants

Methodology

The process of making paper in the research from 7 herbal plants which are lemon grass,vetiver grass, bagasses, pineapple, dragon fruit, leaf sheaf of banana tree, and mangosteen step that are raw material preparation, washing fiber and spreading fiber.[2][3] The paper is tested for tensile strength, tearing resistance and dampness which are important properties in making paper products.[4] The paper products; which are bag, envelope and boxes, are designed according to paper properties and forms of the products.[5]

Beauty, utility and idea are concerned in designing the paper products. The conclusion of making paper from 7 herbal plants, according to the proportion of factors of production, is shown in table 1.

Factors of Production

- The weight of dried herbal plant (gram)
- The weight of caustic soda (gram)
- The approximate concentration (percentage of mass)
- The Quantity of water in boiling (gram)
- The proportion of the weight of herbal and the weight of water (weight/weight)
- The time for boiling after the water is boiled over (hr.)

Results

Table 1 The Proportion of the factors in making paper from 7 herbal Plants

Kinds of Herbal Plants / Making paper factors	lemon grass	vetiver grass	pineapple leaves	bagasse	leaf sheaves of banana tree	dragon fruits rinds	mango-steen
Weigh of dried herbal plants (gram)	200	350	200	350	350	400	300
Weight of caustic Soda(gram) Approximate concentration Percent by mass)	90 3	350 10	200 10	350 10	350 10	40 2	150 5
Quantity of Water (gram)	3,000	3,500	2,000	3,500	3,500	2,000	3,000
Proportion of the weight of herbal plant and the weight of water (weigh by weight)	1 : 15	1 : 10	1 : 10	1 : 10	1 : 10	1 : 5	1 : 10
Time for boiling after the water was boiled over (hour)	2	3	3	2.5	2.5	0.5	2

After boiling the paper fiber, the base will be washed out, the spread to be a paper sheet. The paper was tested for tensile strength, tearing resistance, and dampness, as shown in table 2.

Table 2 The testing property of Fiber-Herb paper in Tensile strength Tearing resistance and Dampness

Type of Fiber-Herb Paper	The testing property of Fiber-Herb paper *		
	Tensile strength (N /15 mm.)	Tearing resistance (g.)	Dampness (percent)
bagasse	49.82	343	12.3
leaf sheaves of banana tree	21.49	153	13.2
pineapple leaves	7.75	77.5	11.7
vetiver grass	4.88	52	12.5

* tested by Yuthanapong Daengpeng. Department of Science and Service.

From the table, paper from bagasse has the highest tensile strength, the highest tearing resistance, and low dampness. Therefore, it is suitable for making paper products. The next rank of suitable materials for making paper products are papers from leaf sheaves of banana tree, pineapple leaf, and vetiver grass, respectively.

Figure 2 The paper made from 6 herbal plant fiber

Figure 3 The design of paper product from bagasse

Discussion

Bagasse is like hard wood, suitable for making paper fiber. Moreover, it is a good fiber, easy to dry because it has lignin less than hard wood. Making paper fiber is to dissolve lignen and hemicellulose of bagasse. Lignin holds the fibers of bagasse so that we cannot make thin paper from bagasse. Furthermore, if there are more than 20% of hemicellulose, they will make paper easy to be torn off, not strong, and yielding.[6]

Conclusion

The fiber-herb paper which had suitable tensile strength, tearing resistance and dampness to making paper products were from bagasse, leaf sheaf of banana tree, pineapple leaf, vetiver grass and lemon grass leaf. Paper from bagasse was suitable for making paper products. The making fiber-herb paper could add value to agricultural products, reduce waste, and reduce global warming.

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The Development of Item Bank Software Framework

Piya Thirapanmethee [1*] and Pallop Piriyasurawong [2*]

Abstract

The Item Bank Software Frameworks was developed to present a concept of information systems development. This concept combines the features of the item bank and object oriented programming in the form of Item Bank Software Framework. The designed Item Bank can be reused and further developed without rewriting a new program. The Framework applied a Software Development Life Cycle (SDLC) to develop the system while a Unified Modeling Language (UML) was used for the design. The Framework was coded by PHP and MySQL for the Database Management System. The developed frameworks can be divided into four parts; 1) the connection to the user through the web browser 2) the service for database connection 3) the set of instructions for the developed frameworks and 4) the web services in order to exchange data. In this evaluation the total of 10 representative samples are those who are expert in information technology and education. The statistical values used in this research are the means and the standard deviations. This evaluation shows that the effectiveness of the developed item bank is at the highest level for all aspects except user creation and management is at high level. The effectiveness of the framework is also at the highest level for all aspects except the ease of installation is at high level.

Keyword: Information System Development, Software Framework, Object Oriented Design, Item Bank

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Introduction

Background and Rationale

National Education Act B.E.2542 (1999) and Amendments (Second National Education Act B.E.2545 (2002)defines the education management as "the process of learning for the prosperity of individuals and their society by means of providingthem with knowledge, training, preserving cultures, creating academic progress, and creating knowledge from management of environments, society, learning and supporting factors so that the learners are always able to learn anything all their life". Referring to the academic management of any education institute, there is designation of those who are responsible for conducting and following up academic tasks, project planning, and academic development projects. These personnel also have to evaluate and summarize the results of the said tasks and then improve the curricular appropriately so that they could satisfy the need of learners and society. Also, there are instructional activities, which encourage the learners to develop their potential as targeted, based on methods and evaluation forms that can really measure the capability of the learners (Jintana, 2001)

It is necessary to apply information technology in education because it can facilitate both learners and instructors in terms of fundamental equipment and suitable and modern information sources that comply with the curricular. With systematic and integrated development of innovation, the operation can be performed in an effective and efficient manner (Kittima, 2007). The recent education and instruction systems focus on encouraging the learners to have learning achievement as targeted, and on the process of measuring the learners' capability by means of different tests. Therefore, the creation of tests is one of the most important factors of instructional process in order to measure the learners' efficiency (Somsak, 1999). However, most tests have been created for one use only and the new tests have to be created whenever there is an examination. As a consequence, there has been no analysis of the tests for further improvement and for choosing the most suitable ones. Accordingly, the development of item bank is considered the efficient storage of tests (Suphat, 1999), thereby the test results can be analyzed to find out the quality of tests based on the principles of evaluation, e.g.validity, reliability, difficulty, and discrimination

The analysis of test quality is an important element to develop instruction on the basis of overall results (Minet al., 2009). After attaining the results of analysis, the tests with high quality will be stored for further use in the future. The development of item bank in the form of computer program is a tool for instructors and education institutes to manage the tests (Hengyao and Xiaoyan, 2010). Moreover, the storage of tests in the form of electronic documents, instead of paper form, can save capacity of storage and facilitate the quick search (Deng and Liu, 2010).So, if there is an application of technology in education

management systems in terms of instruction measurement and evaluation by developing an item bank system to store the tests with high quality in the database, it will be very beneficial for the improvement of curricular, instructional methods, and instruction evaluation, all of which contribute to the more appropriate instructional process (Pawinee, 2000).

The development of information system by means of Reuse Techniques can reduce the costs of development, increase quality, and facilitate the improvement of system maintenance (Niwet, 2000). Therefore, the development of information system by means of Software Framework, the collection of particular instruction sets, will be useful for the system developers to apply it in their tasks. This is because, with the development of information system by means of Software Framework, the system developers do not need to develop all of the new system; instead, they reuse the existing instruction setsin the framework, which helps reduce the time spent on the development of information system (Lopes et. al, 2007).

Thus, this research applied the ideas of information system development which included the advantages of item bank and object orient designs in the form of software framework. The item bank was designed in the form of software framework and its operations were based on web services, which were suitable for the processing in different platforms (Narlinrat, 2006). This is to attain anitem bank softwarethat can be reused and redeveloped with no need to rewrite any new programs, and to enable the developers to reduce the complication and processes in the system development while increasing the speed of instruction set improvement.

Objectives of Research

1. To develop Item Bank Software Frameworks
2. To evaluate the application of Item Bank Software Frameworks

Scope of Research

In this research, the researcher developed the Item Bank Software Frameworks based on theories of Object Orient Analysis and Design in order to create the Item Bank Frameworks to store the tests, analyze their statistic values, and find out their quality. The scope of development for the systems of storage and analysis was limited to the multiple-choice tests; and it was tested in Rajamangala University of Technology Krungthep.

Methodology

This researchis research and development by applied the principles of Object Oriented Design and Software Development Life Cycle : SDLC (Khan and Beg, 2013) to develop the system with the following steps:

1.Studying the ideas and theories, and then accumulating the data by researching the information about test banks, framework development, web service, and tools for system development from books, articles, researches, and relevant theses, and also asking users about both existing item bank formats and the desirable ones.

2.Analyzing the data derived from the study of ideas, theories, and information about item bank framework development in order to designate the scope and functions of the whole system.

3. Designing the system based on the concepts of Object Oriented Analysis and Design using Unified Modeling Language: UML, which consists of diagrams and symbols to explain the details of creation and management of different documents from the beginning to the end of the work system, and then writing the program for practical use in system development (Bangchong. and Yarnawan, 1999)and designing the database by means of Entity Relationship Diagram: ERD.

4. Developing the Item Bank Software Frameworks by using PHP to develop the program and web service, and creating database by using MySQL as its management system.

5.Testing and improving the system by means of Unit test, Integration Test, Functional Test, and System test (Tsui and Karam, 2007).

6.Evaluating the performance of the system by 10 experts in the fields of education and information technology.

Results

Design of Item Bank Framework

The design of Item Bank Software Frameworks consisted of 4 main parts: 1) user(Assessor, Primary Instructor, Admin, Item maker, and Student) interface via web browser, 2) database connection (MySQL), 3) instruction sets for the developed framework (Item Bank Framework), and 4) web service for data exchange (Item Bank Service). The said system was illustrated in figure 1.

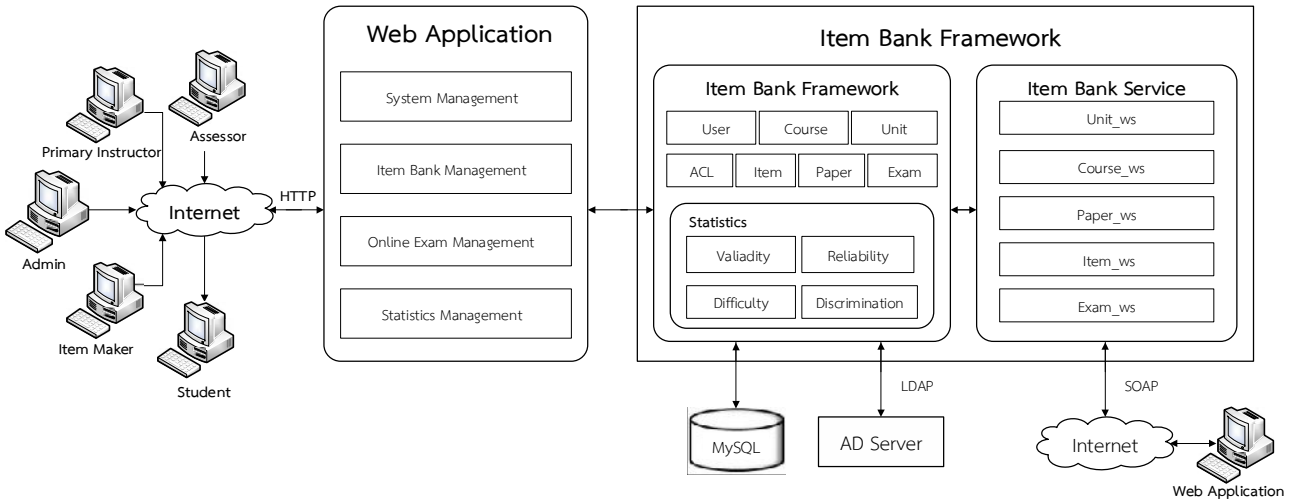

Figure 1 Item Bank Software Frameworks

Analysis and Design of Item Bank Software Frameworks

Designing the overall functions of Item Bank Software Framework based on Use Case Diagram, including Actor and Use Case (Stephen R., 2011),as shown in figure 2, which explains the relationship between actor and use case as followed:

Admin sets user permission, courses, primary instructors, and user group.

Primary instructors set, delete, and update paper; do item analysis report and paper analysis report; set instructors and do examination report.

Instructors set, update, and delete units, and set assessors.

Item makers create, delete, and update items.

Assessors assess IOC of the online exam that students take, and do the score report.

Developers call functions and create additional modules for the framework.

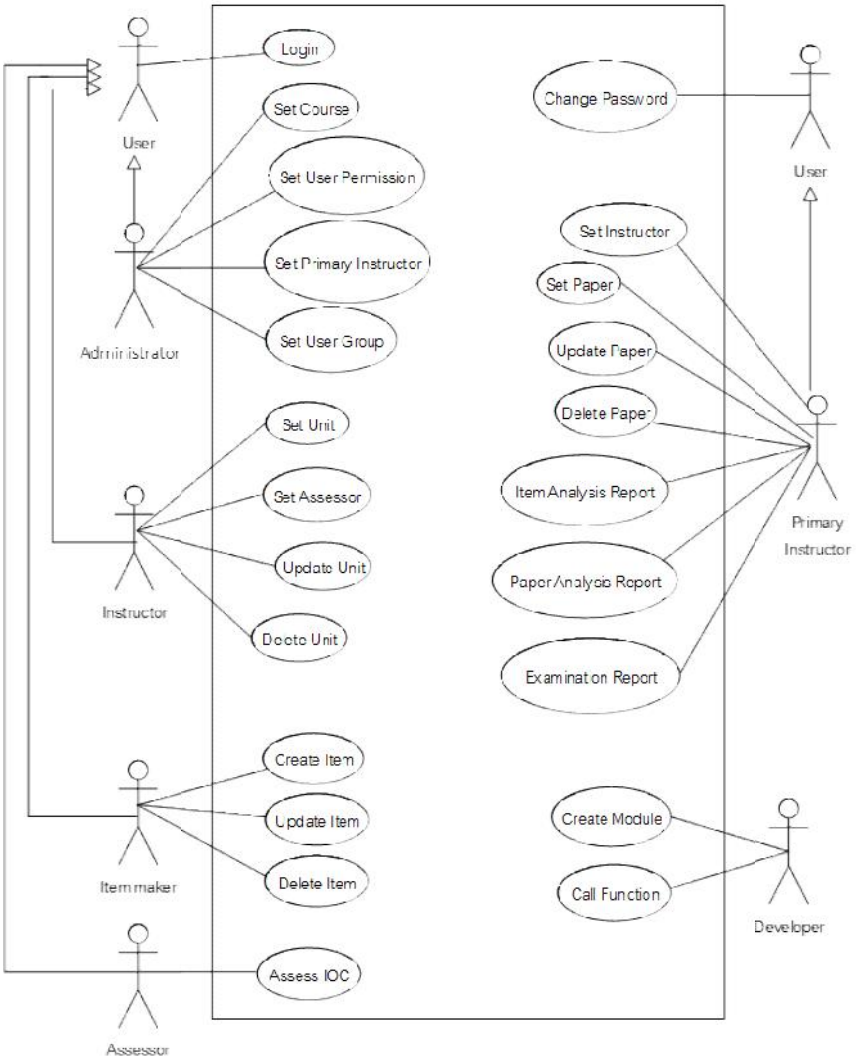

Figure2 Use Case Diagram

Designing classes and the relationship thereof based on Class Diagram, including 15 classes, i.e. Faculty: detailed information about the faculty, Department: detailed information about the department, User: information about users in the developed system, Instructor: information about the instructors, Primary Instructor: information about the primary instructors and their subjects, Assessor: information about the assessors, Student: information about the students, ACL: management of access control list, Course: information about the courses, Unit: information about the units, Paper: information about the paper, Item: information about the items, Multiple-choice: information about the multiple-choice exams, and Exam: information about the exams. Thereby, these classes were shown in figure 3.

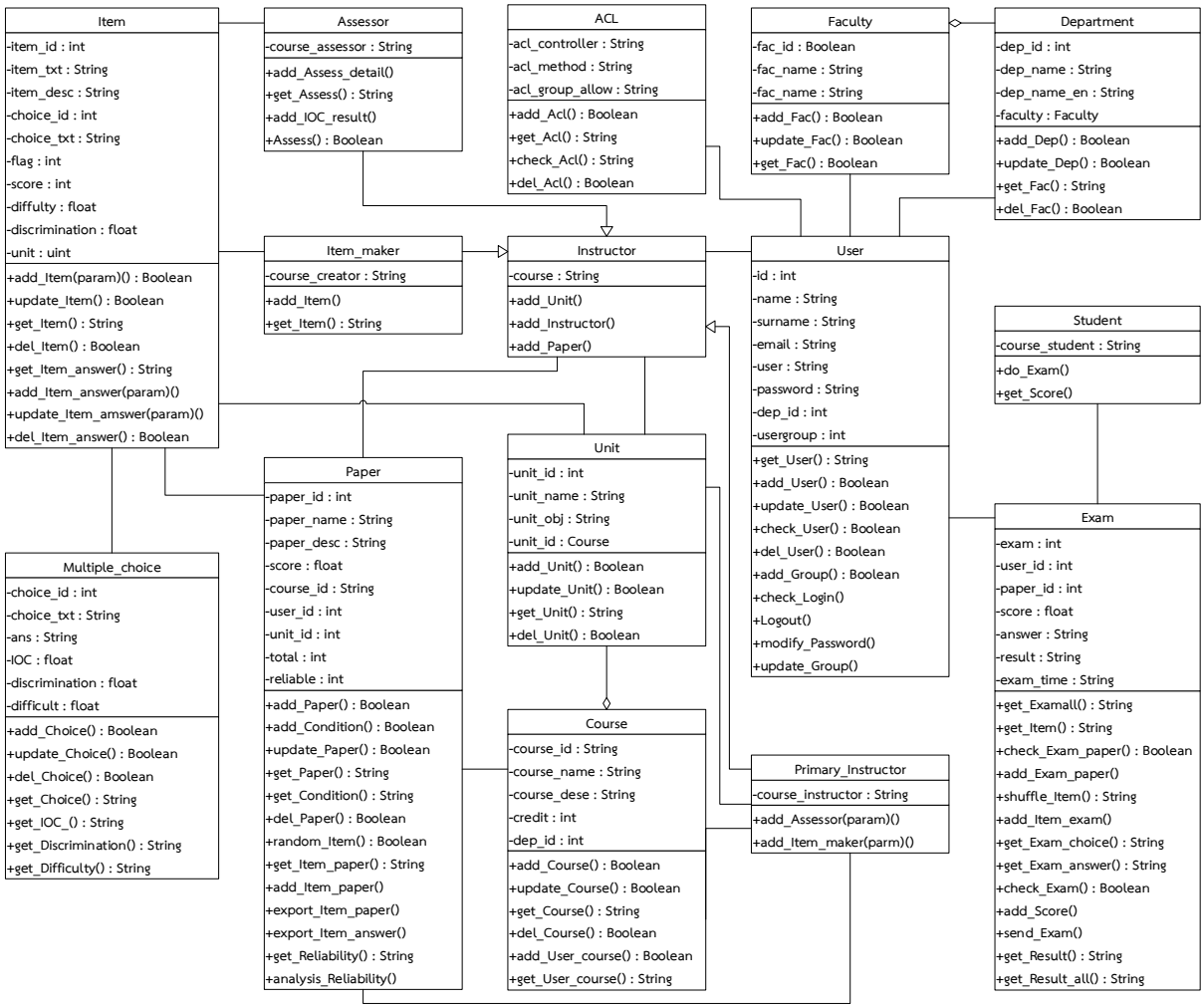

Figure3 Class Diagram

Designing step-by-step functions of Item Bank Software Framework based on Activity Diagram, including Client, Web Application, Web Service, Function, and Database. The process began with the Client sending a request to Web Application. Once the request was checked, Web Application called the web service, which then called the function as requested. Thereby, the function would connect to the database or do anything as requested. After the request was satisfied, the function would send the results back to web service, and then the web service sent the said results to Web Application so that they were displayed on the Client. The aforementioned process was illustrated in figure 4.

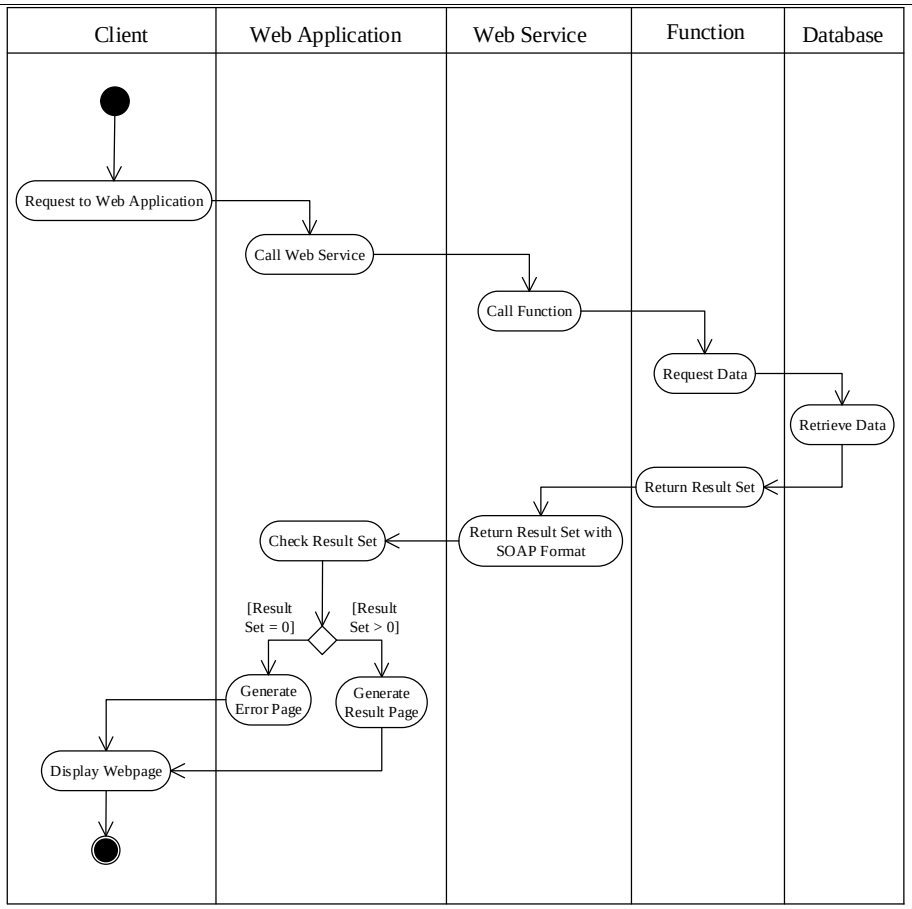

Figure4 Activity Diagram

Designing software and system elements for the development of Item Bank Software Frameworks based on Deployment Diagram as shown in figure 5.

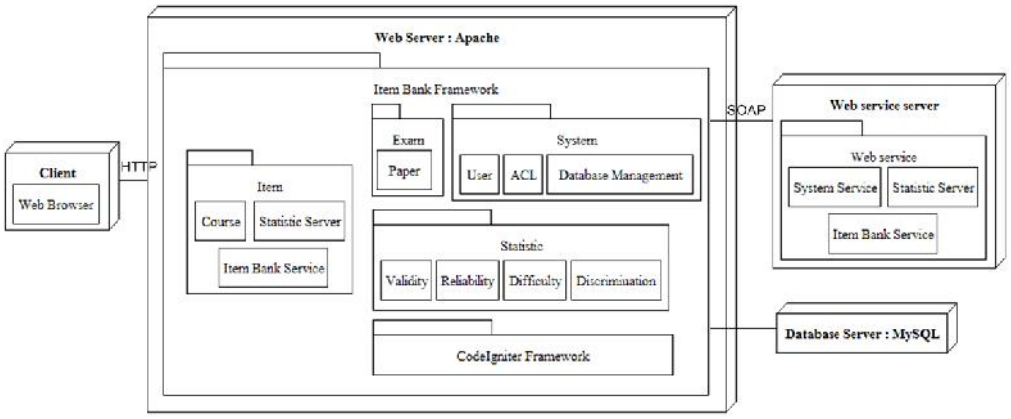

Figure5 Deployment Diagram

According to figure 5, Item Bank Software Frameworks were composed of Client, which was a Web Browser connected to the internet; Web server, which stored the instruction sets of Item Bank Framework; Web Service Server, which exchanged the data within the system; and Database, which managed the section of database.

Designing the database based on Entity Relationship Diagram : ERD, which included 18 entities; i.e. user: storing information of all users, user_group: storing information of user groups, group_all: storing information of individuals in user groups, faculty: storing detailed information of the faculties, department: storing detailed information of the departments, course: storing all information of the courses, course_user: storing course information of the each user, chapter: storing informatio n of all chapters, item: storing information of multiple-choice exam, choice: storing information of choices of the exams, item_qa: storing information of completion tests, item_history: storing information of the used exams before the amendments, item_assess: storing information of evaluation on each item, paper: storing information of all paper tests, condition_item: storing information of item conditions: storing information of item on all papers, exam_paper: storing information of the exams, and item_exam: storing information of all items in the exams. Thereby, the relationship of all the entities above was shown in figure 6.

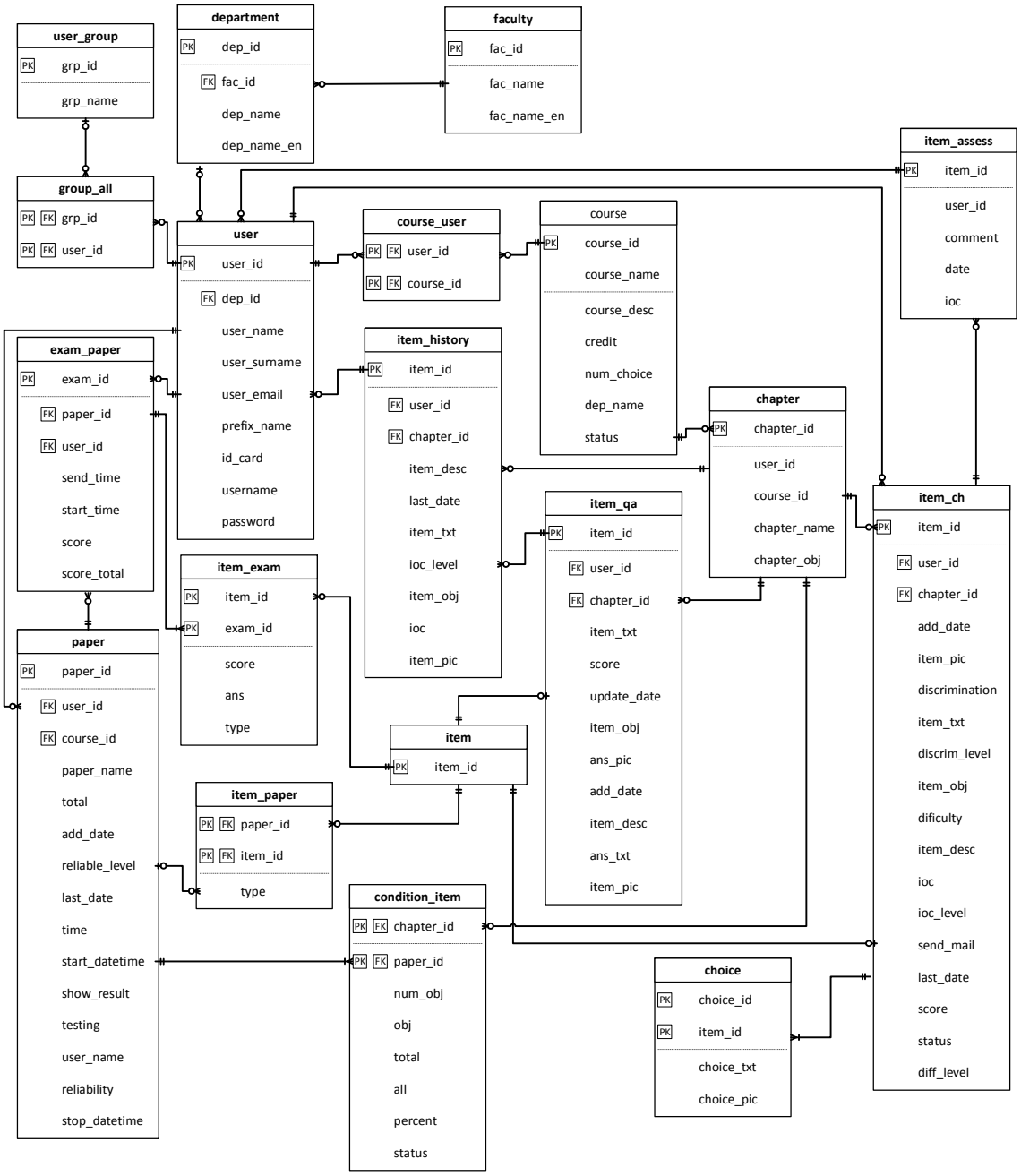

Figure6 Entity Relationship Diagram

Results of evaluation on the efficiency of Item Bank Software Frameworks

The evaluation on the efficiency of Item Bank Software Frameworks was conducted, in terms of the usage and framework functions of Item Bank Software Frameworks, by 10 experts in the fields of education and information technology. The results thereof were shown in Table 1 and Table 2.

According to Table 1, the overall efficiency of Item Bank Software Frameworks was in the level of "very high". Once considering each category separately, it was found that all categories were of very high efficiency except that of Creation and management of users, which was in the level of "high" ($\bar{x}$ =4.37 , S.D. = 0.49). In terms of ranking, Creation and management of courses had the highest efficiency ($\bar{x}$ = 4.67 , S.D. = 0.474), and Creation and management of online tests had the highest efficiency ($\bar{x}$ = 4.57 , S.D. = 0.496).

Table1 Results of evaluation on the efficiency of Item Bank Software Frameworks

Details of Evaluation	Results		Efficiency Level
	$\bar{x}$	S.D.	
1.Creation and management of users	4.37	0.490	High
2.Creation and management of courses	4.67	0.474	Very High
3. Creation and management of items	4.68	0.503	Very High
4. Creation and management of exams	4.81	0.382	Very High
5. Creation and management of online tests	4.57	0.496	Very High

Table2 Results of evaluation on the efficiency of framework functions

Details of Evaluation	Results		Efficiency Level
	$\bar{x}$	S.D.	
1.Convenience on framework setting	4.40	0.516	High
2. Formats and methods of using frameworks	4.70	0.483	Very High
3. Ability to create and set up additional module (Plug-in)	4.80	0.422	Very High
4. Suitability of setting of framework elements	4.70	0.483	Very High
5. Reduction of steps in program development	4.60	0.516	Very High

According to Table 2, the overall efficiency of framework functions was in the level of "very high". Once considering each category separately, it was found that all categories were of very high efficiency except that of Convenience on framework setting, which was in the level of "high" ($\bar{X}$= 4.4 , S.D. = 5.16). In terms of ranking, Ability to create and set up additional module (Plug-in) had the highest efficiency ($\bar{X}$= 4.8 , S.D. = 0.422), followed by Formats and methods of using frameworks and Suitability of setting of framework elements, which had the highest efficiency ($\bar{X}$=4.7 , S.D. = 0.483), and Reduction of steps in program development, which had the highest efficiency ($\bar{X}$=4.60 , S.D. = 0.516).

Discussion

Item Bank is an appropriate information system that is worth developing for use in education institutes, which corresponds to the research of Piya and Pallop (2013), who studied Model of Cloud Computing for Education. Also, it is in compliant with the research of Pradit (2011), who developed Online Test Bank System Using Discrimination Analytical Technique for Far Eastern University, and found that the online test bank could reduce the number of work steps while increasing convenience to both instructors and students.

The Item Bank Software Frameworks developed herein were designed on the basis of object-oriented programming and by means of developing each program separately, namely Software Components. These components were created based on the principles of information system development in which the stages and activities were obviously designated (Dennis and Wixom, 2003). This enables the developers to reuse the instruction sets, helping them reduce the time needed to develop the programs while facilitating the maintenance of programs, which is in accordance to the research of Niwet (2000) and Kirapuk(2002). In addition, the reliance on web service to exchange data of Item Bank Software Frameworks is corresponding to the research "A Web Services Based Online Training and Exam System" of Panget al., (2008).

Conclusion

Item Bank Software Frameworks developed herein is an application of current technologiesas a tool for improve the quality of item and in order to enhance the efficiency of existing information technology. The design adds value to the invested information technology resources and softwares by

reusing them and improving their performance. With no need to begin the new system development, this design is considered the most efficient and the most effective application.

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THE SYNTHESIS MODEL OF KNOWLEDGE MANAGEMENT SYSTEM IN THE INFORMATION TECHNOLOGY SERVICES AT HIGHER EDUCATION

Watcharin Warinthaksa,[1*] Montean Rattanasiriwongwut[2*] and Monchai Tiantong[3*]

Abstract

This research has an intention to study about elements and the Knowledge Management System (KMS), in order to bringing about a tendency of building a synthesis model of knowledge management system in the information technology services at higher education, by studying elements and process of knowledge management system from the tendency of professionals and some well-known organizations in knowledge management. Then arrange and group those who are similar the most and use them to survey in 5 levels regarding opinions of the professionals who manage in departments involving the career of the information technology in universities. From studying, it is realized that there are totally 7 popular elements to be using. The most important elements according to opinions of professionals are including; leadership & strategies, procedure of knowledge management, executors, information technology and communication. Important elements are source of knowledge and organizational culture. And neutral important element is evaluation. And there are 8 steps of procedure of the knowledge management which are widely using. The most important procedure according to the opinions of professionals are; conveyance & dissemination of knowledge, constructivist learning, sharing & exchanging, improvement and appliance. The important procedure of knowledge management consequently are; knowledge acquisition, storage & retrieval and indication of knowledge. Procedure of knowledge management from what have been studying is to be using to create a model of a new knowledge management. We can use it to manage the body of knowledge of the information technology services at higher education effectively.

Keywords : KM, KMS,

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Introduction

Nowadays, offices & departments in all parts including either government or municipality are all realize and give precedence to the importance of knowledge management inside the organization, much more. If any organization is able to do storage & retrieval the knowledge; for example: Know-How or the Best Practice, it is valuable to transfer and share to the others in the same organization and it shall bring about a sustainable improvement to them. Previously, we found from surveys that organizations from all around the world have a trend to grow up in the knowledge management rapidly. They realize about the importance of using the knowledge management system as a tool in their work (1), which is successful in knowledge management in accordant to various factors. Anyway, the Information and Communication Technologies is the factor that encourages of ease and comfort in the knowledge management and make it becomes concrete. Abilities of the Information and Communication Technologies which is used to manage the knowledge to bring about and improve the Knowledge Management System (KMS) make it easier and more convenient (2). The Information and Communication Technologies becomes a powerful tool that organizations use to manage knowledge effectively. They can search, store and use knowledge comfortably and quickly. Especially, it eradicates obstacles about distance and time in conveyance and dissemination the knowledge (4). There are 4 difficulties found in research of Desouza (3) that interviewed users of the KMS regarding to the obstacles in appliance of the Knowledge Management System are consisting of;

1. Difficulty of the system to indicating of which person is a professional that can convey and disseminate knowledge to the others.
2. Difficulty of the system to catch up knowledge from persons or Tacit Knowledge and how to convey and disseminate knowledge to the others in the organization and let them learn and accessible.
3. Lack of activation from executives.
4. Incorrect push or drive from the executives, previously the executors could feel about the pressure and lack of motivation to use technology.

Result of the research of Quaddus and Xu (1) which studied about factors that affect to using the KMS of officers in companies in Australia is including; organizational culture, support from the executives, advantages that each person shall get and image of the KMS itself.

Su Huishuang and Tian Shuo (5) analyzed process of knowledge management of big organizations via multi-dimension of methods by using purposes and behaviors according to human factor in theory of Wuli, Shili and Renli. This work presents simple theory and principal to encourage an effective KMS in big organizations in order to achieve process of wanted knowledge collecting.

Junming Hou and group (6) studied about how to manage the knowledge by building ontology for co-designation. By presenting to use the ontology in knowledge management, which has a cooperation of the whole organization (professionals, knowledge engineers and executors of the system), it provides a flawless result in artificial intelligence and including presenting ideas to apply semantic web.

Hanlie Smuts (7) and group studied about framework of the KMS and found a problem that obstructs is a difference in each organization. Each organization has a different process to improve the KMS then cause of a confusing to anyone who will improve it and also gets confusing when choose for a good practice.

If consider from the information we got, there are various steps that we can use the KMS to help improving the system. To insinuate the information technology services into the KMS, we have to choose for a suitable element the most, or which elements should use other method of management or process to handle. This is for ability to build a technology environment that is beneficial for building a sustainable knowledge in the organizations.

From what have been mentioned above, researchers are interesting to study about process of building the KMS has which elements and many popular processes, which standard should be suitable to use in any organization that serve especially in the information technology services.

Objectives of the Research

To analyze elements and processes of the KMS in the organizations that reflect to the success of knowledge management inside the organizations that provide a result in the information technology services for higher education.

Hypothesis

Which elements and processes that being used the most in the KMS of organizations, they can be using to be a tendency of designing a format to improve the KMS for the organizations who serve especially in ICT sustainably.

Implementation of the Research

This research has been studied from other researches both local and overseas. And we used questionnaire to measure the priority from opinions of those professionals.

1. Study about meaning of the Knowledge Management System (KMS)
2. Collect elements of the KMS from professionals both local and overseas, totally 16 persons, and then compare of whether similar or different in order to consequent the elements to be using in the KMS.

3. Study about process of knowledge system improvement from 18 professionals (both local and overseas) then compare and conclude of which is popular in using in order to measure priority of the process of KMS.

4. Learn from opinions of professionals and executives management from where they serve the information technology, totally 9 persons, about elements of the KMS which is using the most.

Materials and Methods

This is the statistics used to evaluate the result for sample survey due to find out the average $(\bar{x})$

$$\bar{x} - \sum_{\frac{i-1}{N}}^{N} X_i$$

When

$\bar{x}$ = Average

$\bar{x} - \sum_{\frac{i-1}{N}}^{N} X_i$ = TOTAL VALUE

N = NUMBER OF POPULATION

STANDARD DEVIATION

$$\text{S.D.-}\sqrt{\frac{n\sum_{i-1}^{n} fx_i^2 - \left(\sum_{i-1}^{n} fx_i\right)^2}{n(n-1)}}$$

When S.D. = STANDARD DEVIATION

x_i = INFORMATION OF EACH QUANTITY

f = FREQUENCY

n = NUMBER OF SAMPLE SURVEY

Evaluation by bringing information surveyed from opinions of the professionals concerning priority of elements and processes of the KMS, which is in 5 levels, and presents the information analysis that the researchers indicate standard of how to interpret the meaning of survey like this (8);

Table 1 Standards showing how to interpret the meaning of survey

Average Points	Priority of Elements and Processes of Knowledge Management System
4.50-5.00	Highest
3.50-4.49	High
2.50-3.49	Neutral
1.50-2.49	Less
1.00-1.49	Least

Primary Agreement

1. Professionals are executives in high level of management in departments that serve the information technology services in universities of both government and individual.

2. Collecting information in different date, time and place affect nothing to the result of research.

Definition of Vocabulary

1. Knowledge Management System (KMS) means collecting, system management, storage and accessibility to the information to bring about knowledge by using information technology and computer to keep storage systematically. Furthermore, share knowledge which advice by professionals who are able to interpret and apply knowledge into building innovation (10).

2. Elements of the Knowledge Management System (KMS) means components or mixing, expressing opinions by professionals and academicians in various dimensions regarding important elements of the knowledge management system (11).

3. Process of Knowledge Management System means sub-process that connecting each other's to access and use knowledge from its source and make it move then bring about development of innovation (12).

Results and Discussions

From collecting elements of the Knowledge Management System of 16 professionals and popular organizations from both local and overseas, comparing be consequence according years of publishing that information by overall image like this.

Table 2 Shows comparison elements of the KMS which is collecting from the researches

Professionals/Organizations / Elements	APQC(1995)	Lee(1997	Carla O' Dell(1998)	Xerox(1991)	Siemens(2001)	SPRING(2001)	Siriraj(2001)	Lotus(2002)	Danai(2002)	True (2003)	Awad,E.M.&Ghaziri	SCS(2004)	Vijarn (2004)	Ben(2005)	Calabrese and Orlando	Sivanit (2008)	
Information Technology and Communication	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	16
Procedure of knowledge Management	✓			✓	✓	✓	✓			✓	✓	✓	✓	✓		✓	12
Evaluation	✓		✓	✓	✓	✓	✓			✓						✓	8
Source of knowledge	✓	✓			✓			✓				✓				✓	7
Executors								✓		✓	✓	✓	✓	✓		✓	7
Organizational Culture	✓	✓	✓				✓		✓						✓		6
Leadership and strategy	✓				✓	✓	✓		✓						✓		6
Training				✓	✓		✓			✓					✓		5
Management and behavior				✓						✓							3
Prizing				✓			✓			✓							3
Structure of organization			✓														1
Vision									✓								1

Studying from point of view of the professionals and popular organizations in KMS and take them into priority, it is found that the first 3 elements using in the knowledge Management System are; ICT 21%, process of KMS 16% and evaluation 11%, consequently.

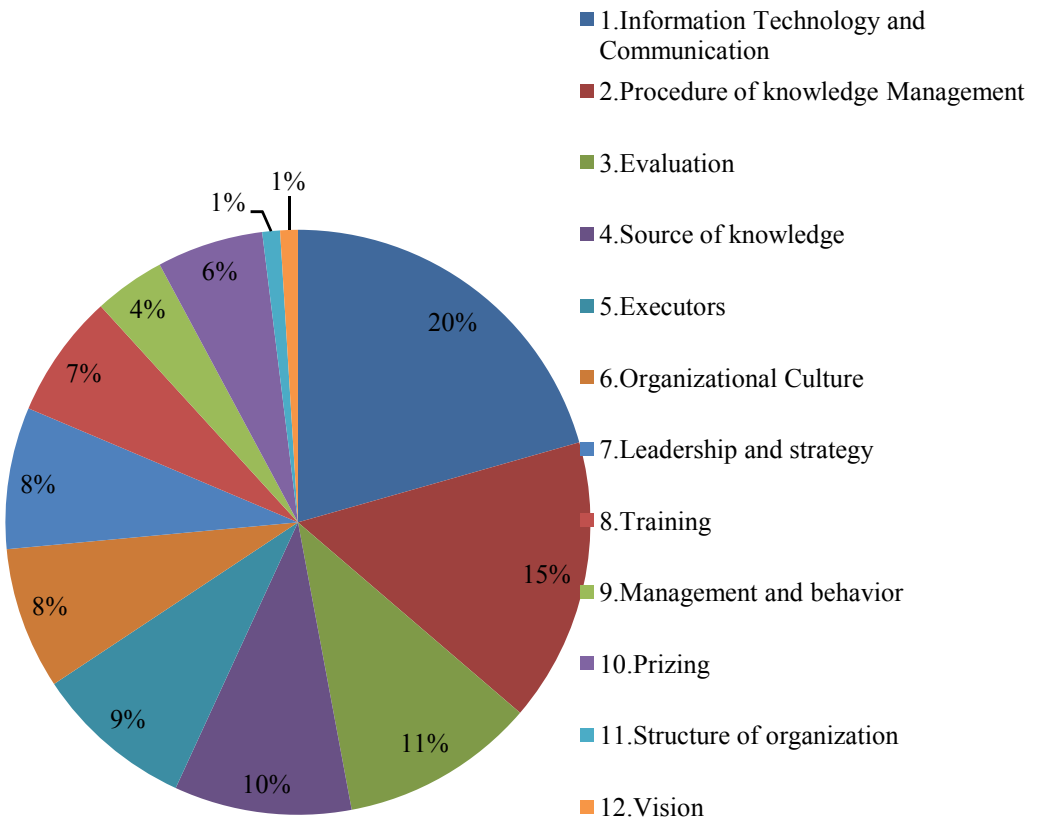


Chart 1 Showing percentage of elements of the KM

It is noticeable that all the professionals and popular organizations are using the ICT, which is 21% of all elements. It shows that the information technology and communication are primary main factors to development the Knowledge Management System.

Other elements which are high using are; process of knowledge management system 16%, Evaluation 11%, Source of knowledge 10%, Executors 9%, Organizational culture 8% and Strategic leadership 8%.

Less using elements are; training 7%, management and behavior 4%, prize 4%, structure of organization 1% and vision 1% as shown in the chart 1.

Researchers brought 16 elements in Knowledge Management System collecting from both local and overseas comparing to choose totally 12 elements for using then choose the 7 most using elements and let the professionals give opinions about the importance of each element in order to confirm the point of view, having a result as follows.

Table 3 Showing levels of opinions of the professionals regarding elements of the knowledge management system

Elements of KM	Levels of Opinions	
	$\bar{x}$	S.D.
Leadership and Strategy	4.88	0.35
Process of Knowledge Management	4.75	0.46
Executors	4.63	0.52
Information Technology and Communication	4.50	0.53
Source of Knowledge	4.38	0.74
Organizational Culture	4.13	0.64
Evaluation	3.75	0.71

From the analysis of all 9 professionals on their levels of opinions in table 3, found that priority of the elements and process of the KMS got points from the professionals during 3.75-4.88 with following details.

1. Leadership and Strategy has average point ($\bar{x}$) at 4.88% which is highest important in the Knowledge Management System.

2. Process of Knowledge Management System has average point ($\bar{x}$) at 4.75% which is highest important in the Knowledge Management System.

3. Executors have average point ($\bar{x}$) at 4.63% which is highest important in the Knowledge Management System.

4. Information Technology and Communication have average point ($\bar{x}$) at 4.50% % which is highest important in the Knowledge Management System.

5. Source of knowledge has average point ($\bar{x}$) at 4.38% which is high important in the Knowledge Management System.

6. Organizational Culture has average point ($\bar{x}$) at 4.13 which is high important in the Knowledge Management System.

7. Evaluation has average point ($\bar{x}$) at 3.75% which is high important in the Knowledge Management System.

Procedure of Knowledge Management

Knowledge to be using in order to be successful and meet the target, it is necessary to have process or procedure to manage systematically, which consists with sub-procedures in accordant to each other. Therefore, it can use knowledge from various sources and develop to be innovations (14). The professionals and famous organizations provide procedure of knowledge management which is different knowledge, comparing in the table 4.

Table 4 Comparison of procedures of the knowledge management

No	Procedure	Wiig	Marquardt	KPMG	Liebowitz	Trapp	Goh	Probst and Other	Vail	Kucza	Turlan and Other	Awad, E.M. &	Kosd	Phiroj	True	Office of National	Twarna	Chalee and
1	Knowledge Using	✓	✓	✓	✓	✓	✓	✓	✓		✓			✓		✓	✓	✓
2	Knowledge Building	✓	✓	✓	✓		✓		✓	✓	✓		✓		✓		✓	✓
3	Knowledge Sharing & exchanging	✓	✓		✓	✓		✓	✓	✓					✓	✓	✓	✓
4	Knowledge Indication				✓	✓		✓		✓		✓			✓	✓	✓	✓
5	Knowledge Seeking		✓			✓	✓	✓	✓			✓	✓			✓		✓
6	Storage and retrieval of knowledge		✓		✓				✓	✓	✓		✓			✓		✓
7	Conveyance and dissemination of knowledge	✓		✓		✓		✓			✓		✓	✓				
8	Knowledge Development				✓	✓		✓	✓				✓					
9	Organization and indication of knowledge								✓	✓		✓				✓		
10	Knowledge Collection				✓		✓			✓					✓			
11	Knowledge Selection				✓						✓	✓						
12	Knowledge Evaluation					✓					✓							
13	Knowledge Improvement					✓	✓								✓			
14	Knowledge Compilation								✓							✓		
15	Building groups of cooperation													✓				
16	Strategy											✓		✓				
17	Follow Up/Checking										✓	✓						
18	Knowledge Control					✓												
19	Target of knowledge					✓												
20	Structure of a KMS team											✓						
21	Technology Indication											✓						

From using procedures of the KMS collecting from researches of both local and overseas, totally 18 researches, to compare due to show all the 21 procedures. And there are 8 procedures which are the most famous to be using, asking the professionals to give their opinions. Here is the result.

Table 5 Levels of opinions of the professionals regarding the knowledge management

Procedure of the KMS	Levels of Opinions	
	$\bar{x}$	S.D.
Conveyance and Dissemination of Knowledge	4.78	0.44
Knowledge Building	4.67	0.50
Knowledge Sharing & Exchanging	4.67	0.50
Knowledge Development	4.56	0.53
Knowledge Using	4.56	0.53
Knowledge Seeking	4.22	0.44
Knowledge Indication	4.11	0.33
Storage and Retrieval of Knowledge	4.11	0.78

From the analysis of the professionals on the 8 steps of KMS, the result is shown in table 4 can be concluded like this.

1. Conveyance and Dissemination of Knowledgehas average point ($\bar{x}$) at 4.78% which is highest important in the Knowledge Management System.

2. Knowledge Buildinghas average point ($\bar{x}$) at 4.67% which is highest important in the Knowledge Management System.

3. Knowledge Sharing& Exchanginghas average point ($\bar{x}$) at 4.67% which is highest important in the Knowledge Management System.

4. Knowledge Developmenthas average point ($\bar{x}$) at 4.56% which is highest important in the Knowledge Management System.

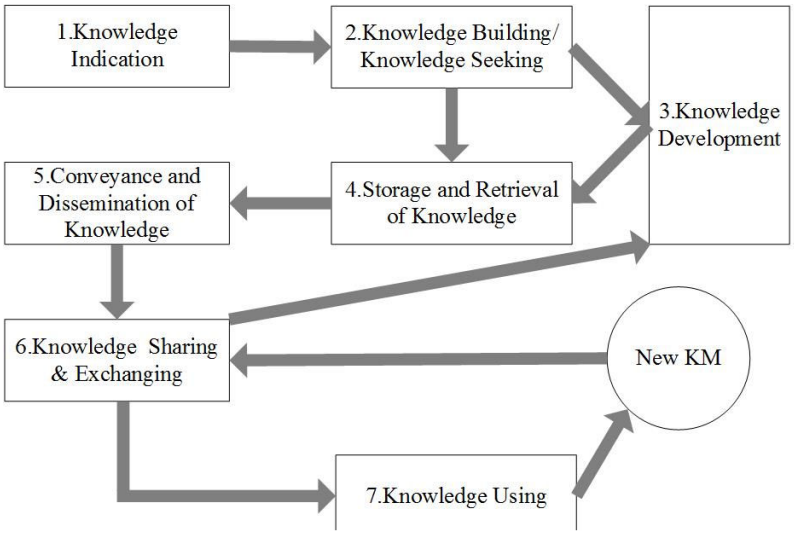
5. Knowledge Usinghas average point ($\bar{x}$) at 4.56% which is highest important in the Knowledge Management System.

6. Knowledge Seekinghas average point ($\bar{x}$) at 4.22% which is high important in the Knowledge Management System.

7. Knowledge Indicationhas average point ($\bar{x}$) at 4.11 which is high important in the Knowledge Management System.

7. Storage and Retrieval of Knowledgehas average point ($\bar{x}$) at 4.11 which is high important in the Knowledge Management System.

The conventional knowledge management uses a concept of "Knowledge Cyclic" to share knowledge. This model share knowledge that support the information technology services at higher education.



Picture 1 Knowledge management model for the information technology services at higher education.

Conclusion

If consider from opinions of all the 9 professionals, we found that elements and procedures of the KMS in the organizations that affect to the success of knowledge management at higher education has average points during 4.88-4.50 which is the most important. There are totally 4 most important elements; leadership and strategy, procedure of knowledge management, executors and information technology & communication.

Regarding the high rank of importance, there are 5 suitable procedures including; conveyance & dissemination, building knowledge, sharing & exchanging, development and using consequently. They have average points during 4.78-4.56.

Those elements and procedures mentioned shall be using in a concrete development of knowledge management system in departments who serve concerning ICT of universities, for example, computer department, academic resources center and information technology departments or any other departments concern. Because it comes from collecting points of view of the professionals of the information technology which are the most suitable and special to the departments of information and technology services.

Knowledge management modelfor the information technology services at higher education is a combination of interaction and innovation. This model provides an environment where the system grows with the people.

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Sirindhorn Building, Rajamangala University of Technology Rattanakosin: Visual potentials and Building Space

Tanapon Worachat[1*] and Patan Yarnkoolwong[2*]

Abstract

The study has 3 objectives: 1) to study the potential for visibility and accessibility of the area of each space within the building, 2) to suggest improvements and design to create an environment that fosters an atmosphere of educational activities, 3) to increase the efficient use of space in the building, and the results can be adapted to improve other buildings .

By analyzing the potential of vision (visual field analysis) into 2 parts: 1) analysis, see the photo 2) Analysis of visual space syntax methods by using Depth map.

The use of space within the building are also areas outside the classroom performance and key officials , including the elevator hall hallhall office . Hall , classrooms L-shaped corridor (L) , etc. can be modified to have a space that promotes the learning of the residents in the field of learning disabilities . For school buildings , such as the lack of available space both outside and in the course promotes learning . Exhibition space (social activity and exhibition) space research and teaching in each class. Recreational areas, sports activities , recreation and dining area is proportional.

Keywords:Isovists, Space Syntax, Space

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Introduction

Learning environment was needed to support the work, both independently and team. The open area or glass wall use between classrooms and corridors, classrooms and recreation areas will make students and visitors who walk through to see what happens in the classroom that motivate and create an environment for the design of the interior environment for a new faculty building today. An important concept is the design building environment effect. To learning and affect with work performance. (Oakes & Lipton. 2002: 383-406).

The aim of research is to analyze the areas of visibility and accessibility of the Sirindhorn Building Floor Plan for recognizes the potential of the area to create and develop the spaces in the future.

The Sirindhorn Building divided into two parts: **The Eastern Wing**; Faculty of Architectural and Designoffice, library, computer laboratories, meeting room, storage,pantry, toilets and janitor room, etc. and **The West Wing**;Rattanakosin College for Sustainable Energy and Environment office, College of Innovation Management office, auditorium, function rooms, pantry, toilets and janitor room, etc.

The Faculty of Architecture and Design, RMUTR was established in 1996 to provide a comprehensive range of specialized degree programs in the built environment. The interdependent study program integrates the concepts of art and science as a discovery process leading to the use and development of appropriate technologies to meet the needs of Thailand's creative industries and the challenges of a dynamic 21st century global Community. Currently (2015), eight undergraduate programs are available: Architectural Technology, Construction Management, Interior Architecture, Urban Design, Industrial Product Design, Communication Design Technology, Facility Management and Digital Media Design.

Faculty of Architecture and Design has occupationin The Eastern Wing. 1st Floor hasparking and Wood Workshop, 2nd Floor has Exhibition Room and multi-purpose area (waiting and activities area), 3rd& 4thfloor has academic office and computer laboratories, 5th – 8th Floor has Lecture and Design Studio, 9th Floor has indoor recreation area. For areas in the West Wing on the 2ndfloor has the Rattanakosin College for Sustainable Energy and Environment and College of Innovation Management academic offices and classrooms,3rd Floor has auditorium and lecture rooms.

The Sirindhorn Building has 3 problems. 1) Learning activities seeing. 2) Recognition of the academic office.and 3) The potential of main areas in the building:The academic office space; the area should be control various parts, easily accessible and visible,lecture rooms and design studio;the areasshould beseen from hall,corridors and halls.

Materials and Methods

1. Theory and related works

1.1 Education Building Elements and Circulation

10 physical environments in educational building should be consideration such as adequacy, suitability, safety, healthfulness, accessibility, flexibility, efficiency, economy, expansibility and appearance.

Design Guidelines for good classroom that should be consideration such as 1) should take into account the nature of the teaching methods of teaching and learning atmosphere in the objectives of the activity in the classroom. 2)Selected furniture that easy to move and allow all students to see the teacher and blackboard clearly. 3) Good sound system. 4) Good lighting system (Both natural and artificial light). 5) Good ventilation. 6) Good Visual system.

1.2 Interior Environment for Learning Space

Learning Environment are everything that surrounding the learner, both tangible and intangible, and affecting students both positive and negative effects on the efficiency and effectiveness of learning of the students.

1.3 Space Syntax

Space Syntax Theory (Hillier and julienne, 1984) is a tool for create a measure system and display the relationship between the shape and layout, or between shape and frequency in area used. (Khaisri, 2551)The areas that have visual potentials or Isovists and easy to access should be make more activities and varies of user.

Space Syntax Software, use for analysis in the area of quantitative multi-level (PelinDursun, 2007) for the study was an analysis of the area in building scale, which led the field to the views inside buildings to make a comparison on the overall system. Roaming the campus to see the chart embedded in the city prior to the study. Most research concluded in Indoors space.For the Space Syntax program selection in research, the VBA (Visual Basic for Application) on the AutoCAD application is appropriate. The Keyword in Space Syntax Software is “Areas that visible from many areas are the most Isovists areas”

2. Research Methodology

How to Conduct

1. Study the basics of building a history, purpose and goals of the land use area and so on.

2 Mapping of the area and the potential for visibility and accessibility of the area.The total area of the system by a computer program Depth map.

Tools used for data collection.

The researcher used to collect the following information.

1. The observation space.

2 Layout of buildings and the use of space.

3. Photography

Data Collection

The research is conducted using data collected by observation and photography vistas of space within each area.

Data Analysis

The researcher analyzed using a computer program Depth Map and compared with photographs and the use of space.

Results and Discussions

The objectives of Sirindhorn Building, Rajamangala University of Technology Rattanakosin: Visual potentials and Building Space was as follows:

1) To study the potential of space, visibility and access to each area within the building.

2) To suggest improvements and design. To the environment promoted an atmosphere of educational activities

3) To increase the efficient use of space in the building. The results can be used to improve other buildings.

The vision potential analysis (visual field analysis) had two parts: 1) the photo analysis, 2) Space Syntax visual analysis methods by using Depth map.

Part :The photo analysis

Because Sirindhorn Building Redevelopment of the area has changed over time, so it is a separate analysis. The use of the building built in 2555 and improving the use of space in the current year 2557, the authors have chosen to analyze the potential of living space in its current form because I can see the problem from its use. Actually better Also in 2012, the use of different areas within the building prepared for the use of space in the future anyway.

Now, staffs and students of the Faculty of Architecture and Design in The Sirindhorn Building use the fire escape for the main corridor because of the convenience fromparking area on 1st Floor, and the Main Entrance on 2nd Floor for visitors and students.

TheSirindhorn Building thatinclude;

1stFloor has the indoor parking,wood workshop, toilets and electrical system service area. (Pictures as shown in the Figure 1)

Figure 1 Indoor parking and fire escape on 1st Floor

2ndFloor has a multi-purpose activity area (Pictures as shown in the Figure 2),exhibition room, coffee shop (Pictures as shown in the Figure 3)stationery and Rattanakosin College for Sustainable Energy and Environment office, College of Innovation Management office. (Pictures as shown in the Figure 3)

Figure 2 Multi-purpose activities area on 2nd Floor

Figure 3coffee shop and College of Innovation Management office on 2nd Floor

3rdFloor has Faculty of Architecture and Design academic staff office (Administration office, 3 Department offices) and computer laboratory. (Pictures as shown in the Figure 4)

Figure 4 Faculty of Architecture and Design academic staff office on 3rd Floor

4thFloor has 4 Department offices and computer laboratories and 3 computer laboratories (Pictures as shown in the Figure 5)

Figure 5 Department offices and computer laboratories on 4rd Floor

5thFloor has2 lecture rooms and 3 design studios. (Pictures as shown in the Figure 6)

Figure 6 Lecture rooms and design studios on 5rd Floor

6th - 8thFloor, each floorhas 2 lecture rooms 4 group study rooms and 3 design studios. (Pictures as shown in the Figure 7)

Figure 7 Lecture rooms, group study rooms and design studios on 6th - 8th Floor

9thFloor hasindoor recreation area.

Part 2:Space Syntax visual analysis methods by using Depth map

The area analysis paradigm (Isovists) The Sirindhornbuilding display Visibility Graph program (Depth Map) the extent of the issues.

Case 1

The analysis requires that doors and openings to allow traffic through them only. They show the connectivity of the landscape area and the ability to reach and visibility.

Case 2

The analysis requires that the door openings and windows. They show the connectivity of the landscape area and the ability to see only.

Visibility Graph shows the potential of visibility and access to different areas of the descending **red** areas show the areas that are visible and easily accessible from all areas within the layers and**blue** areas could visible and accessible from all areas. However, such programs have some sort of color vision easiest to most difficult to see the colors;**red**, **orange**, **yellow**, **green**, **blue** and so on. (Pictures as shown in the Figure 8-14)

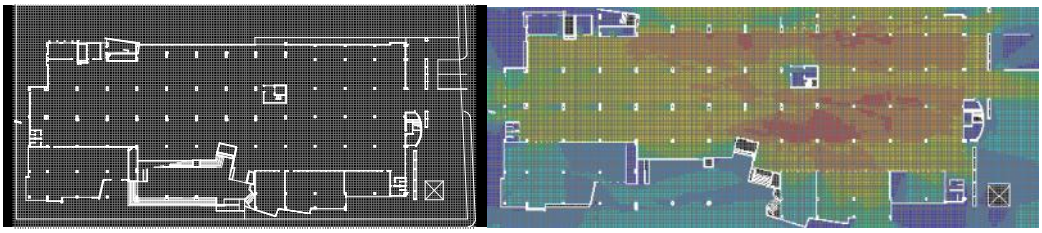

Fig.8. 1stFL. Visual potentials and Building Space Use (Case 1 left and Case 2 shown in right side)

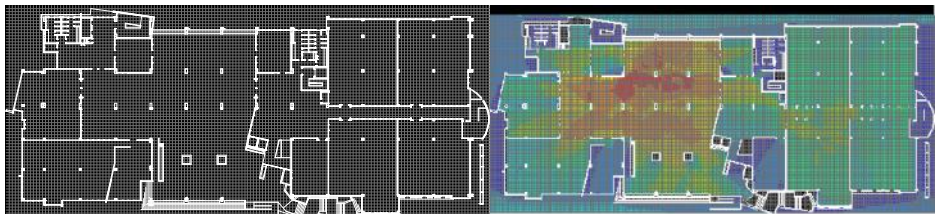

Fig.9. 2nd FL. Visual potentials and Building Space Use(Case 1 left and Case 2 shown in right side)

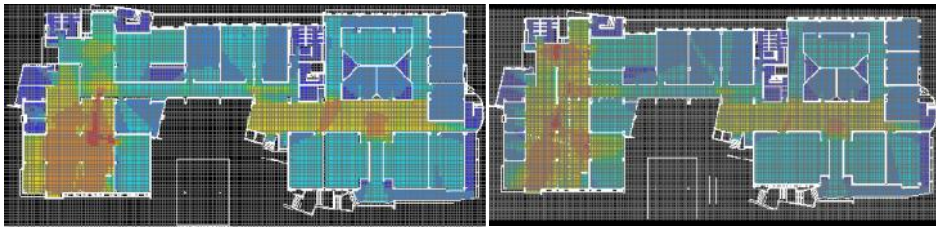

Fig.10. 3rd FL. Visual potentials and Building Space Use(Case 1 left and Case 2 shown in right side)

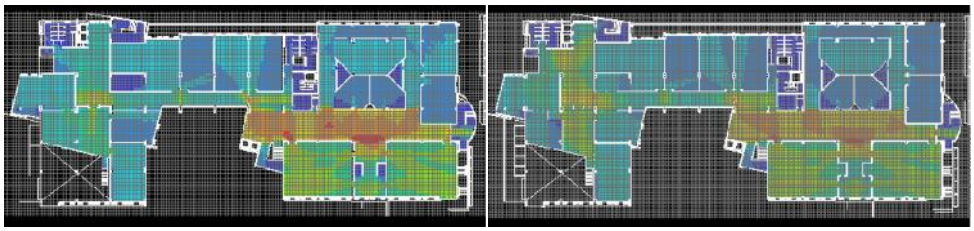

Fig.11. 4th FL. Visual potentials and Building Space Use(Case 1 left and Case 2 shown in right side)

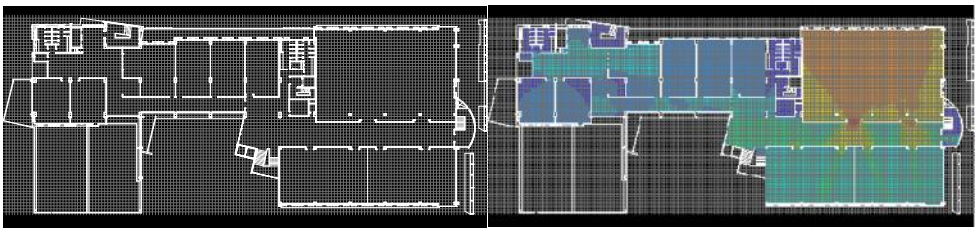

Fig.12. 5th FL. Visual potentials and Building Space Use(Case 1 left and Case 2 shown in right side)

Fig.13. 6th-8th FL. Visual potentials and Building Space Use(Case 1 left and Case 2 shown in right side)

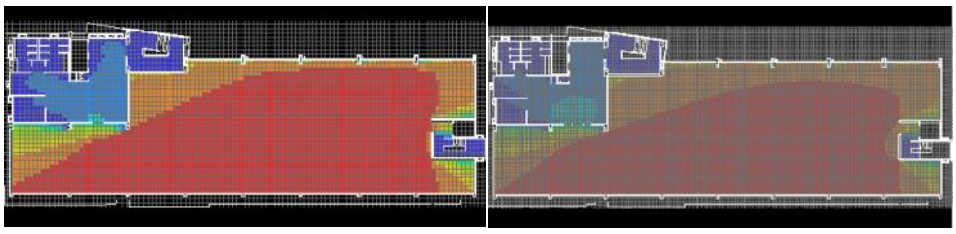

Fig.14. 9th FL. Visual potentials and Building Space Use(Case 1 left and Case 2 shown in right side)

The results of the analysis tools used by the program areas of space syntax Depth map to see the Isovist different in each area by dividing the area of each floor and to compare the use of a variety of building users. Potential of the area depends on the level of the paradigm and the manifold's benefits good or bad is the paradigm. It allows users to realize the building. Shared social space Proper location of the release area is proportional as well as the level of security. To the growth of learning and to optimize the use of space within the building is the same.

Made aware of chart Position or area inside the building is a significant difference. Both of which can be seen and accessed easily and are hard to see and difficult to access. A physical environment that is likely to cause a provocation. That cause human behavior to cause the strong properties such as sophistication, which are ambiguous things. These can affect learning, remembering, thinking affect the learning behavior. The learning process is important in the environment of buildings, such as the placement of the banner that users can easily visible. The areas of teaching, guest can see the process of the work. And users in the room can see outside to the relaxed environment. Improvement Plan area is visually spots to secure the more active. To select the location of the planned area for event guests can see and engage with the design environment to learn new ways to support the skills of the 21st century. Building design must consider the benefits before the new format that supports collaborative learning that is involved. Problem solving and communication

Conclusion

The results of such analysis can answer the following research questions

1) How is the visual potentials and building spaces?

From the Sirindhorn Building by Space Syntax analysis found to have improved a great field vision to become the preferred paradigm that bad. Because users demand it, such as shut the glass wall to close the view from the corridor to privacy, and concentrate on work, etc. However, this research has uncovered area was observed in the hall corridor. In each class, such as

1st Floor with good vision should be to utilize a variety of areas, parking areas, security guardsobservations area.

2nd Floor with good field vision and has multi-level benefits such as; activities area, multipurpose area, recreation, exhibition area, meeting area and outdoor learning area.

3rd - 5th Floor looks similar setting. The Corridor within the building has good vision and need more information area and multipurpose area to support.

6th -8th Floor looks similar setting.Elevators hall has good vision but the paradigm of the corridor area is looking compressors and compressed within the room. The need to consider such activities would interfere with teaching and learning within the room or not.

2) The Purpose for educational activities support in the future.

The analysis found that the used of space within the building are also areas outside the classroom performance and key officials, including the elevator hall, office hall, classrooms hall and L-shaped corridor (L) can be modified so as to supportmany fields of learning. For school buildings, such as the lack of available space both outside and in the course promotes learning. Exhibition space (social activity and exhibition) space research and teaching in each class. Recreational areas of sport, recreational and eating area is proportional.

Recommendations for research

In this research didn't analysis in 6 areas that shown in following.

1) The important of accessibility in vertical plane analysis.

2)The intelligibility analysis to allow visitor to understand the circulation on each floor.

3) Because of TheSirindhorn Building is a new building and uses in some part of area. So should be consideration in the future when fully usage.

4) The research is not covered by sub-level details in a closed room for the visual potentials in the interior space.

5)The research lacks analysis thoroughfare walkway and street within the University. To be informed by the views and access from streets to Sirindhorn building.

6) Though the building is a resting area for cleaning. But the behavior may actually want the rest of the children. Repository of an insufficient number of janitors, etc. It should be designed to study this area in the future.

Acknowledgement

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A Study of Association Rules for Recommender System of Computer Science Seminar Topics Using Frequent Pattern Growth (FP-Growth) Algorithm

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Abstract

Student's seminar topics selection is very difficult to decide. Various seminar topics are provided but students' interest and their ability is not match to. Moreover, the correction of information to support a selection of a seminar topic is still so hard. Nowadays, recommender system using the techniques of feature selection and association rules is provided for supporting students' decision.

The paper is to contribute a study of association rules for recommender system of computer science seminar topics in case of Computer Science Branch, Faculty of Science and Technology, Rajamangala University of Technology Thanyaburi. Student's qualification such as grade result, favorite subjects and score from questionnaire are selected to create suitable rules to recommend a list of computer science seminar topics. Programming, Computer Apply, Database System and Network System are computer science seminar topics collected in this domain. The research is to compare Apriori and Frequent Pattern Growth (FP-Growth) algorithms to create related data and list to users. The experimental result is shown that the confidence value of FP-Growth algorithmgive 80.30% which is higher than the confidence value of Apriori algorithm.

Keywords : Apriori algorithm, FP-Growth algorithm, association rule, recommender system

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Introduction

For many years, a Seminar subject of Computer Science Branch, Faculty of Science and Technology, Rajamangala University of Technology Thanyaburi has been registered by students who have to do presentations and papers for publication. An analysis of experts and lecturers of the faculty recommend that the topic of each student does not suit enough for himself/herself. He/she cannot explain his/her selected topic to lecturers clearly because of lack understanding. The cause of the problem is, the student selects a seminar topic with factors such as popular topic, easy topic, and friend's idea which do not come from his/her own interesting. The best way to select a topic should be his/her own idea that he/she is interested in and has enough knowledge and ability to finish the seminar project. The suitable topic for each student will lead to have efficient study.

From the previous research, Kitsana and et al. [1] proposed methodology of association rule discovery, data classification and data prediction applying to improved quality of student by proposing a system that assists students in selecting the appropriate major according to their profile and in their course register. Other research, Narongsak and Jiratta [2] provided the association rules implemented the FP-Growth algorithm to guide the higher education study. The proposed association rules are generated by using the grade point average and the point average of 7 subjects. As a result, this paper proposes the

Recommender system for students to select seminar topics using factors of knowledge, ability and their own interesting topics applying to be association rules. Section 2 introduces materials and methods, and experiment solving the problem. Section 3 describes results and discussion. Final section concludes proposed system results.

Materials and Methods

1. Theory and related works

1.1Recommender System [3] is a system to filter user's related requirement data and then suggest to the user. The highlight of recommender system is automatic information suggestion for user that is different from the information retrieval.In previous research, the recommender system is applied in many domains. Phanarut and Phonpimon [4] presented the recommender system for purchasing mobile phones using user-based collaborative filtering approach. The system concept is using the similarity of mobile phones' rating between the group of users in the system and the target user to prediction. The proposed recommender system can help users to find the details of mobile phones, the favorite and recommendation. Chamaiporn and Maleerat [5] developed the recommender systems for South National Park of Thailand tourism using Google Maps API on smart phone. The system is implemented by using google map for navigation and the collaborative filter with k-mean technique for the recommendation. Phanarut and et al. [6] are built a decision support system to choose crops and organic fertilizers suitable

for each other. The system is developed by using the k-nearest neighbor techniques of classification based on the similarity between a crops need and organic fertilizers have. This system can help user for the introduction of crops and fertilizer appropriate in good level. Teerapong [7] contributed the behavior analysis on the applying major selection and the comparison of model to forecast the numbers of new students using data mining technique. The research consists of 2 main parts. First component is the behavior analysis that is applying the K-mean technique of clustering and using the Apriori technique of association rule discovery. Last component is the comparison of two forecasting model between the constructed model using decision tree technique and the constructed model using an artificial neural network. As the result of this research, the proposed system givesthe high accuracy.

1.2Association Rule Discovery[8] is to find frequent patterns, which are patterns that occur frequently in data.There are two-step process[9] such as 1) Find all frequent itemsets: by definition, each of these itemsets will occur at least as frequently as a pre-determined minimum support count. This step is the iteratively find frequent itemsets with cardinality from 1 to k (k-itemset) known as a level-wise search. and 2) Generate strong association rules from the frequent itemsets: by definition, these rules must satisfy minimum support and minimum confidence. Association rules [10] come from frequency related pattern called frequent *pattern* and frequency relation called*association of item set* from data in transaction. The result is form of association rule pattern as show in equation 1 below.

$$\text{Item 1} \rightarrow \text{item 2} \qquad (1)$$

An association rule [11] has two parts such as an antecedent (if) and a consequent (then) as show in above equation. An antecedent is an item found in the data. A consequent is an item that is found in combination with the antecedent. Association rules are created by analyzing data for frequent if/then patterns and using the criteria *support* and *confidence* to identify the most important relationships. Support is an indication of how frequently the items appear in the database as in equation 2 below.

$$\text{Support } (X \rightarrow Y) = P(X \cup Y) \qquad (2)$$

The equation 2 means probability value ofX and Y occurrence that the value is between 0 to 1. The value nears 1 that means frequency occurrence pattern. Confidence indicates the number of times the if/then statements have been found to be true as in equation 3 below.

$$\text{Confidence } (X \rightarrow Y) = P(X \cup Y) / P(X) \qquad (3)$$

The equation 3 means probability value of X and Y occurrence depending on time series.

Inthis research, association rules are used to analyzing and predicting student behavior for recommender system of Computer Science seminar topics.

1.3Apriori algorithm concept [8] is using prior knowledge of frequent itemsets properties to prune out some dominant infrequent itemsets, and then to ignore the process ofcounting their support. The algorithm [12] is used for association rule creating and it is calculation of value the relationship occurrence between itemset in database as describe detail in topic 1.1

1.4 Frequent Pattern Growth (FP-Growth) Algorithm [13] [14]

The heart of algorithm is the usage of a special data structure named frequent-pattern tree (FP-tree), which retains the itemset association information. In practical work, the algorithm is divided into 3 steps as follows: first step is topack the input database creating an FP-tree instance to represent frequent items.

After that, the result of first step is divided into a set of conditional databases, each one associated with one frequent pattern. Final step, each such database is mined separately. In practical using this strategy, the algorithm reduces the search costs looking for short patterns recursively and then concatenating them in the long frequent patterns, offering good selectivity.

2. Experiments detail

2.1 The Data

The dataset used in the research is bachelor degree students of Computer Science Branch, Faculty of Science and Technology at Rajamangala University of Technology Thanyaburi in the academic year of 2009-2012. The total number of dataset in this research is 814records in the file format of arff. We use Weka tool [15] for generating the association rules as show in Figure 1.

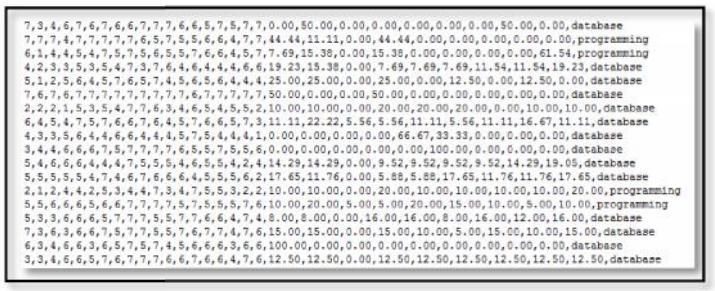

Figure 1shows dataset in the arff format file

2.2 The Experiment Design

The research compares two popular techniques to investigate student's qualification database. A first technique is Apriori. The concept is to generate itemset pattern and then to calculate the support value of database. If an itemset doesn't satisfy the minimum support threshold, then this itemset isn't frequent and if the itemset is added to the set of itemset, then this set isn't frequent either .The disadvantage of this algorithm[9] is using long time to load data from multiple database, and mining long association rule patterns needs many passes of scanning and generates lots of candidates pattern. A second technique is FP-Growth. The algorithm process is to read data and to create FP-tree then to calculate the support value fromFP-tree. This technique uses working time less than Apriori techniques.

In the research, association rule processes are described as follows:

1) Apriori techniques

- Gather student's qualification such as grade result, favorite subjects and score from questionnaire,
- Transform questionnaires data into transaction database group by time series and then saving into database,
- Analyze data to find a list of computer science seminar topics such as Programming, Computer Apply, Database System and Network System which are equal or more than 50 percent,
- Calculate the support value by counting amount of each seminar topic in percentage forming,
- Count amount of two seminar topics and amount of three seminar topic and four seminar topics,
- Seminar topic selection is equal or more than 50 percent will becalled frequent itemset,
- After previous steps finish, the frequent itemset is generated to association rules that consist of Left Hand Side (LHS) and Right Hand Side (RHS) as show in Equation 1, 2 and 3.

2) The construction of FP-Growth tree

- It starts with creation the root of the tree,
- Then, all data is scanned to sort order,
- The branch of tree is created for each student data with items having their support count,
- To facilitate tree traversal, an item header table is built so that each item points to its occurrence in the tree via a chain of node-links,
- Finally, the frequent patterns in dataset are transformed to the FP-tree.

Results and Discussions

From experiment, association rules are created by student's qualification data inWeka tool as show in Figure 2.

```
J48 pruned tree
------------------

Web_Programming <= 3: programming (6.0)
Web_Programming > 3
|   Advanced_Computer_Programming <= 5
|   |   Data_Structure_Algorithms_and_Complexity <= 6
|   |   |   Web_Programming <= 6: database (27.0/6.0)
|   |   |   Web_Programming > 6
|   |   |   |   Principle_of_Computer_Programming <= 3: database (6.0)
|   |   |   |   Principle_of_Computer_Programming > 3
|   |   |   |   |   l_network <= 21.05
|   |   |   |   |   |   Foundation_of_Programming_Languages <= 5: database (8.0/2.0)
|   |   |   |   |   |   Foundation_of_Programming_Languages > 5: programming (9.0/2.0)
|   |   |   |   |   l_network > 21.05: programming (4.0)
|   |   Data_Structure_Algorithms_and_Complexity > 6: database (5.0)
|   Advanced_Computer_Programming > 5: programming (5.0/2.0)
```

Figure 2shows the results of association rule from Weka tool

The proposed model is developed to the recommender system of seminar topics of computer science from outcome as show in Figure 2. The website is implemented in real world using for four-year students of Computer Science Branch, Faculty of Science and Technology, Rajamangala University of Technology Thanyaburi. Figure 3 shows the main page of the recommender system of seminar topics. Student's qualification such as grade result, favorite subjects and score from questionnaire are selected to create suitable rules to recommend a list of computer science seminar topics. Figure 4, 5, 6 and 7 show the process of seminar topics selection. Figure 4, the related computer science subjects are shown in questionnaire webpage. Users fill their grade data for all each subject and then they can select more than one choice in the interesting area webpage as show in Figure 5. The system can suggest the domain of relation of student profile as show in Figure 6. The users can know suitable seminar topics for them considering the summarization of questionnaire mark as show in Figure 7.

Figure 3shows the main page of recommender system for seminar topics

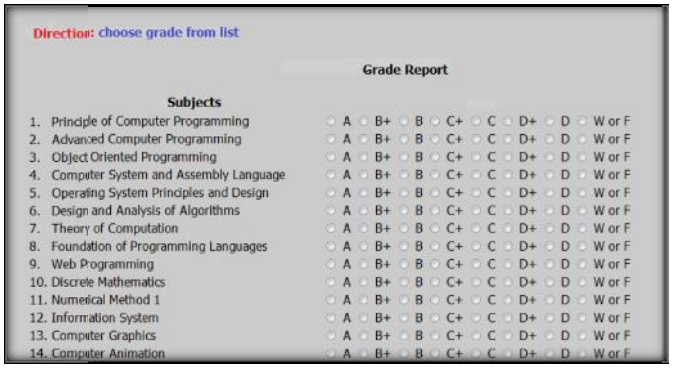

Figure 4 shows each subject grade

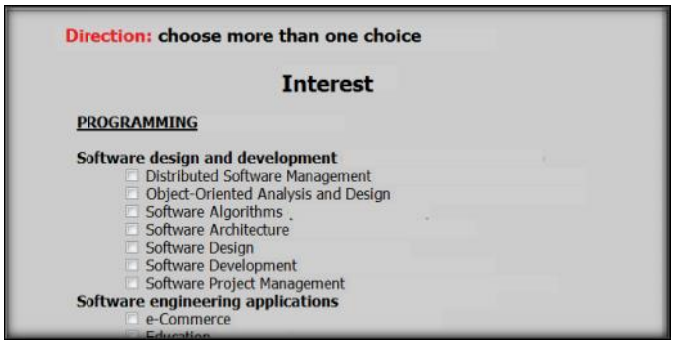

Figure 5 shows interesting areas

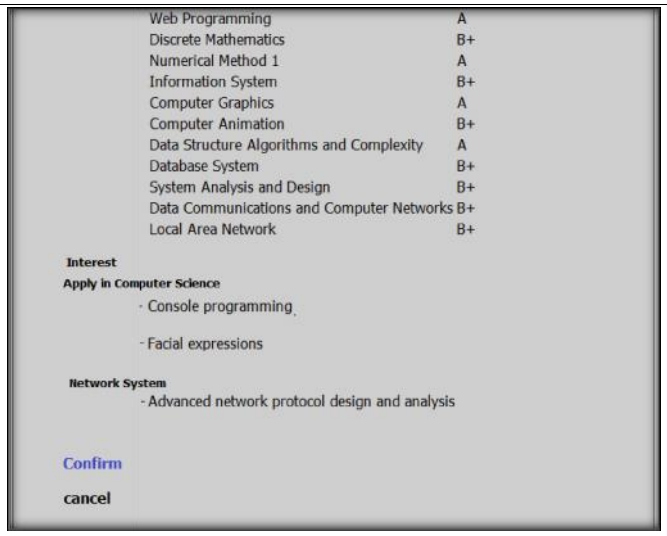

Figure 6 shows recommender areas

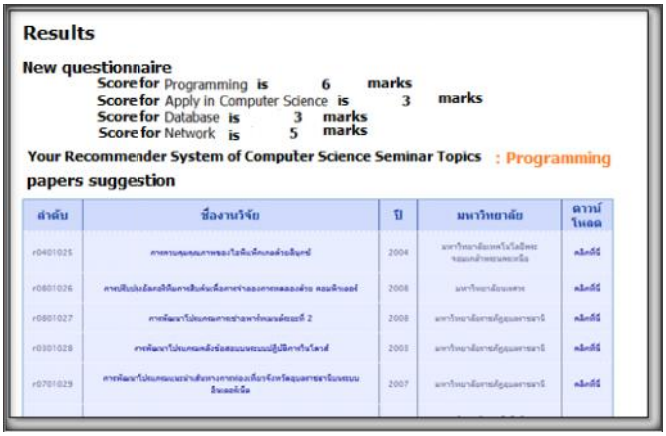

Figure 7 shows results of selection seminar topics

From seminar topics selection above, there are four seminar topics in this domain such as Programming, Computer Apply, Database System and Network System. The research is to compare Apriori and Frequent Pattern Growth (FP-Growth) algorithms to create related data and list to users. The experimental result is shown that the confidence value of FP-Growth algorithmgive 80.30% which is higher than the confidence value of Apriori algorithm as show in Table 1 below.

Table 1 Comparing two measure values between Apriori and FP-Growth algorithms

Algorithms	Support value	Confidence value
Apriori	60.49%	78.89%
Frequent Pattern Growth (FP-Growth)	66.67%	80.30%

Conclusion

This paper is to contribute a study of association rules for recommender system of computer science seminar topics in case of Computer Science Branch, Faculty of Science and Technology, Rajamangala University of Technology Thanyaburi. The website is developed in real world using for the Computer Science student. The qualification data such as grade result, favorite subjects and score from questionnaire are selected to create suitable rules to recommend a list of computer science seminar topics. There are four seminar topics in this domain such as Programming, Computer Apply, Database System and Network System. The research compares two algorithms,Apriori and Frequent Pattern Growth (FP-Growth) algorithms to create related data and a list to users. The experimental result is shown that the confidence value of FP-Growth algorithmgive 80.30% which is higher than the confidence value of Apriori algorithm. Further plan for the research, the proposed system can provide for every branch in faculty and extend to other faculties in the university.

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Factors Affecting the elderly using computer in Phupieng District, Nan Province

Suksawan Khamwong[1*] Sittichock Janratanasiri and Metta Talaluck

Abstract

The purpose of this study was to determine factors affecting the elderly using computer in Phupieng District, Nan Province. The data collected by 150 elderly living in Phupieng District. This study was by Participatory Action Research:PAR. Data was collected by questionnaires, computer training and evaluation of computer using . Statistical data analyses were frequency, percentage, mean , standard deviation and Multiple regression Analysis. The result of this study found that there were three factors affecting the elderly using computer at significant level 0.05 with correlation from high to low respectively as follows: 1) The utilization. 2) The appropriateness of trainers. 3) The appropriateness of place and computers. The respondents suggested with frequency from high to low respectively as follows: 1) There should be ongoing computer training 2) There should be coordination with the district administration and a doctorate. Regular parish activities and provide financial support. After acquiring computer use-habits trainees found access to a world of vital information on topics such as healthy eating, avoiding drugs, the values of exercise and which medications are useful for them. In this way entire generations can became happier and healthier. It could be an economic plan for the government.

Keywords: Computer Using, Elderly Learning

Introduction

The United Nations estimates that the year 2001-2100 will be the century of the elderly. This refers to the population aged 60 years or more that is to say 10 percent of the world population. While the allocation of resources to the elderly increases. The issues both social and economic, challenge the necessity that each country must have a plan.(United Nation,2007). For Thailand, the Office for National Statistics indicates that the country has been classified as a country in the aging society, since the year 2005 , i.e. Amongst the elderly population , the country has 10.4 percent of the total population . The Office of the National Economic and Social Development Board has forecast Thailand 's demographic transition to an aging society stating that:- During the year 2009 -2028 the proportion of the population aged 60 years and over will increase from 11.1 percent to 23.5 percent . 1 in 4 of the population will be aged, thus changing the age structure in Thailand. This was mainly due to the rapid decline of fertility which caused an increase in the number and proportion of the elderly population and its impact on society and the economy. The workforce reduction of an aging population would affect the total production of the country. while the allocation of resources to the elderly increases. The impact on the management of the society that is reliant on family members increases. This phenomenon will affect the stability of economic and social development and continue in the long term. Dealing with an aging society is a challenge that all parties must work together in supporting the response of national mechanisms . That will help to develop operating procedures in elderly social achievement .

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The aging of society is elderly became familiar with computer use and the internet in their search for health and communication, despite the fact that the Phupieng older are mostly impoverished farmers.

Therefore in this study, the researcher was interested in continuing to encourage the elderly to gain knowledge in using computer to find information in the health-care and for the ageing food for the elderly and for self care for such diseases as diabetes, and high blood pressure. This search extends to entertainment to promote mental health and moods for communication

These learning modes extend even to friends in the online world, and to learn more about the need to promote lifelong learning about the aged . As a result, the elderly living with their children are happy and also a contributor to the society. This was comparable to older individuals worship and a source of knowledge that has vitality. Therefore, using the computer for learning in the elderly , as well as knowledge about art, music, language, and education about computers and the internet is so important.

Materials and Methods

1. This study focuses on the research contributions for the community. Participatory Action Research is collected field data, as are observation, inquiry and computer workshops for learning by the elderly. The group is co-process research, and provides information for the duration of the operation. The underlying data store contains information on gender, age, education, occupation and underlying computing habits.
2. The research operation was from June 2013 to September 2013. The target population of the study consisted of elderly healthy volunteers from the Phupieng District. The tools used for data collection were questionnaires and evaluation of the practical training on the use of computers for study by the elderly. This study collected information into quantitative data. The basic statistical analysis including frequency, percentage and standard deviation and Multiple Regression Analysis.

Results and Discussions

The result of this study found that there were three factors affecting the elderly using computer at significant level 0.05 with correlation from high to low respectively as follows: 1) The utilization. 2) The Appropriateness of trainers. 3) The Appropriateness of place and computers.

From basic data query turns out that the participants “Teaching the elderly for computer using in Phupieng District, Nan Province”. There are 84 females for 56 percent and 66 male for 44 percent, for the age about 45-54 years old were 55 persons for 37 percent , the age about 55-64 years old 48 persons for 32 percent , the age about 65-74 years old 31 persons for 20 percent and the age more than 74 years old 16 persons for 11 percent . The education of trainee were elementary education (Pratom 4) for 53 persons for 35.3 percent, elementary education (Pratom 6) for 42 persons for 28.0 percent , high school education amount 26 persons for 17.4 percent , primary school education for 20

persons for 13.3 percent and bachelor's degree for 9 persons for 6.0 percent. For occupation, there agriculture for 77 persons for 51.3 percent, for merchandisers for 48 persons for 32.0 percent, there are government officer amount 18 persons for 12.0 percent and others such as retire for 7 persons for 4.7 percent. The elderly have congenital disease such as:- high blood pressure for 53 persons for 36 percent and they have diabetes for 39 persons for 27.0 and frequency, percentage in using computer is shown in Table 1.

Table 1 Frequency and percentage in using computer, E-mail, Google and Facebook.

Behavior	Computer	
	frequency	percentage
Used	126	84.0
Never	24	16.0

According to multiple regression analysis, in the first stage, the researcher has adopted three variables into the multiple regression analysis with the direct method because the researcher wants to analyze all variables that can be grouped before taking them to stepwise regression. The results are as followed in Table 2.

Table 2 shows the function coefficients of all variables from direct analysis.

variables	Function Coefficients (ci)
1. Utilization	0.746
2. Appropriateness of the trainers	0.672
3. Appropriateness of places and computers	0.456

After analyzing with the direct method, the researcher brought three variables to stepwise analysis. By bringing the best variable into the equation first then the second best one was brought to the equation to improve the classification of the equation. And in the following steps, the remaining best variables were brought to the equation step by step. The results of analyzing selected variables by selecting the variables that can be classified while still be in that group, it was found that there were three variables that are capable for classification which are shown in Table 3 below.

Table 3 summarizing the variables that are capable for classification.

variables	Wilk's Lambda
1. Utilization	0.028**
2. Appropriateness of the trainers	0.027**
3. Appropriateness of places and computers	0.023**

**P<0.05

Table 3 shows that when the only one utilization variable was analyzed in the first classification, the Lambda was 0.028 which means only one utilization variable could explain the variability of the group for 97.2 percent since the Lambda was nearly zero compared to the maximum - minimum value which is 1:00 and 0:00. So there was still discrimination power remaining which was not classified by the utilization variable for 2.8 percent. In the second stage, when bringing the trainer variable to be analyzed, Lambda was decreased to 0.027 which means that the trainers variable could explain clearly about classification when compared to utilization variable. Taking variable to be analyzed one by one and step by step until the third stage which was a place and computer variables. It was the final analysis, Lambda decreased to 0.023 and it has statistical significance level of 0.05 (Chi-square = 438.151, degrees of freedom = 3).

The results of the stepwise analysis by Wilk's Lambda of table 3 shows that the three variables together can be used to separate the group of elderly who use computers and don't use computers. The discriminatory power was decreased from using only utilization variable to classify. It can be seen from the Lambda reduction to 0.028 in the first analysis until it decreased to 0.023 in the third step. It means that the three variables together which are utilization, the trainers and the places and the computers can describe the classification of this group for 97.2 percent.

Table 4 Standardized Canonical Discriminant Function Coefficients

variables	Function Coefficients
1. Utilization	0.605
2. Appropriateness of the trainers	0.569
3. Appropriateness of places and computers	0.421

Table 4 shows the standardized canonical discriminant function coefficients which were ascending. The standardized canonical discriminant function coefficients were the key that can be used to judge the significance of the variables. From Table 4, it can be seen that the variable that was important to classify the group membership was utilization. And the appropriateness of the trainers and the appropriateness of places and computers lecturer were important to classify the group members respectively.

Table 5 Structure Matrix shows Structure Coefficients

variables	Function Coefficients (ci)
1. Utilization	0.746
2. Appropriateness of the trainers	0.672
3. Appropriateness of places and computers	0.456

Table 5 from the analysis, it is seen that the sign of the coefficient indicates the direction of the relationship between variables with group of elderly who use computers and don't use computers. According to table 5, considering only three variables that are able to classify, it was found that there was no variable that has a negative structure coefficient. The variable has a positive coefficient structure were utilization, appropriateness of the trainers and appropriateness of places and computers

Table 6 Classification Function Coefficient

variables	Export Interest	
	Elderly who use computers	Elderly who don't use computers
1 . Utilization(x1)	49.146	19.052
2. Appropriateness of the trainers (x2)	24.415	11.680
3. Appropriateness of places and computers (x3)	14.197	7.862
Constant	-300.577	-57.067

Fisher's linear discriminant functions

In Table 6, the coefficients of the variables in the classification by the estimated value of the function to classify the group of elderly who use computers as follows,

-300.577+ 49.146 (x1)+ 24.415(x2) + 14.197(x3)

And the approximation of functions to classify the group of elderly who use computers

-57.067+ 19.052 (x1)+ 11.680 (x2) +7.862 (x3)

So Fisher's linear discriminant functions were

$\hat{D}$ = -243.51+30.09 (x1)+ 12.730 (x2) +6.330(x3)

Table 7 Mean and standard deviation of the sample of elderly people who use computers and don't use computers separated by factors.

variables	Elderly who use computers		Elderly who don't use computers	
	$\bar{x}$	S.D.	$\bar{x}$	S.D.
1. Utilization	4.53	0.30	1.75	0.22
2. Appropriateness of the trainers	3.97	0.42	2.20	0.49
3. Appropriateness of places and computers	4.00	0.66	2.29	0.31

Table 7 revealed that the elderly use computers for these following factors, utilization ($\bar{x}$ = 4.53, SD = 0.30), the appropriateness of the trainers ($\bar{x}$ = 3.97, SD = 0.42) the appropriateness of places and computers ($\bar{x}$ = 4.00, SD = 0.66). And elderly people who do not use computers for these following factors which were utilization ($\bar{x}$ = 1.75, SD = 0.22) the appropriateness of the trainers ($\bar{x}$ = 2.20, SD = 0.49) the appropriateness of places and computers ($\bar{x}$ = 2.29, SD = 0.31).

1) The Utilization is the first factors affecting the elderly using computer with the Standardized Canonical Discriminant Function Coefficients level 0.746. They can explain by the elderly though computer using is importance for communication, serving internet and for entertainment. Participants are aware that they wanted to have more knowledge that can be useful in everyday life. This is consistent with the model of Suteera Jamlonsupalak. The training Manager, who said: "Teaching the elderly should be done since the being use the simplest language." The majority of elderly who come to learn to use the internet often check an electronic mail sent to themselves or access the internet for searching for information, cookbook, use Microsoft word or read the daily news. Even though this is the 3rd training , and there is a membership fee and tuition fee and other activities. But the amount of member are still full and the elderly tend to renew their membership. To repeat their studying, and to meet friends of the same age . We have members who are aged up to 87 years. Most of the students are seniors , such as those who previously were businessmen or public servants, who have good knowledge of English, and have children who use the internet at home. Air Vice Marshal Prasan Daranon, Former director of the Bhumibol hospital, our new member said, using the Internet to find information to a site of interest , such as golf, business, medical textiles. And Narong said that having children should never be interfered with internet monitoring or periods regarding the privacy; if they have access to inappropriate sites, it must be a judgment of the individual. But learning to use the Internet requires a lot more talk in the family. He can talk on the same subject, so there is no gap. As this study showed, the participants were aged greater than 75 years and had retired to join this project because that project was beneficial to

themselves. Even though some people are farmers and have low education. They still think that It is interesting to study to use computers for the elderly.

2) The Appropriateness of the trainers is the second factors affecting the elderly using computer with the Standardized Canonical Discriminant Function Coefficients level 0.569. They can explain by Politeness of lecturers, Attention of lecturers, and Ability in transferring knowledge that can be performed which corresponds to the work of Jantana Jirakan, (2002) who has studied "the satisfaction in the computer training, a case study of the elderly". This study aims to investigate the level of satisfaction in training of the elderly and studying the factors that are involved. This project have 100 samples which are the elderly participants in Batch 28, during the 4th March to 6th May 2003. At the Presidential Towers Building Bangkok by using a Multiple Choice and Rating Scale. This study reached the conclusion that the elderly are satisfied in the computer training, health economic and activity, the interpersonal relationships and the teaching activity are in high level. The factors that involved with the satisfaction are health, and interpersonal relationship.

3) The Appropriateness of places and computers is the last factors affecting the elderly using computer with the Standardized Canonical Discriminant Function Coefficients level 0.456. They can explain by this project was set in a timely manner and appropriate location. They have sufficient number of computers and fast internet connection and good processing and make the participants have the great satisfaction. Which accord to the research of Jaruwan Pimpiko and Saman Loipha (2012) which is about "The use and the need of information and communication of the elderly in Khon Kaen Municipality area". This research aims to study the problem, the ability to use and the need of information technology and communication including opinion about the role and importance of technology and the communication among elderly in Khon Kaen Municipality area. The data were collected by interview from 180 elderly. The result is most of the elderly don't used computers and internet because they think it's not important, they don't know how to use and don't have computers. However, they think computer are important in this modern time. For elderly who use computers and internet, most of them use it for work and entertainment respectively and use it at home, 2-3 days a week. The ability in information technology and communication, it was found that the elderly can be able to operate computer program especially typing program in medium level, the ability in using internet especially search engine and E-mail in low level. The elderly want Khon Kaen Municipality to set up more place for using computers and need to be trained in using computer and internet in high level

Conclusion

The result of this study found that three factors affecting the elderly using computer at significant level 0.05 with correlation from high to low respectively as follows: 1) The utilization. 2) The appropriateness of trainers. 3) The appropriateness of place and computers. The other suggestions and comments were there should be ongoing training and should be co-ordinated with the Sub Administration Organization and Sub-district Non-formal and Informal Education Centre for further activities and the budget. Conditions of the successfulness the use computer in the elderly should be (1) supported by Sub-district Non-formal and Informal Education Centre. (2) Health volunteers should be involved in providing health checks and data comparisons between before and after participating practices using computers for the elderly. How can they have better health?

After acquiring computer use-habits trainees found access to a world of vital information on topics such as healthy eating, avoiding drugs, the values of exercise and which medications are useful to them.

Acknowledgement

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Developing Executive Information System (EIS), a Group of Agricultural Cooperatives: a Case Study of Agricultural Cooperatives in Songkhla

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Abstract

This research aimed 1) to develop the model of information system, 2) to develop the executive information system (EIS) in a group of agricultural cooperatives: a case study of agricultural cooperatives in Songkhla, for assisting the corporative manger to use the data in considering the tasks operation, and 3) to assess the approval of using system. The subjects were the corporative mangers and the plan and operation officers of 6 branches include 18 people. The system was designed by using theSystem Development Life Cycle (SDLC) process.The instruments used in this research were the information system model, the executive information system and the information system approval questionnaire. The data were analyzed by using the means value and standard division.

The results showed that 1) the information system model were composed of 4 parts; users, database, data processing and output system, 2) the developed information system was invented as same as the model. For users, it was divided into the executive information system which composed of 7 categories for accessing the data in table and graphic form, and the official information system which composed of11 categories accompanied with the data inserting system 3) the users' approval of the developed information system at a high level.

Keywords: Executive Information System (EIS), SDLC, table form, graphic form

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Introduction

Nowadays advances in computer and network systems have developed rapidly. People are able to communicate quickly and work simpler and faster as well. The Internet users have increased dramatically in popularity. Current workers use a system of information via the internet is faster.

Information system is a set of elements that act data gathering, processing, storage and dissemination to support the decision making and controlling in organizations. The operating system in the organization composed of Input processing and output. The system might be reflected back the feedback to evaluate and improve data import. Information systems can be classified as follows. [1]

Information system for Operational-level systems isTransaction Processing System (TPS) support the work of the operating segments based to assist in daily operations and control items such as data control and sales materials.

Figure 1A four level pyramid model of different levels of hierarchy in an organization based on the different types of information systems

Information system for Knowledge-level systemsisKnowledge Work System (KWS) andOffice Systems, a system that supports the workers who are normally working on data and help to bring new knowledge to use and control the flow of documents.

Information system for Management-level systems isManagement Information System (MIS) andDecision Support Systems (DSS) which help investigate, monitor, and decision making and administer in the upper management level.

Information system for Strategic-level system isExecutive Support System (ESS) orExecutive Information System (EIS) for the highest executive level which support long-term planning, presents the relationship between the internal and external environment in order to predict future events.

Executive Information Systems or EIS is a system that supports senior executives to simpler work on the organization strategies such as goal setting, planning, decision making, predicting future situation and being able to access to monitoring the effectiveness of the organization itself. [2] When mentioning agricultural corps, normally their members are farmers regarded the majority of our country population. The principle of an agricultural corps indicated that it is belong to its members, operated by them for the benefits of all members. [3] From the interview with the agricultural corps administrators found that there is no EIS to manage the farmer corps. The system is managed by documentation only, therefore, the statistical data obtain takes time and need much related documents and staff to work on. Comparing with EIS, it is able to provide such data and summarization faster than the former system whichless documentation and fewer staff required.

The researcher team has developed EIS for the senior executives in the agricultural corps through web application which can be accessed anywhere andanytime where internet is available. Moreover, EIS offers reports in the form of table and graph to possibly simplify the data comparison making in each categorymonthly or annually. This enables the crops administrators to simpler decision making and planning.

This research aimed to develop EIS for the senior administrators in agricultural crops, a case study in Songkhla province. The executive of agricultural cooperatives are able to use this information

technology indecision making, planning and predicting the future events. In section 2 introduces Materials and Methods. This part presents a research plan which consists of information system design, DFD design, ER Diagram design and User Interface design, populations and samples, research instruments, instruments design, data collection and data analysis. Section 3 figures out Results and Discussion. This part showed the results of the model and the system of information verification system, the example of information verification system for the senior executive cooperatives, the system training to the new users. Finally, in Section 4 concludes the summary of the executive information system development.

Materials and Methods

1. Theory and related works

Data Flow Diagram or DFD show the way the data flows in the system [4] and how the system works. The users will learn where the data comes and goes to, where it is stored and what happen in the way of data flowing. Meanwhile, DFD will show the system overview on how the external factors flow in the system by the process of data storing, and data flowing presentation.

ER-Diagram is used in the design of database[5]. There is a way to support database design, which consists of entity (Entity) as objects or things that we are interested in the task. An attribute (Attribute) is a property of the object of interest and the relationship between information that occur in the system. There are several kinds of relationship such as one by one (One to One), one of several things (One to Many), or many-to-many things (Many to Many).

The research team has reviewed the related literature from [6] steps of EIS development for senior administrators. It was found that there are five steps of the development procedure; 1) survey on problems and needs 2) analyze the system 3) system design 4) create and develop 5) assessment in partial of IT system development.

Our team has studied on IT development from [7], [8] and found that the IT development needs to use System Development Life Cycle (SDLC) which has various forms; the basic steps include Requirements Analysis, Design, Implementation, and Maintenance. Requirements Analysis is analyzing the problems and needs for the system. Design is to design as per the problems and needs found to highly meet the needs. Implementation is to set verification system in order to check, thoroughly test the system accuracy and maintenance to improve the system according to the implementation advices.

2. Research plan

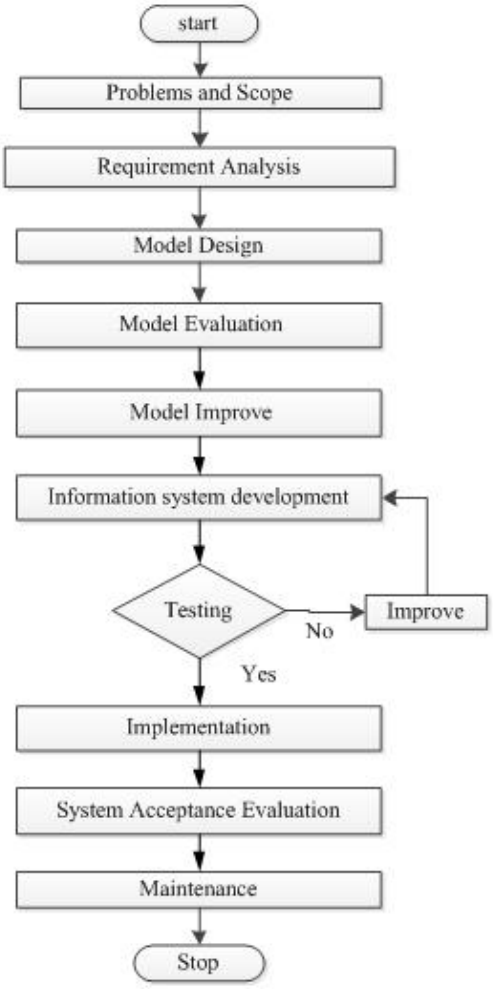


Figure 2 Research plan.

Figure 2 shows that the research plan started from investigating the problem and area of this research by interviewing with the senior administrators in agricultural crops, therefore, the EIS which has a similar system to the former one (documentation) was in need and subjected as a goal. Next the problem analyzing was performed. The model design was designed using System Development Life Cycle (SDLC) to analyze the problems and needs, then the model was created, checked, adapted then the assessment and acceptation form was designed by experts. The experts had evaluated the research tools and select the question items which had 0.6-1.0 of validity to be included in the assessment then the model acceptation of the designed model was done. The result was used in order to improve the design

model accordingly. When the model was complete, the EIS was then developed through the web application by SDLC method with the free program without copyright and fees, for instance, Hypertext Preprocessor (PHP) [9] To create the website, the MySQL [10]was used in the database part.phpMyAdmin [11] Topresent graphic used JpGraph [12] After the system was completely done, the try out and adjustment of all parts was performed until the system was ready to activate. The system training was started and finished within time allocated. The acceptation assessment had been done and the result and discussion was used in system development accordingly for the better performance of the system.

3. The design of the EIS for agricultural crops

From the data analysis of information needs led to a model design, the first step is to design a Context Diagram, which shows the overview of the system. Then, design the data flow diagrams (Data Flow Diagram: DFD), that shows how the data flow on the system. The database is designed by using Entity Relationship Diagram (ER Diagram).

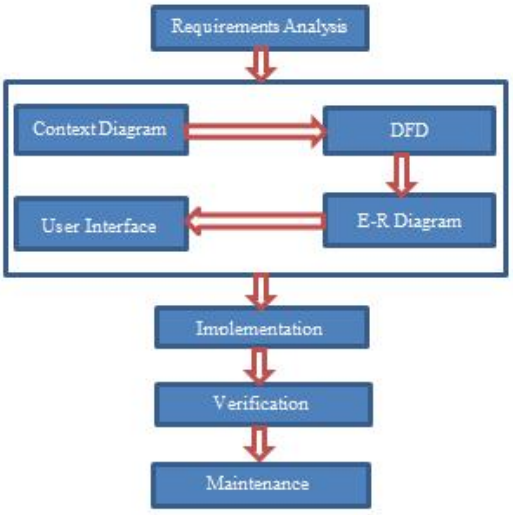


Figure 3 The design of the EIS for agricultural crops.

Finally, the researcher designs the User Interface. The model is checked by the IT experts and improved the model to the highest performance as shown in Figure 3.

3.1 The overview of EIS for agricultural crops

The overview of EIS shows how the data input to the system. A data entry officer, a data validation officer and the agricultural corps administrators are able to edit the personal data themselves. A data entry officer fill in the information in the system, then the system itself will report the records and then the users can check their information table. For a data validation officer, he/she will validate and edit the data. The system will report the record files and also the information table can be monitored by any users. At last, the agricultural corps administrators can use all of the system functions, which shown only for the executivesas shown in Figure 4.

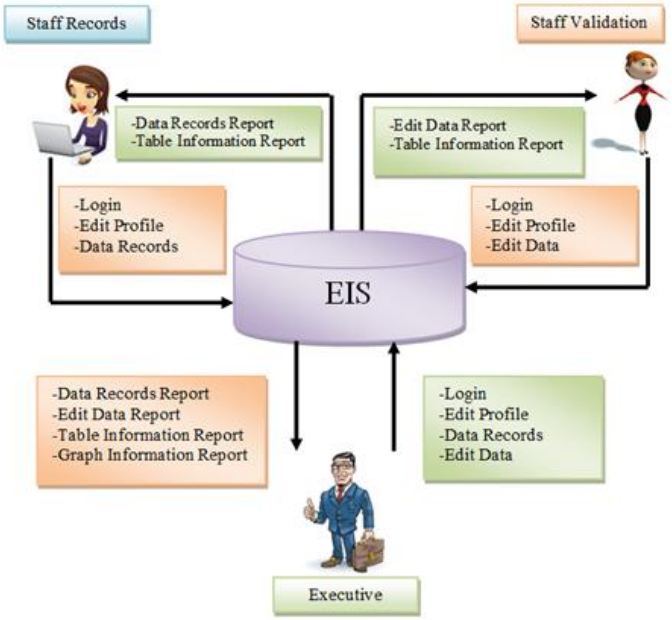


Figure 4 The overview of EIS for agricultural crops.

3.2Data Flow Diagram (DFD)

DFD Level 0 data flow as overview of EIS, but the format is different as shownin Figure 5.Figure 6 shows process 1: The user authentication system. A data entry officer, data validation officer and the agricultural corps administrators log in as the user by using their username, password, and section. In the user authentication step, the system will use the data from members' database to validate the usage and the right user.

Process 2: Profile modification. A data entry officer, data validation officer and the agricultural corps administrators can edit their personal information via profile modification step. The system will send a report to the user after they have edited their profile already.

Process 3: Password Changing. A data entry officer, data validation officer and the agricultural corps administrators can change their password in this step. The system will edit their new password and then send them a report of the changed password.

Process 4: Information adding. A data entry officer, data validation officer and the agricultural corps administrators can input the administration report into the system via information adding function, with this step, the administration report will be added into the database and the system also send a report of information adding to users.

Process 5: Information editing. A data entry officer, data validation officer and the agricultural corps administrators can check the administration paper report with the report in the system and can edit the information in the system in this step.

Process 6: Table Information. A data entry officer and a data validation officer can view their table information only. However, the agricultural corps administrators can view all of the table information sections.

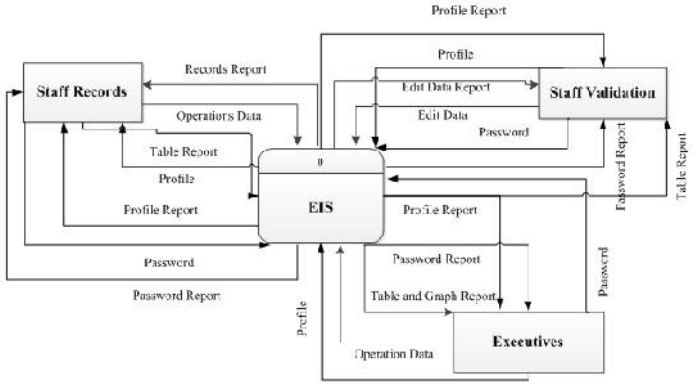


Figure 5DFDLevel 0.

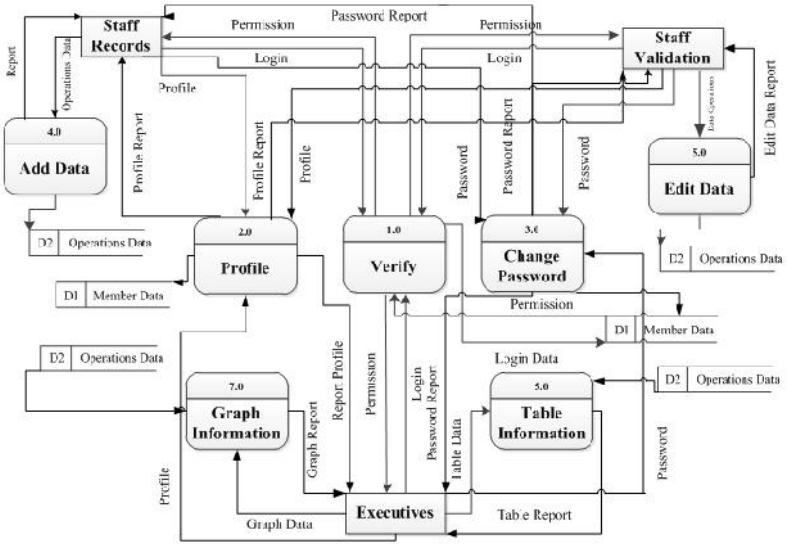


Figure 6DFD Level 1.

Process 7: Graph Information. Only the agricultural corps administrators have a right to view the graph information. This process will bring the information from database and present the graph to users.

3.3The design of database by using ER-Diagram

The operation data of agricultural corps are as follows,

1. The agricultural corps has several members.
2. The agricultural corps has many plans and operations

From operation of agricultural cooperatives above, is written the ER-Diagram as below.

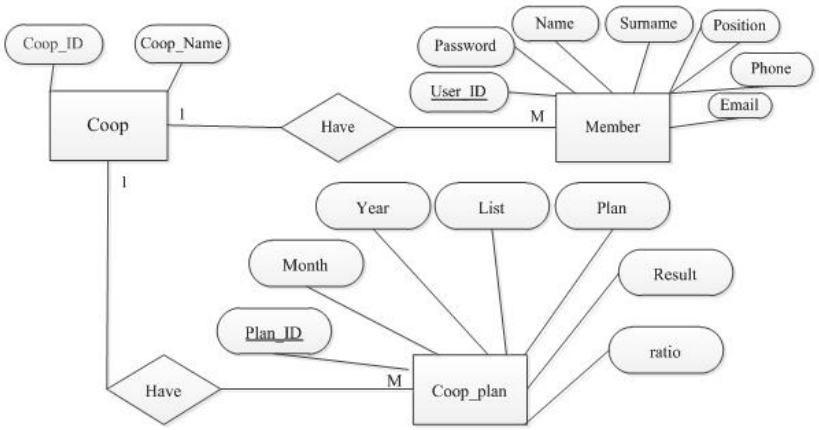


Figure 7ER-Diagram

The agricultural corps has several members.Cooperative entity has an attribute ID number of cooperative (Coop_ID) and information is both numbers and letters. Cooperative code is the primary key. And the name of the cooperative (Coop_Name) is character data. The relationship is one-to-many with registered Entity. Member entity which has attribute ID (User) information is either alphanumeric code, members will be a key. Password (Password) can be either alphanumeric or alphabets. Name (Name) will be the letter name and (Surname) as character data. The job position must be letter and the phone number is numbers. E mail address can be both of alphabet and numbers. The information can be converted from ER-Diagram into relational database table as table 1. The data converted from ER-Diagram members into relational database table as table 2

Table 1 Cooperative table

Coop_ID	Coop_Name

Table 2 Member table

User	Password	Name	Surname	Position	Phone	Coop_ID

The agricultural corps has many plans and operations. Cooperative entity has one-to-many relationship with the entity, plan and implementation which includes the following attribute ID number plan (Plan_ID) as numeric data and a main key. Month (Month) is text data and Year (Year) is numbers. A list (List) text data plan (Plan) to a number of works (Result) numeric data. Ratio plans and results (Percent) data is decimal numeric 2 places.The data converted from ER- Diagram members into relational database table as table 3.

Table 3 Cooperative plan table

Plan_ID	Month	Year	List	Plan	Result	Ratio	Coop_ID

3.4The design of user interface

As an interface with user, the researcher has designed all of the applications in the system namely Access Information system, Editing system, data table system, chart information system, profile correction, password changing and logout system, the design of the user interface system access which consisting of username, password, and sections.

Figure 8 shows the design of a system. According to the menu, the menu consists of 11 items each of the following operations, human resources, funding, loans to members, intensive to send the payment, interest on track, purchased during the year , sales during the year, repayment of loans, plan to invest in property, income, expenses, filling personnel data, which consist of the monthly and yearly activities plans.

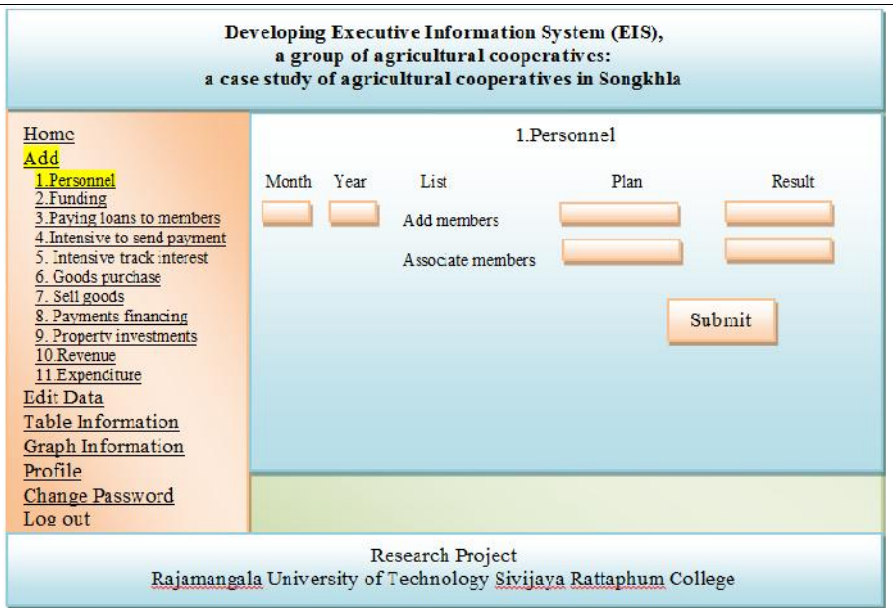


Figure 8 According system

4. Population and subjects

Population is the 19 agricultural cooperatives in Songkhla province. The sample was divided into 3 groups: group 1 Cooperative executives Group 2 information technology professionals Group 3, executives and employees using the system. By sampling specific sample group 1 and group 3 from the Cooperative that used the same pattern of operation, that is Rattaphum crops, Khunniang crops, Bangklum crops, Hatyai crops, Klong Hoi Kong crops, and Na Mhum crops. The number of samples as follows: Group 1, 12 patients, group 3: 18executives and employees group 2 : 5 information technology professionals.

5. Research Instruments

5.1Group Discussion Record Form

5.2 Evaluate Form of Information system Identity Verification for the senior executive cooperatives: A case study of farmer cooperatives in Songkhla province. There are two parts. Each part contains details as follows:Part 1: The questionnaire of information system identity verification which divided into two assessment factors totally 12 items—assessment on component of the model of 7 items and overall assessment of the model of 5 items. The identity verification is a rating scale question complied of Likert's Rating Scale dividing into 5 levels.Part 2: The opinions and suggestions

5.3 Evaluation of Information system Identity Verification for the senior executive cooperatives: A case study of farmer cooperatives in Songkhla province. There are three parts of this section. Each part has details as followsPart 1: General information of the respondents—gender, workplace and work position

Part 2: Information system identity verification divided into 4 aspects of 13 items—the convenience aspect of 3 items, the reliability aspect of 3 items, the need aspect of 4 items and the quality system design aspect of 3 items. The Information system identity verification is a rating scale question complied of Likert's Rating Scale dividing into 5 levels.Part 3: The opinions and suggestions

6. Instruments design

6.1 To design the model and the information system for the senior executive cooperatives: A case study of farmer cooperatives in Songkhla province, there is a process to design the system in accordance with the System Development Life Cycle (SDLC) as a). Requirement: Analyze the problems and needs of the system, b). Design: Design from the problem analysis and system requirements to meet the needs, c). Implementation: create the model and system, d). Verification: Test the accuracy of the detail, and e). Maintenance: develop the models and accurate monitoring.

6.2 The questionnaire of the model verification and the system verification was created according a framework and objective. The questionnaire was a 5-rating scales examined the reliability by the experts to find the index consistency between questions and objectives (IOC – item-objective congruence index) [13]

7. Data Collection

The data collection was conducted in a focus group of senior executive. To evaluate the information system verification, the researcher evaluated the group after the training was held in a computer laboratory at Rajamangala University of Technology Srivijaya, Rattaphum College. The evaluation process was examined by the experts to test the validity of the model sending via e-mail within 1 week.

8. Data Analysis

Data was analyzed with qualifying percentage (percentage), mean ($\bar{X}$) and the standard deviation (SD). Statistical method used to certify the quality of questionnaire was IOC – item-objective congruence index.

Results

1. The result analyzing the model of Executive Information System (EIS), a Group of Agricultural Cooperatives: a Case Study of Agricultural Cooperatives in Songkhla

Table 4 The result analyzing the model of EIS.

No	EIS Acceptation Statement	$\bar{x}$	S.D.	Degree
	EIS Model component evaluation			
1	EIS model overall satisfaction.	4.40	0.54	much
2	Process is easy to understand and continuous operation.	4.20	0.44	much
3	EIS model is able to understand its role and function.	4.60	0.54	very much
4	EIS model is appropriate for each element of the model system to demonstrate the reliability of the model.	4.00	0.70	much
5	The data clearly shows a continuous flow system.	4.20	0.83	much
6	Creating an accurate modeling principles and meets the needs of builders.	4.20	0.83	much
7	The model is reliable About managing data in the database. And the report was based on models.	4.40	0.54	much
	Total	**4.25**	**0.65**	**much**
	Overall Model Evaluation			
8	The information from the survey of the needs of those involved help to develop a prototype system to meet the needs of users.	4.20	0.83	much
9	Database Management Systems, data can be applied to the relevant parts.	4.00	0.70	much
10	The development of an approach to building software applications to solve problems in the management of agricultural cooperatives management.	4.40	0.54	much
11	The system can be used as part of the executive management of the agricultural cooperatives.	4.2	0.83	much
12	The user can use information technology based on roles and responsibilities.	4.60	0.54	very much
	Total	**4.28**	**0.67**	**much**
	Overall	**4.26**	**0.66**	**much**

2. The result analyzing the Executive Information System (EIS), a Group of Agricultural Cooperatives: a Case Study of Agricultural Cooperatives in Songkhla

Table 5The result analyzing the EIS.

No	EIS Acceptation Statement	$\bar{X}$	S.D.	Degree
	User friendly			
1.	The difficulty of the model used.	4.66	0.49	very much
2.	The screen is designed to be user friendly. Uncomplicated menu.	4.83	0.38	very much
3.	The system working process is quick to use.	4.75	0.45	very much
	Total	**4.75**	**0.38**	very much
	Reliability			
4.	Accuracy and completeness of thedata.	4.41	0.79	
5.	Adequate data protection.	4.75	0.45	very much
6.	Help rectifying the former system problems.	4.91	0.28	very much
	Total	**4.75**	**0.53**	very much
	Users need fulfillment			
7.	Information obtained meets the needs of users.	4.41	0.79	much
8.	Information provided by the system can be applied to decision making.	4.66	0.65	very much
9.	System capabilities can be utilized	4.75	0.62	very much
10.	Overall satisfaction	4.66	0.47	very much
	Total	**4.71**	**0.52**	very much
	Quality and design			
11.	Model format	4.50	0.52	very much
12.	Model output	4.41	0.66	much
13.	Model attractive to users	4.41	0.51	much
	Total	**4.45**	**0.50**	much
	Overall	**4.62**	**0.58**	very much

3. The Result developing the system of Information Verification for the senior executive cooperatives: A case study of farmer cooperatives in Songkhla province

Information system provides various capabilities: login system, data adding system, data editing system, data table system, data graphic system, profile modification system, password changing system and logout system.

3.1 Login System

To access the system, the users have to fill the data, password and the member section to login the system as the following picture.

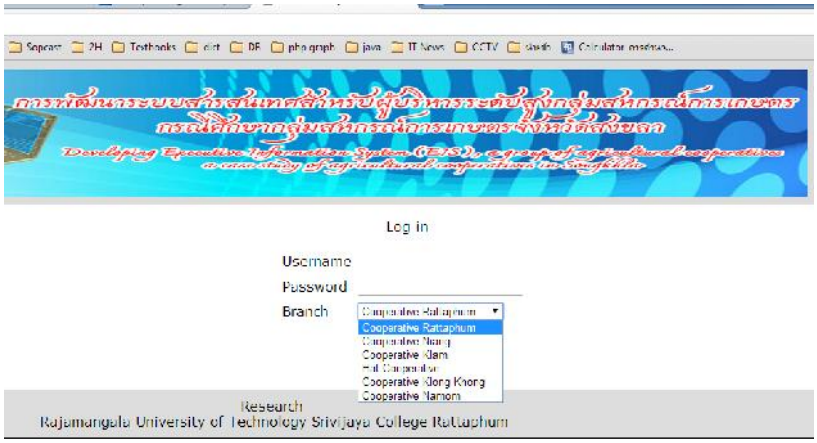


Figure 9 Login menu

3.2 Data Adding System

Data adding menu was divided into 11 parts according the report and monthly plan. The user can click the menu in order to add the required data. To add the personal data, the user can choose the month and year of data adding, and fill the data plan and work at the adding new member, and then add the required data as showing in the following figure.

Figure 10 The Use of Data Adding Menu

3.3 Table Data

To view the results and plan monthly, the user can specify the month and year. If it is the executive view, it can be seen the branch as the Figure 11. The reported table data showed in Figure 12.

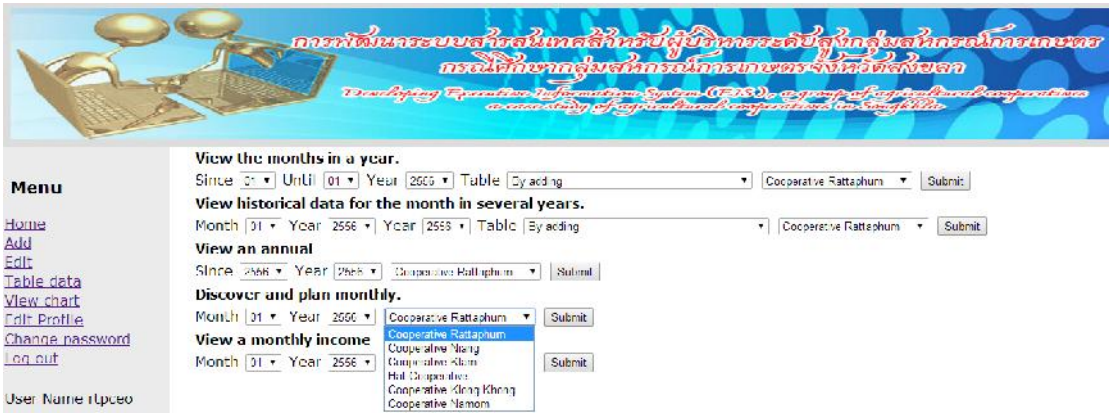
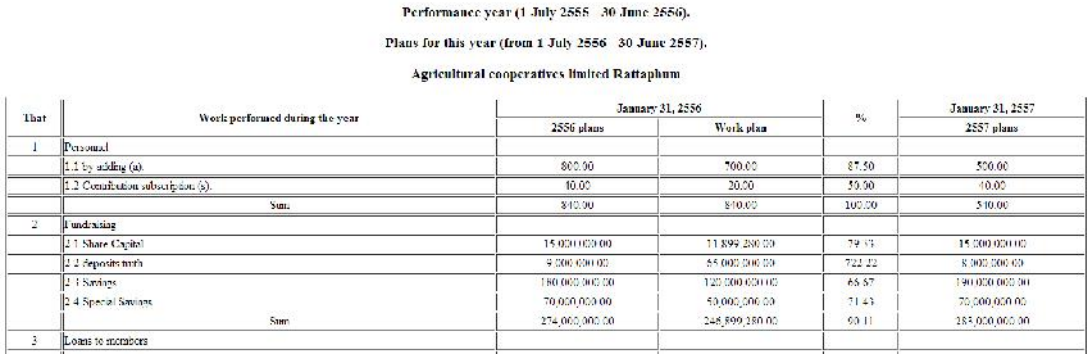


Figure 11 The View of Results and Monthly Operational Plans



Performance year (1 July 2555 - 30 June 2556).

Plans for this year (from 1 July 2556 - 30 June 2557).

Agricultural cooperatives limited Rattaphum

That	Work performed during the year	January 31, 2556		%	January 31, 2557
		2556 plans	Work plan		2557 plans
1	Personal				
	1.1 by adding (a).	800.00	700.00	87.50	500.00
	1.2 Contribution subscription (s).	10.00	20.00	50.00	10.00
	Sum	810.00	810.00	100.00	510.00
2	Fundraising				
	2.1 Share Capital	15,000,000.00	11,899,200.00	79.33	15,000,000.00
	2.2 deposits with	9,000,000.00	65,000,000.00	722.22	8,000,000.00
	2.3 Savings	180,000,000.00	120,000,000.00	66.67	190,000,000.00
	2.4 Special Savings	70,000,000.00	50,000,000.00	71.43	70,000,000.00
	Sum	274,000,000.00	248,899,200.00	90.11	283,000,000.00
3	Loans to members				

Figure 12 Results of Monthly Operational Plans

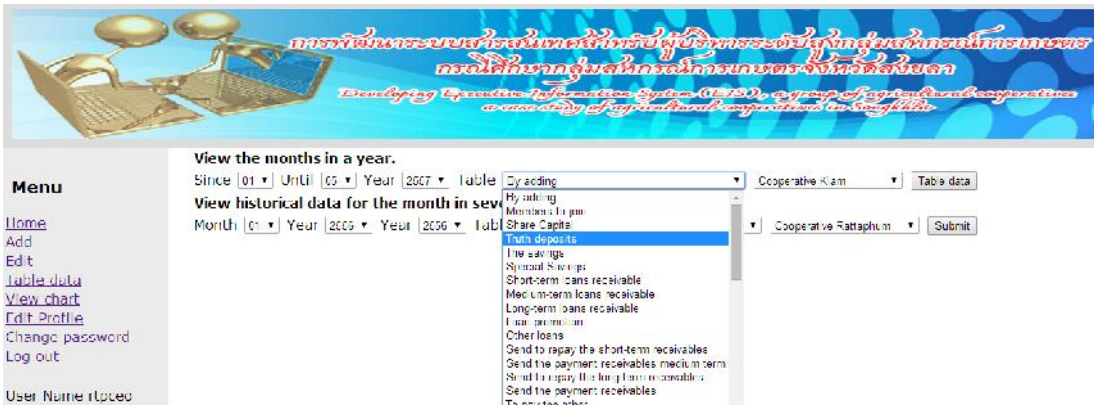


Figure 13 The View of Graphic Data, One Month in a Year

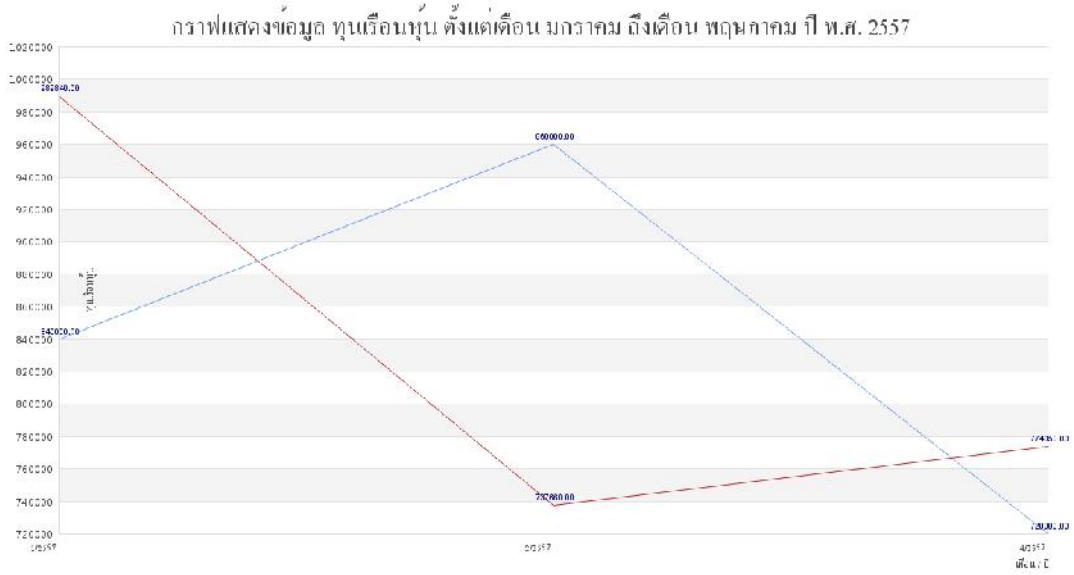


Figure 14 Results of One Month in an Annual Graphic Data

3.4 Graphic Data

Only administrators can use this menu which being able to specify the month, the year and the branch as shown in Figure 13. The reported graphic data showed in Figure 14.

3.5 System Training to the Users

Participants were trained to use the management information system of agricultural cooperatives. They were Executives Cooperative, the filling operation officer, the information operation examiner as shown in Figure 15.

Figure 15 System Training to the Users

Discussions

Result of the development of information systems for executives was accepted at the highest level. The team of researchers used SDLC in systems development. The system met the needs of users, and was effective corresponding to the research objectives[14].It was demonstrated that an information system could be developed bythe SDLC that brought about a quality system, and met the users need.

Conclusion

This research aimed 1) to develop the model of information system, 2) to develop the executive information system (EIS) in a group of agricultural cooperatives: a case study of agricultural cooperatives in Songkhla, for assisting the corporative manger to use the data in considering the tasks operation, and 3) to assess the approval of using system. The subjects were the corporative mangers and the plan and operation officers of 6 branches include 18 people. The system was designed by using theSystem Development Life Cycle (SDLC) process.When the design was completed, it was evaluated by the experts. The result of evaluation was applied to improve the information system model. Then, the system model was developed as the EIS. This system had beenretested in order to ensure that it could be used in the cooperatives. Then, the EIS was properly trained to users. The Executive Information System had been assessed. The assessment results were applied to improve and put into the best practice.The instruments used in this research were the information system model, the executive information system and the information system approval questionnaire. The data were analyzed by using the means value and standard division.

The results showed that 1) the information system model were composed of 4 parts; users, database, data processing and output system, 2) the developed information system was invented as same as the model. For users, it was divided into the executive information system which composed of 7 categories for accessing the data in table and graphic form, and the official information system which composed of11 categories accompanied with the data inserting system 3) the users' approval of the developed information system at a high level.

According to the acceptance of the evaluation system for executives of agricultural cooperatives: A case study of farmer cooperatives Songkhla province, the overall system analysis was at the highest level ($x = 4.62$). Importantly, the information system was actually in use and request to continue use the system. It was the efficiency of planning, management and forecast events that would occur of the executive of agricultural cooperatives. The lowest score of system acceptance was the quality system design ($x = 4.45$). So, there must be designed and developed further in order to obtain stability in use, reliability and accuracy of the data.

Acknowledgement

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Factors Influencing Retention of Staff at Rajamangala University of Technology Suvarnabumi

Laddawan Someran[1*]

Abstract

The aims of this study were to study the factors that influenced the retention of staff at Rajamangala University of Technology Suvarnabumi (RMUTSB) and the opinions of staff in five dimensions: 1) Compensation and welfare; 2) Security of employment; 3) Progress and stability in working conditions; 4) Working together and relationships with other people; and 5) Personal satisfaction. This study applied a quantitative research design. The sample consisted of 223 staff at RMUTSB chosen by using stratified random sampling within campuses and simple random sampling between campuses, generating 179 completed questionnaires. The initial data analysis consisted of means, standard deviations, frequencies, percentages, t-test, one-way ANOVAs and comparisons of the differences in pairs by the Least Significant Difference (LSD) method. The hypothesis testing of the demographic characteristics of respondents and retention factors found differences in levels of job satisfaction according to their age, married status, education level, and work experience that were significant at or below the .05 level. On the other hand, employment status and location of their campus were not significant at or below the .05 level. In conclusion, this study produced original knowledge about some of the factors influencing RMUTSB staff opinions about retention at this University.

Keywords: Retention, Job satisfaction, Academic staff, Administrative staff, Thai universities

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Introduction

For the past few years, scholars and human resource managers have been increasing their research into employee turnover in their organizations. There are also many scholars and researchers considering how to increase "employee retention" (Chou, Chich, Yuan & Hsiao, 2005; Douglas, 2005; Dahm, 2006; Sanchez, 2007; Wang, 2006). In the current climate of economic uncertainty, the retention of current employees has become a significant strategy for human resource professionals in most organizations (Findley, 2007).

Employees, as human capital or resources, are very precious in any organization or society. They play a very important role by contributing to progress in many parts of the nation, organizations, government, private business and education from the primary to university level that are conducted by human beings. In particular, educational institutes play an important role for the nation in developing young people and in creating and transmitting knowledge to develop the country.

In Thai universities, staffs are categorized into two types, academic staff and administrative staff. Those in the academic field are responsible for researching and teaching, while those in the administrative field are responsible for supporting studying and teaching. Consequently, staff play an important role in setting the framework for the educational system. In the last 10 years, many universities have changed the administrative and hiring system to be more modern and flexible to cope with continual change. For example, they have changed the personnel hiring system from staff being government officials to become employees of their university. The aim of this change has been to increase the flexibility of hiring staff when staffing needs in various fields grow or decline. Their employment contract is less secure than that of a government official, but they receive higher salaries than government officials. Besides, more temporary employees have been hired recently, especially in the supporting field. Consequently, staff who perceive a lack of encouragement in their working environment may be more likely to resign. That is why the organization has to waste much time and payments for loss of existing staff and training of new staff. In addition, it is important to establish and implement clear guidelines in human resources management in order to enhance the effectiveness of the working environment for staff. Consequently, this researcher was interested in studying what factors assist in retaining staff at RMUTSB. When all the data were collected and analyzed, recommendations for improvements inhuman resources management policies were submitted to the senior university administrators.

Methodology

Population and Sample

The population for this study was all of the staff who were working in RMUTSB in the academic year 2012, a total of 515 people (RMUTSB: Personnel Administration Division, 2012). To select the sample size for this study, Krejcie and Morgan's (1970) table was used as a guideline. After using a stratified random sampling technique, the sample of this study was set to be 223 people from the total of 515 staff. In addition, simple random sampling was undertaken at the four campuses of RMUTSB.

Instrument

A questionnaire was constructed by the researcher, was administered by hand by hand method as the instrument for data collection. The questionnaire was divided into three parts, as follows:

1) Demographic information of participants, including gender, age, employment status, education background, location, salary, and work experience in eight items.
2) Compensation and welfare, conditions of security, condition of progress and stability in working environment, working together and relationships with other people, and personal satisfaction factors structured as a five-point Likert rating scale in 25 items.
3) An open-ended question to reveal specific factors that would contribute to the answers.

The researcher collected the completed questionnaires by return post or by email and calculated the various subscale reliabilities by using the Cronbach Alpha method of testing for the internal consistency of each scale. Cronbach Alpha coefficients of more than 0.70 are acceptable for research purposes (DeVellis, 1991). For compensation and benefits, conditions of security, conditions of progress and stability in working environment, working together and relationships with other people, and personal satisfaction, coefficients of 0.91, 0.91, 0.91, 0.92, 0.91, and 0.92 respectively, were obtained. The very high level of Cronbach Alpha coefficients in every section of the questionnaire meant that no items were omitted.

Data collection

To collect the data, the researcher undertook the fieldwork herself, because the researcher was able to increase the response rate with a hands-on approach. Moreover, the researcher explained the purpose of the study and questionnaires to participants. (More details are needed here to describe how you collected the data. Did you hand each questionnaire to each staff member or send them to departmental heads for distribution and collection?)

Analyzing data

For the initial data analysis, the researcher employed the descriptive statistics of using frequencies, percentages, means and standard deviations. Inferential statistical tests were used to test the hypotheses and to compare the factors influencing retention of staff according to demographic factors. Specifically, t-tests and one-way ANOVAs at the 0.05 significance level were undertaken and then the researcher compared the mean differences in pairs by the least significant difference (LSD) method.

Results

Almost all the sample of completed questionnaires were 144 female staff (80%). The most common age range of staff was between 20 - 30 years old (47%). The greatest staff had single status (65%). The highest employment status was government officer (50%). The most was university staff (50%). The greatest had a Bachelor's Degree level (71%). The mostly staff was working at the Hantra Centre (41%). The most common salary level was between 10,000 – 25,000 Baht (83%) per month. Moreover, the most common work experience was between 1 – 10 years (72%).

Table 1 Levels of opinions of retention factors

Retention factors	N = 179		Result	Ranking
	$\bar{x}$	*SD*		
Compensation and benefit	2.98	0.76	Somewhat Important	5
Condition of security	3.16	0.78	Somewhat Important	3
Condition of progress and stability in working environment	3.13	0.79	Somewhat Important	4
Working together and relationship with other people	3.62	0.71	Important	1
Personal satisfaction	3.37	0.74	Somewhat Important	2
Total	3.25	0.60	Somewhat Important	

Table 1 indicates the means of the opinion retention factor subscales. It was found that, on average, the staff's total opinion about retention factors was somewhat important to them ($\bar{x}$ = 3.25, *SD* = 0.60). Almost all aspects of their opinion were at the somewhat important level, including compensation and benefits ($\bar{x}$ = 2.98, *SD* = 0.76), the condition of job security ($\bar{x}$ = 3.16, *SD* = 0.78), the conditions of progress and stability in working ($\bar{x}$ = 3.13, *SD* = 0.79), and personal satisfaction ($\bar{x}$ = 3.37, *SD* = 0.74). The factor of working together and relationships with other people was the highest factor at the important level ($\bar{x}$ = 3.62, *SD* = 0.71).

To analyze the factors influencing retention of staff according to demographic variables, the researcher used t-tests and one-way ANOVAs, at the .05 significance level. It was found that the staffs' gender, age, marital status, education background, salary, and working experience were not significantly different. On the other hand, employment status and campus location were two factors that were different at the .05 level of significance. For employment status, it was found that the staff at RMUTSB with different employment status had no opinions that were different as far as retention in terms of the condition of security, working together and relationships with other people, and personal job satisfaction. However, staff at different employment levels had different opinions towards the retention factors of compensation and benefits between university officer and short-term contract employees. As for the conditions of career progress and stability in working environment, government officials and university employees had different opinions from short-term contract employees at the 0.05 level of significance.

For the location factor, it was found that staff at RMUTSB working at different locations to have no significantly different opinions about compensation and other benefits, condition of progress and stability in working environment, and working together and relationship aspects of their employment. On the other hand, staff at RMUTSB working at different locations had different opinions about the condition of security, with staff who were working at Hantra Center having different opinions from staff at the Suphanburi and Nonthaburi Centers at the .05 level of significance. As far as personal job satisfaction was concerned, staff working at the Hantra Center had significantly different opinions from staff at the Nonthaburi Center and staff at the Wasukri Center had different opinions from staff at Suphanburi Center.

Discussion

In an empirical study of the levels of opinions of RMUTSB staff about retention in five dimensions, it was found that, overall, the opinions were at the somewhat important level. For each aspect being considered, it was found that working together and relationships with other people was the most important factor for RUMTSB staff. The second highest factor was personal job satisfaction which was at the somewhat important level, the third factor was the working condition of security which was also in the somewhat important level, the fourth factor was condition of career progress and stability in working which was in the somewhat important level, and the fifth factor was compensation and welfare which was also in the somewhat important level.

From the data reported above, it was identified that staff at RMUTSB had overall opinions that were at the somewhat important level, while staff of RMUTSB had the lowest level of their opinions about their compensation and benefits. It was concluded that staff see the importance of compensation and benefit, but did not believe that this aspect of their employment was as important as harmonious relationships with btheir colleagues. This finding is inconsistent with as the result of Samuel and Empt (2009) who studied the retention and resignation reasons of US employees. They found that,

for employees with good performance, a competitive wage system was an important factor in employees' decision to stay or resign from their position. This finding also was consistent with the concept of Songsujaritkul *et al.* (2009) who studied talent retention in a case study of administrators of the True Vision Company. These authors found that the factor of paying adequate compensation affected the retention of talented people. These findings were also consistent with those from the studies of Henke, Choy, Chen, Geis and Alt (1997), Miller, (1999), and, more recently, Odland and Ruzicka (2009) and Bhurtun (2009). These studies all found that compensation and benefits were the main factors that influenced job satisfaction. It may be that there are cultural differences in the importance of compensation between Thai studies and US studies or it may be that university staff are more influenced in their decision to stay or quit by the quality of the personal relationships with their colleagues.

This study focused on the demographic factors, such as gender, age, marital status, employment status, education background, salary, location and work experience that influenced five aspects of university employment: compensation and welfare, the condition of security, the condition of progress and stability in the working environment, working together and relation with other people, and personal job satisfaction. It was found that demographic factors, such as gender, age, marital status, education background, salary, and work experience had no significantly different opinions towards factors of retention staff at RMUTSB. However, the different employment status and location of staff had opinions that were different towards factors of retention staff at RMUTSB, as follows:

Employment status factor: it was found that different employment status was related to certain opinions important to the retention of staff at RMUTSB. When considering each group, it was found that government officers and university officers had a higher opinion level in compensation and benefit, and condition of progress and stability in working than short-term contract employee. This may be an effect of different level of compensation and welfare between short-term and permanent employees. Short-term contract employees receive a lower salary according to their qualifications and position and welfare benefits just prescribed by law. So they feel unstable in their own careers with temporary employment and an annual salary which is not increased. On the contrary, government officers and university officers have compensation and benefits that are higher than short-term contract staff, according to their employment status, such as housing benefits and payment of medical fees. These different working conditions mean that staffs who were government officials and university employees had higher opinions than short-term contract employees. This finding agrees with Herzberg' s Two Factor Theory which proposed that salary, the possibility of career growth, increased status and security were maintenance or hygiene factors that affect the job satisfaction in employees' working lives (Herzberg, 1959). Employment status factors toward their profession and stability were issues that influenced academic staff to stay in their positions at RMUTSB. Having good feelings towards their position is a factor that was confirmed

by Hannay and Northam (2000) and Horstmann (2005). They studied staff turnover and pointed out that autonomy can decrease staff turnover which is consistent with the findings of this study. Similarly, Sook Han, Ja Moon and Kyoung Yun (2009) found that permanent nurses had higher levels of job satisfaction than temporary nurses. Futhermore, Sucaromana, Choochom, Haemaprasith and Supapon (1997) studied job satisfaction in Srinakharinwirot University personnel, finding that those staff who had the highest levels of satisfaction was government officials which is the most stable employment status.

For the location factor, different location was found to affect opinions concerning the retention of staff at RMUTSB. It was found that employees who working in different locations had different opinions, especially about the condition of job security. It was found that staff who working at the Wasukri and Nonthaburi Centers had higher opinions about the importance of job security than those who working at Hantra Center. And in personal job satisfaction opinions, it was found that those who working at Wasukri and Nonthaburi Centers had opinions towards personal satisfaction that were higher than those who were working at the Hantra Center. Moreover, those who were working at the Wasukri Center had higher opinions towards personal satisfaction than those who were working at Suphanburi Center. Security is one of many factors that staff need in their working lives. So, it was concluded that the different location of each center was related to the different job satisfaction levels. This finding agreed with Herzberg's Two Factor Theory which stated that the achievement, the work itself, responsibility and working conditions are motivational factors that affect the employees' job satisfaction (Herzberg, 1959). This finding is consistent with those of Woranart Saengmanee (2004) who found that personal feelings and attitudes towards the work environment influenced both body and mind that made employees satisfied with their work through paying more attention to their work in order to achieve the objectives of the organization. The importance of location needs to be studied further to learn what it was about certain campuses of RMUTSB that produced different levels of job satisfaction.

Implications

There were three implications that were drawn from the findings of this study:

1. RMUTSB needs to improve the hiring policy and the compensation policy for supporting field employees, especially the group of temporary employees who receive less compensation than permanent employees. Moreover, further encouragement for progression and stability in their careers is an important factor in retaining these staff.
2. RMUTSB needs to develop policies to strengthen good relationships at every level of personnel in the organization in order to achieve improved human resources management.

3. The administrators of the university need to improve the working environment and to enhance the employees' job satisfaction, especially those field employees who belong to the Hantra Center, because they have the lowest level of satisfaction about their working environment and personal job satisfaction.

Recommendations for Further Research

Two recommendations are proposed for further research:

1. Future next research studies should sample other contexts, such as staff at another government university or a private university; and
2. A qualitative research method or a mixed-methods methodology should be used to collect in-depth data in order to complement the findings of this research study. The research question could be asked and data sought: Why do staffs in different locations have different opinions about various aspects of their employment.

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Tantanot (Palmyra Palm in Phetchaburi)…Crop for Creative Economy: A Case Feasibility Study on Potential and Creations for Economic AddedValue

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Abstract

Palmyra Palm is an important cash crop in Phetchaburi. so, the main purpose of research was to verify and evaluate the feasibility and the potential for the creation added value Palmyra Palm products by financial and economic analysis methods, together with a rating scale. The data was collected from 120 of Palmyra Palm enterprise of Phetchaburi province, mostly in districts of Banlad Kaoyoi and Mueangphetburi. Palmyra Palm enterprises were surveyed through purposive sampling for case study and interview in order to gain the necessary data to determine the cost and return of enterprises. The highest net present value (NPV) of 3,226,369 Baht was in the production of Palmyra sugarcake and Palmyra fruit jelly seed. Internal rate of return (IRR) was the highest at 28.50% for Palmyra sugarcake. The cost and benefit ratio were also the highest positive on Palmyrasugarcake with 11.92 These result showed that this enterprise were feasibility for added value product. An overall potential of Palmyra manufacture also rated a score of 2.01 out of 3. The highest score was for combined production of Palmyra sugarcake and jelly seed of Palmyra fruit jelly seed at 2.20, the next was 2.17 for the Palmyra ecotourism industry. A contributing factor in production was capital and equipment, whereas conservation of a skilled workforce and its transfer to the new generation, including additional Palmyra cultivation need to be further promoted in order to create a sustainable creative economy.

Keywords: Added Value, Creative Economy, Feasibility, Potential, Palmyra Palm

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Introduction

Palmyra palm is a palm tree which is from one of the oldest tree families in Asia. In Thailand, it is called Tantanot which is a local plant and has become a symbol and an important crop of Phetchaburi province. (Figure 1) The potential of Palmyra Palm can create economic value-added products. One good point is that it has multiple-uses from the roots and leaves. And it is a plant that has a long life. Not a lot of fertilizer and watering is required. Every part of the Palmyra Palm can be utilized [1].

Female Male

Figure 1 Different sexes of Palmrya palm

One value added product of Palmyra Palm could be ecotourism where tourists can visit Palmyra gardens (e.g.Suan Tan, in Phetchaburi) and watch the lifestyle of sugar manufacturers who can also sell their products to tourists e.g. ,jelly seeds of Palmyra fruit, crystallized seeds of Palmyra fruit, Palmyra Jelly seeds in syrup, steamed Palmyra pudding , Palmyra sugar cake (jaggery) and fresh Palmyra juice etc.[2]. Palmyra Palm also has applications in the food industry, it is an ingredient in cooking both main dishes and delicious sweets. Moreover, Palmyra Palm wood can be made into house decoration and various furniture, as well as souvenirs for tourists such as lamps, keychains, etc. The different types of products assist income generation for people in Phetchaburi province.

There are possibilities for the creative economy arising from the potential of Palmyra Palm to create added value product. By integrating existing resources and promoting added value, benefits also increase, for example by thick sugar processing into Palmyra sugar powder with new packaging. As a consequence, Palmyra Palm has become a value added item in the creative economy for the new generation. So, by increasing the quantity of products created from Palmyra Palm, the added economic value is also greatly increased [3].

Palmyra Palm is being established by Phetchaburi province to support a creative economy in order to earn a stable and sustainable revenue within the province [4]. Therefore, there is a question whether Palmyra Palm would be capable and possible of creating added economic value to manufacturers or a group of professionals, and what potential value Palmyra Palm has at any level. Therefore, it is necessary to verify and assess the feasible opportunities for creating economic value added products and to find occupational competency and potential in order to create a value-added industry in the long run.

Materials and Method

The present study was conducted in the district of Banlad, MueangPhetchaburi and Kaoyoi which is popular for Palmyra Palm production in Phetchaburi province. A well structured questionnaire was used to select data from the Palmyra Palm enterprises by purposive sampling under the following criteria: (1) must have minimum Palmyra Palm career experience of 3 years (2) have owned Palmyra Palm tree or rented Palmyra Palm for their occupation, and (3) minimum revenue from occupation involving Palmyra Palm of 20,000 Thai baht per annum. ($1 US = 31 Baht, 2012)

After that, the sample was separated into 5 groups, as shown in table 1 i.e.:

1) the group of manufacturers of Palmyra fruit jelly seeds,

2) Palmyra sugar cake manufacturer group,

3) manufacturers of both Palmyra fruit jelly seeds,

4) Ecotourism industry group,

5) Palmyra handicraft group

Financial and economic analysis tools were applied to the objective of evaluating the feasibility of investment projects, as follows;

1. Net Present Value Method, NPV. Using equation as follows;

$$NPV = \sum_{t=1}^{n} \frac{Rt}{(1+k)^t} - C$$

2. Internal Rate of Return Method, IRR.Equation used as follows;

$$\sum_{t=1}^{n} \frac{Rt}{(1+r)^t} - C = 0$$

3. Cost and Benefit Ration Method or B/C.Economic measure shown as follows;

$$BCR = \frac{\sum Benefits}{\sum Costs}$$

Rating scale is applied based on investigation and assessment of the potentials of producer in each group which contains the following formula:

$$\frac{\text{Sum of the score obtained by each group of producers x 100}}{\text{Sum of index in each indicator}}$$

To determine the range of rating scale 3-2 / 3 = .66 which translated the potential at level 3 range ie. The poor range was of 1- 1.66 or 33.33 – 55.33%. a fair or acceptable range was of 1.67-2.33 or 55.66 – 77.60%, and the highest potential was of 2.34 -3.00 or 77.70 -100%.

Table 1 shows the background of producers

Items	Category of products/Number of Producers					Total
	Palmyra fruit jelly seeds	Palmyra sugarcake	Palmyra fruit jelly seeds and sugarcake	Palmyra Palm Handicraft	Palmyra for ecotourism	
Owners	29	21	38	15	17	120(100.00)
Average age (year)	51.49	61.57	66.71	48.23	53.41	56.72
The level of education						
- Elementary	25	21	35	14	15	110(91.66)
- Secondary	4	0	3	1	1	9 (07.50)
- Higher education.	0	0	0	0	1	1(00.83)
The experience (average, year)	24.75	37.28	33.13	16.29	31.64	26.77
The funding source.						
-self funding	29	21	38	13	17	118(98.33)
-Financial institutions	0	0	0	2	2	2(01.66)
The number of Palmyra tree						
-Male	24	319	916	0	597	1,856(32.93)
-Female	1,879	107	1,117	0	679	3,782(67.08)
Total	1,903	426	2,033	0	1,276	5,638(100.00)
Members of the household.						
-Male	12	4	3	11	4	34(23.44)
-Female	29	19	43	3	17	111(76.55)
Total	41	23	46	14	21	145(100.00)

Result and Discussion

Information sought on production cost which arose in the period of study is showed as follows in the table 2. In the sale information section of the survey results there are two flow marketing channels of products i.e. 35. 85 % sold directly by producers and 65.15 % sold through middlemen in the local area. Detailed data was tabulated as follows in Table 3, which demonstrates the highest revenue was from the combined jelly seeds and sugarcake which were valued at 8,592,710 Baht.

The data analysis has shown the result from the material and method section. In this regard, the output of investment contained in the line of profit, net present value, internal rate of return and cost and benefit ratio which is detailed in the following table 4.

Indicator which assessed the potential of Palmyra producer, focusing on fundamental factors for a career such as capital and equipment etc., Palmyra production and marketing system, the methods of value-added creation, career promotion and investment, and Palmyra research and development for advanced products in the market which detailed in table 6.

Table 2 shows the production cost

Category of Products	Kinds of Cost		Total
	Fixed Cost	Variable Cost	
Palmyra fruit jelly seeds	270,729	1,738,561	2,009,290 (38.54)
Palmyrasugarcake	144,928	109,285	254,213 (4.87)
Palmyra fruit jelly seeds and Palmyrasugarcake	496,381	343,864	840,245 (16.11)
Palmyra handicraft	202,205	269,700	471,905 (9.05)
Palmyra for ecotourism	390,098	1,307,020	1,637,118 (31.43)
Total	1,444,341(27.70%)	3,768,430 (72.30%)	5,212,771(100.00%)

Table 3 shows revenue of producers

Category of products	Marketing channel and value of sale		others	Total
	Themselves	Middlemen		
Palmyra fruit jelly seeds	2,000,900	3,338,300	252,000	5,591,2 00
Palmyrasugarcake	144,928	2,727,900	3,100	2 ,875,298
Palmyra fruit jelly seeds and Palmyra sugarcake	3,869,760	4,722,950	-	8,592,710
Palmyra handicraft	114,000	1,081,666	-	1,195,666
Palmyra for ecotourism	2,237,550	2,604,555	-	4,842,105
Total	8,367,138 (36.23%)	14,475,371 (62.67%)	255,100 (1.10%)	23,095,979 (100.00%)

Table 4 Showsreturns on investment with different tools of calculation

Category of Production	Category of the different financial analysis			
	Profit	Net Present Value (at P/F,8%, 10 yrs)	Internal Rate of Return (at MRR 8%)	Cost and Benefit Ration
Palmyra fruit jelly seeds	3,750,310	6,574,04.80	11.10	2.86
Palmyrasugar cake	2,776,397	1,148,959.43	28.15	11.92
Palmyra fruit jelly seeds and Palmyrasugarcake	7,942,940	3,226,369.65	25.12	10.45
Palmyra handicraft	723,761	81,688.35	9.75	2.53
Palmyra for ecotourism	3,204,987	604,776.60	11.45	2.95

The internal rate of return and cost and benefit ratio indicated that the highest value both of internal rate of return and cost and benefit ration was in the Palmyra sugarcake group.

Actually, all types of product groups gained positive values which were higher than the minimum rate of return 8% by bank lenders. One interesting issue was that the Palmyra sugarcake group was appropriate for long term investment because of the highest rate of IRR and B/C, whereas the Palmyra fruit jelly seeds and sugarcake group was more suitable for a short term investment.

The cash inflow and cash outflow showed the net cash flows with 8 % and from 0-10 year as following table 5;

Table 5 Shows net present value and cash flow of investment

Category of Production	Sum of Expenditure 0-10 yrs (cash outflow) 1	Sum of receipt 0-10 yrs (Cash inflow) 2	Discount rate at (8%,10yrs value of 1Baht) 3	Net present value of receipt (Baht) 4(2*3)	Net present value of investment (Baht) 5(4-1)
Palmyra fruit jelly seeds	2,009,290	5,759,600	.463	2,666,694.80	657,404.8
Palmyrasugar cake	254,213	3,030,610	.463	1,403,172.43	1,148,959.43
Palmyra fruit jelly seeds and Palmyrasugarcak	840,245	8,783,185	.463	4,066,614.65	3,226,369.65
Palmyra for ecotourism	1,637,118	4,842,105	.463	2,241,894.61	604,776.6
Palmyra handicraft	471,905	1,195,666	.463	553,593.35	81,688.35

To determine the potential of value added products was done by using the index of six indicators which are noted in the following table 6

Table 6 shows the potentials of each manufactures

indicators	Category of manufactures					Average
	Palmyra fruit jelly seeds	Palmyra sugarcake	Palmyra fruit jelly seeds and Palmyrasugarcake	Palmyra handicraft	Palmyra for ecotourism	
Fundamental factor for a career	2.28	2.30	2.46	1.93	2.52	2.29
Production factor	2.12	2.39	2.57	1.49	1.62	2.03
Marketing factors	2.05	2.19	2.30	1.80	2.67	2.20
Career promotion and investment	1.66	1.91	1.88	1.17	1.86	1.70
Value addedcreation	2.24	2.36	2.31	1.81	2.30	2.20
Research and development for advanced product	1.6	1.8	1.72	1.50	2.14	1.75
Average	1.99	2.15	2.20	1.61	2.18	2.02

Table 6 demonstrates that the average potential was the highest for the Palmyra combined jelly seeds and sugarcakegroup with 2.2. In conclusion, all the potential indicators were over criteria but some indicators lower than 2.00 needed further improvement.

Discussion

The creative economy of Palmyra Palm arose from the feasibility of producers in production of Palmyra jelly, Palmyrasugarcake combined jelly seeds and sugarcake, handicraft and ecotourism. Palmyra Palm product created income in the group of each professional involved, which transferred ancient knowledge and experience of the ancestors from the past into the present. This corresponds with the creative economy ideals of John Howkins [5] that old culture and wisdom can be applied to a new culture, and then be published or exploited commercially.

All types of Palmyra Palm production are viable, in terms of both career development and production investment, but have problems in terms of lack of specialized labor, and a new generation of youngsters who are rarely interested in this professional inheritance [6].

The potential of Palmyra Palm depends on support and promoting planting Palmyra with more conservation of Palmyra Palm supported by both the private and government sectors. Promoting Palmyra plantations, and adding or maintaining Palmyra Palm and the inherited knowledge in the profession will be useful for a new generation and create sustainability in a potential revenue-generating culture in Phetchaburi province[7].

The feasibility to generate potential image innovation by indicators for (1) career promotion and investment and (2) promoting investments in research and development, and (3) taking advantage of value-added Palmyra Palm products were evaluated at a potential of 1.70 and 1.72,which was low but still acceptable. This has not yet been classified in the high-potential criteria. It is something that requires further development. Study guides on Palmyra Palm products have not yet completely integrated development packaging, modern distribution sources, product prices, or developed existing know-how into a network of competing professionals that would help make products diffuse rapidly as well. [8].

Conclusion

Palmyra Palm has high potential and feasibility for creating economic value added products as well as occupations related to the community in Petchaburi. The return from investment is higher than expenditure. The highest net present value was of combined production of both Palmyra jelly seeds and Palmyrasugarcake. Moreover, Internal Rate of Return (IRR) and the Cost and Benefit Ratio was also highest. Palmyra handicraft was the lowest of all valuations. The potential of Palmyra indicates the Palmyra Palm is part of the creative economy of Petchaburi which is supplying the cultural goods and services market.

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Customer Satisfaction on Social Network : The effect of Website Reputation and Website Design

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Abstract

Customer Satisfaction is what a business needs to focus on, because it will affect the decision to purchase goods and services. In particular customers can't touch goods and service on the internet, so it very difficult to make them satisfied. Previous review of the literature found such factors that Website Reputation and Website Design affect Customer Satisfaction. Therefore, the aim of this research is to study the influence of Website Reputation and Website Design on Customer Satisfaction.The sample used in this study was the students in the high school of Suphanburi province having multi-staged random sampling being responded by 387 sample feedbacks where data were collected by questionnaire. The statistics used in data analysis were in percentage, mean score and standard deviation. Using regression analysis to test the hypothesis with statistical significance level of 0.05.

The result showed that there had been a positive effect of Website Reputation and Website Design on Customer Satisfaction on Social Network. In addition, the result showed the value of Beta for website Design was higher than Website Reputation indicating that Website Design had more effect on Customer Satisfaction than Website Reputation, so we suggest that the marketing executives of educational institute or University should invest more in Website Design than Website Reputation by focussing on public relations while building University's Reputation through Website Reputation by having a good design to achieve Customer Satisfaction that leads to Customer Loyalty and Word of Mouth. The findings of this study can be applied in other industries in the wide range of online business or offline business that wants to create new channels of communication and distribution to selling their product or service.

Keywords: Website Reputation, Website Design, Customer Satisfaction

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Introduction

Social network is a representation of social interactions (B.A. Huberman et al., 2008) that increases the importance for business and academic and it is one of the fastest growing in academic areas (Rivera, M.T., Soderstrom, S.B., Uzzi, B., 2012).Online social networks such as Facebook, YouTube, Hi5, Blog, Myspace and Twister have become quite popular.

In the study of "Global Social Media Check-up 2011", Burson-Marsteller analyzed the social media presence in the companies from Fortune Global 100 list.The result showed in figure 1.

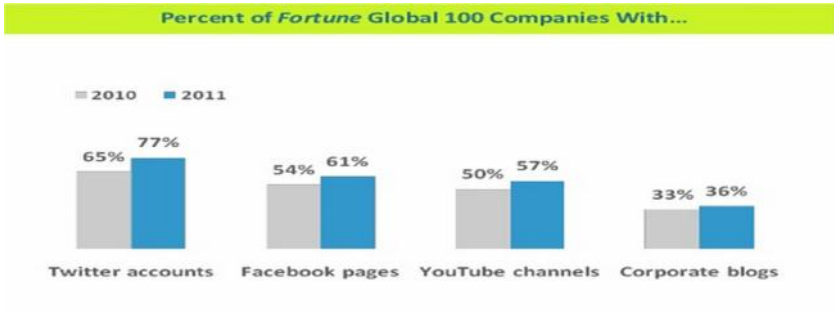

Figure 1 Percent of Fortune Global 100 Companies with social media

Source: http://www.burson-marsteller.com/bm-blog/2011-fortune-global-100-social-media-study/

There was a 12% increase in Fortune Global 100 Companies using Twitter, followed by a 7 % growth in Youtube channels and a 7% growth in Facebook (Burson-Marsteller,2011) Thailand's population is approximately 66 million .There were 25 million Internet users of which 18 million people use Social Network. Of 18 million Social Network users, it was rated that Facebook accounted for 85%, Twitter 10% and Instagram 5%. Active growth compared to the same period of last year found that Facebook usage growth from last year to 24%, Twitter usage growth from last year to 53%, Youtube in active growth from last year to 125 %. Instagram usage grew 178% from a year ago. (Infographic, 2013)

The importance of social network indicates that on Social Media whether an user is just communicating, or stories being told or posting contents, articles, images and videos that one has written himself, making up by own or finding from other media. Then share these with others on their network. Through Social Network sites currently offered on the online world, communication is done via the Internet and mobile phones only. (Marketing oop, 2009) which are more meaningful in marketing field in the term of Word-of-Mouth. Previous studies showed an effectiveness of Word of Mouth on intention to purchase (M.R. Jalilvand and N.Samiei, 2012; X.Wang, 2011; Y.-H. Chen et al.,2010; R. East et al.,2008) .In addition, a previous study showed the most popular antecedent that effects Word of Mouth was customer satisfaction. (Y.-F. Kuo et al., 2009; J. M. Carpenter, 2008 and Y.K. Kim, A.K. Smith, 2007)

Customer Satisfaction is one of the most popular research topics in marketing and e-commerce studies. Previous studies showed an influence of Customer Satisfaction Example and it effects on intention to purchase. (Y.-F. Kuo et al., 2009) on customer trust (J. M. Carpenter. 2008) on customer loyalty (Aysel Erci et al., 2012; H.H.Chang and H-W.Wang, 2011; J. M. Carpenter, 2008) and on word of mouth (Y.-F. Kuo et al., 2009; J. M. Carpenter., 2008; Y.K. Kim, A.K. Smith, 2007) etc. So the antecedents that effect on Customer Satisfaction in social network are important to study in this paper.

There are various studies on Determined Factors affecting Customer Satisfaction Example in the study on Yoon, (2010) Antecedents of Customer Satisfaction with online banking in China: The effect on experience which the result showed that a design has had a significant influence on Customer Satisfaction. In addition previous study found that reputation building skills have positive relationship with customer service satisfaction (Amjad A. Abu-EL Samen et al., 2011; S.M.C. Loureiro, E. Kastenholz, 2011). There are more researches that study more in online context but with the growth of science and technology has resulted in a dynamically changing consumer behaviour.Factors that cause satisfaction remains a matter of interest,so this research aim to study the effect of Website Reputation and Website design on customer satisfaction,especially on Rajamangala University of Technology Suvarnabumi's Website.

Literature review

Customer Satisfaction

Oliver, 1997, p. 13 defined Customer Satisfaction as "the consumer's fulfi llment response. It is a judgment that a product or service features, or the product or the service itself provided (or is providing) a pleasurable level of consumption-related fulfi llment, including levels of under or over fulfi llment" and Kotler (2003, p.61) Don O'Sullivan and John McCallig. (2012) defined Customer Satisfaction as "a person's feelings of pleasure or disappointment resulting from comparing a product's perceived performance in relation to his or her expectations." Customer Satisfaction are more important in a business. Don O'Sullivan and John McCallig (2012) found that Customer Satisfaction has a positive impact on firm value (loyalty, retention, cross premium, and premium price), furthermore its positive effect on customers' repurchase and 'word-of-mouth' behavior (Y.-F. Kuo et al., 2009; J. M. Carpenter, 2008). Casaló, Flavián, and Guinalíu (2008) have found that Customer Satisfaction had a positive effect on both customer loyalty and positive word-of-mouth. This study will be conducted for the target group satisfaction of Rajamongala University of Technology Suvarnabumi (the high school students) who had access to the University's Website.

Website Reputation

Corporate reputation in this study is meant to be Website Reputation that rapidly becomes important in academic and implementation. Corporate Reputation is the overall estimation that gauges a company's net affective image perceived by customers, investors, employees, and the general public (Jooh Lee and James Jungbae Roh. (2012). Corporate Reputation is an intangible asset that increases customer satisfaction, marketing effectiveness. Save cost and differentiates a firm from others. Previous study show the relationship between Company Reputation and Customer Satisfaction are in the study of (Amjad A. Abu-ELSamen et al.,2011; S.M.C. Loureiro, E. Kastenholz,2011; Karimov et al.,2011; S.M.C. Loureiro, E. Kastenholz ,2011) found that Company Reputation had a positive effect on Customer Satisfaction. This study aims to investigate the effectiveness Reputation of Rajamongala University of Technology Suvarnabumi's website on Customer Satisfaction which is the first hypothesis in this paper.

H1. Website Reputation has a positive effect on Customer Satisfaction.

Website Design

Website Design is a first impression for consumer to stop and show interest on Website. Good Website Design enhances usability, thus affecting the success of the websites C. Yoon. (2010). Karimov et al. (2011) found that that web design cues effectively enhance consumers' initial trust towards unfamiliar online vendors. Yoon. (2010) found that design has had a significant influence on Customer Satisfaction Hence, Website Design may also have a positive influence on customer satisfaction. In this study mean to Rajamongala University of Technology Suvarnabumi's Website Design. Accordingly, we expect the following:

H2. Website Design has a positive influence on Customer Satisfaction.

Conceptual framework

Based on the above assumptions, a model is established to show the relationship of Website Reputation, Website Design, and Customer Satisfaction as shown in the Figure 2.

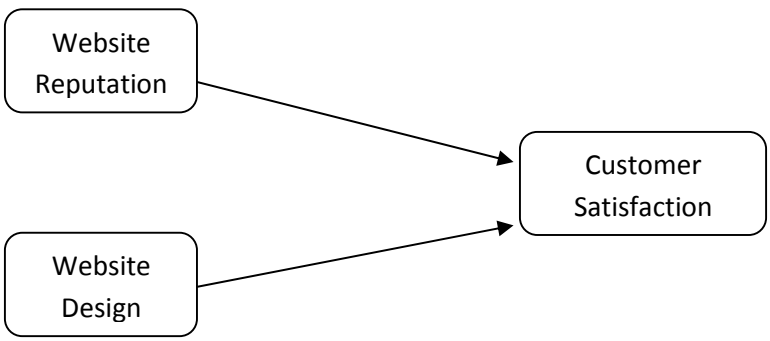

Figure 2 Conceptual model

Methodology

The aim of this paper is to study the effects of Website Reputation and Website Design on Customer Satisfaction. The population were the targeted of Rajamongala University of Technology Suvarnabumi.That were students in the high school of Suphanburi province who have used the services of the University's Website. The sample used in this research was multi-staged random sampling. In order to Collect the data from targeted population, a questionnaire survey was developed from Yoon (2010) and Lai,Griffin and Babin (2009) [36-37]. The survey is composed of 3 parts. 1) Demographic that contains factors: Gender, Age, and Income level, 2) Subjective deals with the factors of Website Reputation and Website Design, and 3) Subjective deals with the factors of Customer Satisfaction. In order to measure the highly significant features that are important to analytical effect of Website Reputation and Website Design on Customer Satisfaction, we used 8 items with 5-point Likert measurement scale 400 questionnaires were distributed to the students in high school of Suphanburi province and 387 out of 400 were received at the response rate of 96.75%. We used Cronbach's alpha to evaluate the reliability of scale of Website Reputation, Website Design, and Customer Satisfaction. The Cronbach's alpha value showed 0.803 that was appropriate for this study.

Results

In order to examine the effect of Website Reputation and Website Design on Customer Satisfaction, descriptive statistics and Pearson moment correlation are being applied. In table 2 Mean, Standard deviation and Correlation of each variable are given.

Table 1 Mean, Standard Deviation and Pearson Moment Correlation (N=387)

	Mean	Standard Deviation	Website Reputation	Website Design	customer satisfaction
Website Reputation	3.9934	.62562	1		
Website Design	4.0572	.57678	.645(**)	1	

** Correlation is significant at the 0.01 level (2-tailed).

From table1 the result show the relationship between Website Reputation and Website Design with Pearson Moment Correlation. 645. It is quite medium which means the data are appropriate to test the hypothesis with multiple regression statistic.

To test the relationship of Website Reputation and Website Design on Customer Satisfaction, a linear regression was computed and all data had been tested for normality. The result showed R square =0.652 that was 65.2% variation in Website Reputation and Website Design on customer satisfaction.

ANOVA shows significance level that P value is less than significance level being 0.05 which is acceptable and that Website Reputation and Website Design have significance on Customer Satisfaction.

The relationship of the Website Reputation and Website Design on Customer Satisfaction is shown in table 2

Table 2 The relationship of the Website Reputation and Website Design on Customer Satisfaction.

Model	Unstandardized Coefficients		Standardized Coefficients	t	p-value
	B	Std. Error	Beta		
(Constant)	.805	.134		6.009	.000
Website Reputation	.359	.037	.379	9.625	.000
Website Design	.524	.041	.509	12.936	.000

A Dependent Variable: customer satisfaction

Constant 0.805; SE=0.3508

R=0.808; R square=0.652; F=360.049; P-Value = 0.000

The result showed that there had been a positive effect of Website Reputation and Website Design on Customer Satisfaction with R value being 0.808 that supports hypothesis (H1and H2), indicating that both variables can predict on customer satisfaction with 80.8 % . In addition, the result showed the value of Beta of Website Design (.509) is higher than Website Reputation (.379) indicating that Website Design has more effect on Customer Satisfaction than Website Reputation.The relationship of the variables are in the following equation:

Customer Satisfaction= 0.805+0.359 (Website Reputation) + 0.524 (Website Design)

The equation shows that 100 % change in Website Reputation and Website Design will bring 35.9 % and 52.4 % respectively change in Customer Satisfaction.

Discussion and Conclusion

The results suggest that Website Reputation and Website Design are correlated to Customer Satisfaction (table 2). The results demonstrate that the value R = 0.652 is medium probably because these factors are not only ones effecting on Customer Satisfaction. The previous research (C. Yoon, 2010; A.M. Aladwani and P.C. Palvia, 2002) showed there had been another factors such as securities, Transaction speed, Information content, Ease of use etc. that had effected on Customer Satisfaction.

However, the result can indicate that the equation for the relationship of the variables are quite appropriate and support hypothesis that Website Reputation and Website Design have positive effect on customer loyalty and is consistent with Yoon.(2010), Karimov et al. (2011), Amjad A. Abu-ELSamen et al.,2011; S.M.C. Loureiro, and E. Kastenholz ,2011.

Previous literature review has supported that Customer satisfaction has a positive effect on Customer Loyalty (Aysel Erci et al., 012; H.H.Chang and H-W.Wang, 2011; J. M. Carpenter, 2008) and Word of Mouth (Y.-F. Kuo et al., 2009; J. M. Carpenter, 2008; Y.K. Kim, A.K. Smith, 2007). More Customer loyalty and Word of Mouth have effected more Performance and Competitive Advantage.

Then the results of this study are Website Design has more effect on Customer Satisfaction than Website Reputation,that support our hypothesis with significant of 0.05. We suggest that the marketing executives of educational institute or University should invest more in Website Design than Website Reputation by focusing on public relations while building the University's Reputation through Website Reputation by having a good Design to achieve the Customer Satisfaction, Loyalty and Word of Mouth.

The findings of this study can be applied in other industries in the wide range of online business or offline business that wants to create new channels of communication and distribution to selling their product or service.

The future research should examine the impact of other variables such as Perceive Value, Perceive Quality on Customer Satisfaction and the effect of Customer Satisfaction on Trust, Customer Loyalty, Word of Mouth, and Competitive Advantage.

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A Study of Problems of Paying Personal Income Taxes of Rajamangala University of Technology Suvarnbhumi's Personnel

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Abstract

This research aims to explore problems and differences of paying personal income taxes of Rajamangala University of Technology Suvarnbhumi's Personnel, divided by status, position, level and type of income. The data is collected from 270 respondents working at the University by using questionnaires. Several descriptive statistics are applied including tables, frequency, percentage, mean, and standard deviation. Moreover, inferential statistics are also used for hypothesis test such as t-test and F-test (One-way ANOVA) with statistical level at the level of 0.05 and 0.01. According to the study, the results indicate that most of respondents have graduated with a master's degree. They are the University's lecturer without any academic position while their monthly income is between 10,001 – 20,000 baht. They are at the age of 31-40 and married. Most of the respondents earn their income from salary and pension. They fill the data on tax calculation in Por.Ngor.Dor. 91 (the personal income taxes) and submit it by themselves through the Internet. However, they do not submit the mid-year personal income taxes and pay the taxes for the year 2010. Some problems of paying the personal income tax are found, for instance, knowledge and understanding of the personal income tax calculation, how to fill the information in Por.Ngor.Dor. 91, form submission, tax payment and personal income tax return. All of these problems are at moderate level. On the other hand, the differences of taxpayers' information are identified such as different taxpayers' status affects different problems of the personal income tax return and different taxpayers' income affects different problems of filling the form.

Keywords: Personal income taxes, Tax return, Taxpayers, Assessable income

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Introduction

Personal Income Tax (PIT) is a direct tax levied on income of a person. The income that it will have to pay to the tax is called the assessable tax under the Revenue Code. The tax calculation will be calculated based on the net income by taking the assessable income deducted with the expense and the deduction, how much is left will be calculated for the tax in accordance with rate specified by law. Personal Income Tax is a direct tax that the tax obligation falls to the person required by the law for the obligation. In other words, it is difficult to the taxpayer that will push the tax obligation to others (Group of taxation academics, 2012). The Revenue Department has classified the assessable income into 8 categories which is able to calculate and deducted the expenditure and the deductions as the Revenue Code specified. After the net income is calculated, it will have to calculate the tax according to the progressive tax rate by the assessable taxpayer up to the minimum criteria as the provisions of the Revenue Code is required to submit the personal income tax return form and paying the tax to the officers in March of the following year.

Responding related past research studies, it has found that there are several factors correlated with the problems on paying the income tax which in this study will take be determined as independent variables, including status, position, income level and type of income according to the details as follows; The status of the taxpayer is correlated with the right to receive the deduction and allowance as the law determined and shall be subtracted from the assessable income after deducting the expenditure in order to alleviate the tax obligation according to the status of each taxpayer (Paichit Rotjanavanit, Chumporn Sansai and Saroj Thongprakam, 2010) under Section 40 (2), the income from the duty or position on employment will be combined with the income under Section 40 (1) and deducted the expenditure as the maximum presumption not more than 60,000 baht. Many earners think that it is not fair for them due to the assessable income under Section 40 (1) and 40 (2) currently states that there are very different costs (Ketsarin Yamklang, 2011).

The income is an another factor that affects the problem on paying the tax due to the personal income tax collection is the progressive rate, the earner who has income less than 150,000 baht per year is not obliged to pay the tax to the Revenue Department. While the earner who has high income will have the attitude on paying the tax that changes upon the income level as the research work by Andreoni et al. (1998) found that the taxpayers tended to avoid the taxes more when the income level increased. However, Houston and Tran (2001) found that the group samples with low incomes tended to avoid the taxes as well by reporting their income less than the actual amount and reporting the amount of expenditure higher than the actuality when compared to the group samples with high incomes.

The Rajamangala University of Technology Suvarnabhumi's personnel has had many categories of income resources such as the administrators have salary, position allowance, and special emolument as their incomes, the professional lectures such as engineering and accounting, the salary,

earning as consultant, compensation for supervision and accounting audit, etc. In relation to the study on the problems on paying the personal income tax by Nathawan Suksawat (1997), it found that the problems involving the classification of assessable income category has caused by the law determined and divided the assessable income into 8 categories and each category deducted the expenditure in different forms. Responding such reasons mentioned above, the author is desired to do the research project of the problems on paying the personal income tax of Rajamangala University of Technology Suvarnabhumi's personnel. The objectives are to study the problems on paying the personal income tax of Rajamangala University of Technology Suvarnabhumi's personnel and the differences of such problems classified by the status, position, income level and a number of income categories.

In accordance with this research, the author has set the hypothesis as follows:

1. The problem on paying the personal income tax of Rajamangala University of Technology Suvarnabhumi's personnel is at moderate level.

2. Differences of personal income taxpayer's status show having different problems on paying the personal income tax.

3. Differences of personal income taxpayer's position show having different problems on paying the personal income tax.

4. Differences of personal income taxpayer's income level show having different problems on paying the personal income tax.

5. Differences of personal income taxpayer's a number of income categories show having different problems on paying the personal income tax.

Methodology

This research was aimed to study the problems on paying the personal income tax of Rajamangala University of Technology Suvarnabhumi's personnel. The population used in this study included 614 university personnel (Administrators = 30, Lecturers = 584). The study was conducted with 270 group samples (Administrators = 30 and Lecturers = 240). Determination of size was used in relation to Krejcie and Morgan's Table (1979) via the Simple Random by determining the deviation at 5% and level of confidence at 95%. Following the combination of concepts and theories from documents and related research works, the framework for the study was determined as follows:

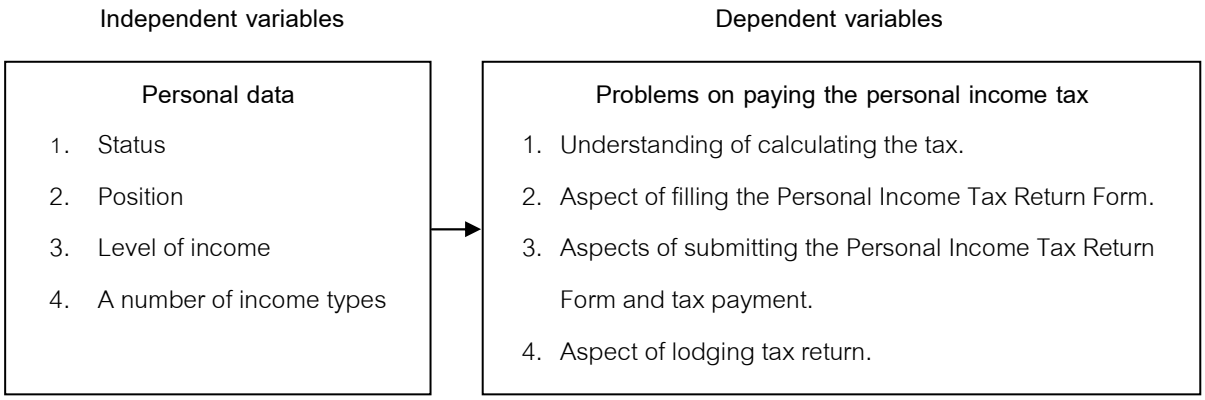

Figure 1 Conceptual framework

This research used the questionnaire as a tool for data collection. The questionnaire was divided into three parts as follows:

Part 1 Personal data.

Part 2 Data on paying the personal income tax.

Part 3 Problems on paying the personal income tax.

The characteristics of questionnaire is the Rating Scale Questionnaire with 5 levels for measuring the level of problem difficulties (1 = having least problems to 5 = having maximum problems).

In terms of measurement of problems on paying the personal income tax of Rajamangala University of Technology Suvarnabhumi's personnel on each aspect, the author has calculated the levels of problems' means by using the criteria on comparison of levels as follows:.

4.51 – 5.00	=	Level of having maximum problem
3.51 – 4.50	=	Level of having much problems
2.51 - 3.50	=	Level of having moderate problem
1.51 – 2.50	=	Level of having less problem
1.00 – 1.50	=	Level of having minimal problem

The author has prepared 30 copies of sampling questionnaire for testing with the target group and the gained results of the test were then corrected of the points of error in order to correct and improve the questions, obviously and enabled to achieve the data matching with the research objectives.

The statistics used in the study:

1. Basic statistical statistics used for data analysis of the questionnaire, Part 1 and 2:

1.1 Percentage.

1.2 Mean.

1.3 Standard deviation.

2. Statistics used for finding the tool quality:

2.1 Analysis for finding the discrimination of question by Item-Total Correlation Method.

2.2 Analysis for the reliability of question by using the Cronbach's Coefficient Formula.

3. Statistics used for testing the hypothesis:

3.1 Testing of hypothesis 1, the statistics used included Mean ($\bar{x}$) and Standard deviation (S.D.)

3.2 Hypothesis 2 and 4, the statistics used included One-way ANOVA when finding statistically significance, then the comparison was conducted by using the paired mean with Fisher Fisher's Least Significant Difference.

3.3 Hypothesis 3 and 5, the statistics used included Independent-Samples T Test.

Results

Resulting from a summary of gained personal data after receiving 212 copies of questionnaires (Administrators = 16, lectures = 196), it found that the majority of respondents were between 31-40 years of age (44.3%), having married status (50%) and finished master degree (70.8%), as lecturers (92.5%), non-academic position (76.9%), having average monthly income between 10,001 - 20,000 baht (43%).

In relation to data on paying the personal income tax, it found that the respondents had the single 40(1) category (76.8%), submitted the personal income tax return form via the internet and by itself (66.5 % and 76.4% respectively), did not submit the half year-personal income tax return form (88.2%), knew the schedule for submitting the personal income tax return form (88.2%), knew the criteria on deducting the expenditure for calculation of income tax (80.2%), used the personal deduction right (100%), used the form 91 for submitting to pay the personal income tax of year 2010 (84.0%), never request for lodging tax return (76.9%), never attended the lecture on taxation (84.9%), used to read the instructions for filling out the tax pay list form (67.0%) and never been assessed by the Revenue Department (92.5%).

It has concluded that the respondents had personal income tax's problems in overall aspects at moderate level (Mean = 2.78) and in each aspect of personal income tax's problems were also at the same moderate level as shown in Table 1;

Table 1 A summary of testing results of the hypothesis, problems on paying the personal income tax of Rajamangala University of Technology Suvarnabhumi's personnel.

Hypothesis of research	$\bar{x}$	S.D.	Results
Levels of problems on paying the tax of each aspect			
Understanding of personal income tax calculation	2.95	0.82	Accept hypothesis
Filling out the personal income tax return form	2.84	0.81	Accept hypothesis
Submission of the personal income tax return form and tax payment	2.66	0.84	Accept hypothesis
Request for lodging tax return	2.68	0.92	Accept hypothesis
Problems on taxation classified by taxpayer data	Statistics used	Sig. value	
Understanding of personal income tax calculation			
Status	ANOVA	0.151	Refuse hypothesis
Position	T-test	0.740	Refuse hypothesis
Level of income	ANOVA	0.095	Refuse hypothesis
A number of income categories	T-test	0.789	Refuse hypothesis
Filling out the personal income tax return form			
Status	ANOVA	0.278	Refuse hypothesis
Position	T-test	0.466	Refuse hypothesis
Level of income	ANOVA	0.035*	Accept hypothesis
A number of income categories	T-test	0.807	Refuse hypothesis
Submission of the personal income tax return form and tax payment			
Status	ANOVA	0.205	Refuse hypothesis
Position	T-test	0.161	Refuse hypothesis
Level of income	ANOVA	0.649	Refuse hypothesis
A number of income categories	T-test	0.271	Refuse hypothesis
Request for lodging tax return			
Status	ANOVA	0.039*	Accept hypothesis
Position	T-test	0.120	Refuse hypothesis
Level of income	ANOVA	0.071	Refuse hypothesis
A number of income categories	T-test	0.903	Refuse hypothesis

* At a significance level of 0.05

The following Table 2 showed the results of testing the levels of problems on paying the personal income tax in each aspect were different in relation to personal data (status, position, income level and a number of income categories).

Table 2 Results of testing the levels of problems on paying the personal income tax classified by personal data.

Personal income taxpayer's personal data	Categories of problems on paying the personal income tax			
	Understanding of tax calculation	Filling out the personal income tax return form	Submission of the personal income tax return form and taxation	Request for lodging tax return
Status	✘	✘	✘	✓
Position	✘	✘	✘	✘
Income level	✘	✓	✘	✘
A number of income categories	✘	✘	✘	✘

Remarks: ✘ = Having no correlation, ✓ = Having correlation

As shown in Table 2, it indicated that differences of position and a number of income categories did not enable the levels of problems on paying the personal income tax differently in numerous aspects. Responding the personal data related to the status, it found that different status enable to the levels of problems on paying the personal income tax in aspect of the request for lodging tax return, differently. Meanwhile, resulting from an additional study, it found that the personal income taxpayer with having single status would have the problems on paying the tax more than those with other status. In relation to personal data in aspect of income level, it found that differences of income levels resulted to the levels of problems on paying the personal income tax, differently. Also, resulting from an additional study, it found that the personal income taxpayer with income level of 20,001 - 50,000 baht would have problems on filling out the personal income tax return form more than those with other income levels.

Discussion

As seen in the results of the study, it indicated that the problems on paying the personal income tax of the personnel of Rajamangala University of Technology Suvarnabhumi, overall and each aspect, were at moderate level. Those problems involved with the understanding of tax calculation which was consistent with the research work presented by Panitnat Yensap (2008), A Study on Knowledge and Attitude on Personal Income Tax, it found that the knowledge concerning the personal income tax of the sample group which comprised of government officers, enterprise employees, employees of private businesses in Bangkok, most of them had knowledge at moderate level, they had problem of filling out

the personal income tax return form and it was consistent with the research work presented by Pitchaya Uthairat (2012), A Study of Consent to Pay the Personal Income Tax under the Revenue Code, it found that in aspect of improvement of the management system on taxation, the taxpayers required to improve the personal income tax return form (P.N.D. 90 and P.N.D. 91) in order to achieve more convenience of paying the tax by reducing the procedures of self-assessment for remaining the least.

It found that the problems concerning submission of the personal income tax return form and payment of personal income tax were consistent with the recent study presented by Surachet Chaosin (2009), A Study on Persuasion to the Taxpayer for submission of the personal income tax return form 2012 (Form P.N.D. 90, P.N.D. 91) According to the Schedule of the Local Revenue Office, Mueang Samut Prakan Branch 1, Mueang District, Samut Prakan Province, it found that the problems that caused the submitting the Form P.N.D., lately, i.e. Insufficient financial sum to pay the tax, incomplete documents for submitting the Form P.N.D. and impolite behavior of officials and the problem concerning the request for refunding of personal income tax which was consistent with A Study on Satisfaction of the Taxpayers on submission of the Form P.N.D. and Tax Payment via the Internet in Bangkok Area, presented by Utsanee Korjittavanit and Monwika Phadungsit (2010) which recommended about the request for lodging tax return and the very late consideration of request for lodging tax return due to ineffectiveness of the process for requesting of lodging tax return documents resulted to the taxpayers lost the time to send the documents several times and it also resulted to the request for lodging tax return becoming lately.

In relation to classification of problems on paying the personal income tax, it indicated that differences of positions did not let the levels of problems on paying the personal income tax in numerous aspects be different. The academic and administrative emoluments of the university personnel were regarded as the income derived from the duty or job positions done whether such jobs or positions would be permanent or temporary which characterized as the assessable income under Section 40 (2) of the Revenue Code, the taxpayer is required to bring the income for submitting the personal income tax return with the Form P.N.D. 90 (Department of Revenue, 2006) which had the practical guidelines for paying the income tax as same as the income, 40 (1). It was inductive that the problem on tax was not different from the personnel who did not have academic and administrative positions. Responding consideration of details of income categories of the respondents at this time, it found that the respondents had another 5 categories of incomes exceptional from 40 (1) i.e. 40 (2) (4) (5) (6) and (8) which was consistent with A Study on Problems of Personal Income Tax presented by Nathawan Suksawat (2007), it found that the assessable income that the taxpayer misclassified the category and let cause the problem on deduction of the expenditure were the income in categories of 40 (1) (2) (3) (6) and (8). However, for the personnel of Rajamangala University of Technology Suvarnabhumi, even though there would be different number

of income categories, but it did not let the levels of problems on paying the personal income tax in various aspects be different.

In relation to differences of status, it found that there would be problems on paying the personal income tax in aspect of the request for lodging tax return, differently. This showed that those whose status were single would have the problem on the request for lodging tax return more than those with the other status. It was analyzed that the problem on the request for lodging tax return caused by the earner had the tax to be paid less than the withholding tax at source. Mostly, it was caused by the single person because it had low tax base whilst the law regarding the submission of the form P.N.D. of the couple of marriage at the doing the research also provided his wife with income in addition to 40 (1) would have to take the income in combination as the income of her husband. This let enable the tax base of the couple of marriage higher and would have to pay the tax. The opportunity of causing the problems on refunding the income tax from the Department of Revenue seemed lesser. However, such law is currently corrected because it is contrary to the constitution on the equality of male and female in accordance with the decision No. 17/2555 dated July 4, 2012. Thus, let the husband and wife are able to separately submit all categories of incomes (Kanittha Ninrattanon and Dr. Monvika Phadungsit, 2013). Thus, there would be no differences of the problems on the request for lodging tax return even though there would be different status from now on.

It also found that differences of income levels would have the problems on paying the personal income tax in aspect of filling out the different form P.N.D. by the earner who had income levels of 20,001 - 50,000 baht would have the problems on filling out the form P.N.D. more than those who had other income levels at present in accordance with the measures to stimulate the state economics which found that those with a monthly income of less than 20,000 baht would have net income under the rate interval that was exempted of the tax (Khemvika Tangprakayroj, 2010) and the result of study found that those who had income higher than 50,000 baht often hired the others to fill the form P.N.D. Thus, the problem in this matter has mostly occurred with those who had income levels of 20,001 - 50,000 baht.

Conclusion and Suggestion

The research on the problems on paying the personal income tax of Rajamangala University of Technology Suvarnabhumi's personnel aimed to study the problems on paying the personal income tax of Rajamangala University of Technology Suvarnabhumi's personnel and the differences of such problems classified by the status, position, income level and a number of income categories. Data collection was conducted via the questionnaire with the personnel of Rajamangala University of Technology Suvarnabhumi and analyzed by using numerous kinds of statistics and other methods such as the basic statistics (Percentage, Means and Standard deviation), Item-Total Correlation Method and

Cronbach's Coefficient Formula. The findings revealed that most respondents had problems on paying the personal income tax, they included: Problems on the knowledge, understanding of the personal income tax calculation, filling out the personal income tax return form, submission of ordinary personal income tax return form and tax payment. It found that the problem of requesting for lodging tax return was at moderate level, the taxpayer with different status would have different problems on requesting for lodging tax return and different levels of income would have different problems on filling out the personal income tax return form.

Responding the problems mentioned above, the author has proposed the guidelines for solution as follows:

1. The government should encourage the people to realize that payment of personal income tax was the responsible function of the people.

2. The Revenue Department was needed to define the eight categories of personal income tax, obviously and released to the public for acknowledgement. The tax pay list form would have be improved to be easy to fill out the data, the manpower rate of officers for providing the service to submit the tax pay list form should be increased in the period of closing to the expiration and provided the obvious policies to the officers in matters of condition and period of request of lodging tax return and in the future the technology for proofing the identification should be applied as well as transfer of lodging tax return via the online system.

3. The financial officers of the agency being responsible for deducting the withholding tax at source would have to ask the document for deducting of the income earners, completely. The services should involve the submission of the personal income tax return form and tax payment to the income earners, and should provide the documents for annual income calculation to be completed at the end of the year, at once.

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Reflection on Language Program Development via Practical Inquiry Lens in the Contexts of Australian and Thai Institutions
- Different but Alike -

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Abstract

This paper is to reflect both productive and challenging issues in current language program development experienced in a high school in Australia and universities in Thailand through the theoretical framework of Practical Inquiry. The reflection, from the eyes of an English language teacher who is seeking for a better understanding in the change, more appropriate practices in teaching, and a more appropriate place to stand as a professional, is developed by comparing and contrasting not only the actual situations in language program development but the interactions among the four curricular commonplaces: 1) teachers, 2) learners, 3) subject matter, and 4) milieu, in which the institutions, administrative policies, parents and job market are taken into consideration.

Keywords: Language Program Change, Practical Inquiry, Interactions among Curricular Commonplaces

Introduction

As the ASEAN Community in 2015 approaches, Thailand is gearing up in all different aspects getting herself ready towards the change, including an effort to foster educational cooperation among ASEAN Members States. The situation now strengthens the significance of English as the major communicative tool in the ASEAN Community. Therefore, it is a challenging issue, especially among "TESOL practitioners", regarding the "reform" that strives not only for our students' achievement in English proficiency but also our challenge in TESOL profession, in getting the two parties ready to study and to work in the currently "changing" community.

In perceiving that "change" is necessary, it is also important to realize that we, TESOL practitioners, can both affect and be affected by dynamic interactions among different shareholders, no matter in which position we are, either on the receiving or initiating end of change. Even though it is the best not to step on anybody's toes, it does not mean "change" should be ignored on the expense of a "student-satisfying" language program which works for the students' needs while striving for their achievement.

Fullan and Miles (1992) also mentioned that teachers need not only to make the change process more explicit within their own minds and actions, but also contribute to the knowledge of change on the part of those with whom they interact. In this paper, I therefore share some experiences regarding the

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language program development in both Australia's and Thailand's contexts by looking at it through Schwab's Practical Inquiry framework, in which the interactions of the teachers, one of the four major curricular commonplaces (teachers, students, subject matters, and milieu) with the others are mainly focused. Furthermore, some challenging issues are taken into account with hope for certain changes in TESOL profession.

Materials and Methods

1. Theoretical framework

As a teacher who has been striving for the achievement of the students in mastering English proficiency particularly in the time of "change", I perceive myself as a part of the cogwheel that can both affect and be affected in the dynamic interactions among different curriculum shareholders. To better understand my roles and what contributions I can make to the institution; therefore, it is necessary to understand how the relationship among the curricular commonplaces in a particular teaching context is like at the start.

If the relationship among the curriculum shareholders is concerned, Schwab's Practical Inquiry appears practical to be used as the theoretical lens to look into each teaching context because, according to Schwab, the curriculum is viewed as the result of a dynamic interaction among four commonplaces: 1) teachers, 2) learners, 3) subject matter, and 4) milieu (see Schubert, 1994; and Lange, 1990).

And if the contributions among the TESOL professionals towards the language program "change" are expected, the Practical Inquiry, stated by Coulson and others (2012), becomes one of the most effective tools used in looking at the curriculum as the fact that the orientation, processes and purposes of the Practical Inquiry begin and end with practice.

And if the belief that teachers can also be the initial end of "change" and that "change" is also needed as a part of our profession, the Practical Inquiry is therefore an appropriate framework for teachers to work within. It is because Practical Inquiry is based on the following four assumptions (see Schubert, 1986):

1) The source of problems is found in the actual state of affairs, not in the abstract conjuring of researchers who tend to imagine similarities among situations that cannot be grouped together defensibly.

2) The method of practical inquiry is interaction with the state of affairs to be studied, rather than detached induction upon it and deduction about it.

3) The subject matter sought in the process of practical inquiry is situational insight and understanding, instead of law-like generalizations that extend across a wide range of situations.

4) The end of practical inquiry is the increased capacity to act morally and effectively in pedagogical situations, not primarily the generation of generalized, publishable knowledge.

2. Background information

In this paper, the reflection is mainly on the language programs implemented in particular institutions experienced both in Australia, where English functions as the primary language, and in Thailand, where English plays a less significant role as a foreign language. The reflection is developed in a comparative style comparing the Australian and Thai contexts. For better understanding the issues, the background information of the relevant education providers, their language programs and their goals are discussed.

2.1 Language Programs at an Australian Institution

The language programs at this particular Australian education provider, which serves non-Australian students, are based on the philosophical view that English literacy is a key for the disadvantage migrant students to step into the mainstream of Australian society i.e. the university education and the job market. Though the deficiencies in literacy among the students might be viewed as the school's disadvantage, it is on the contrary perceived as a prominent factor for the bilingualism which should be capitalized among the students through the implementation of two innovative language programs: LOTE (Language Other Than English) and Write it Right.

2.1.1 LOTE Program

Regarding LOTE (Language Other Than English) program, the role of the community languages, Greek and Macedonian, is emphasized and brought out as the student's strong point in terms of bilingualism. The native tongues here are considered great support on the student's English proficiency and at the same time they can also help maintain the migrant students' cultural identity.

2.1.2 Write It Right Program

Moreover, with Write it Right program, English is taught by means of genre approach. This instruction method is claimed to make the rules of the English language visible for the non-native students through a great exposure to the language.

2.2 Current Language Teaching Trend in Thai Institutions

In Thailand, it is undeniable that English is playing a more and more important role in socio-economic aspects in life of many people. It is widely accepted that accessing to English or lacking of it often affects the social mobility and life opportunities of many people who do not speak the language. Consequently, several education providers offer a series of English programs that are claimed to help their students to achieve good command of English, promising that they could meet the current demands of the job market and higher education.

2.2.1 Communicative Approach

The role of English in ASEAN is strongly supported by Article 34 of the ASEAN Charter in stating that English is the working language of the community. Therefore, it seems outdated if the phrase "English as a lingua franca" has never been brought into discussion among TESOL practitioners in the Community. Regarding the current role of English in ASEAN, it therefore vocalizes the need for English language program development and it is again that the communicative approach will be reemphasized as the means to help the students to learn to speak the language through meaning-based tasks.

Reflections and Discussions

Perceiving myself as a "change" agent, one of the responsibilities towards "change" suggested by Fullan and Miles (1992) is not only to make the change process explicit in our own mind and actions, but to contribute the knowledge of change to whom we interact. Therefore, through this reflective paper, my experiences and views regarding possible changes are shared with the framework of Practical Inquiry in mind. In addition, as a teacher who believes that we can initiate "change" in our profession, this reflection therefore mainly focuses on the part of the teacher, a majority of people, as "change" must deal with existing conditions so that "change" is normal and possible for everyone to move forward (Fullan, 2001). Through this paper, the interactions between teachers and other curricular commonplaces can be viewed as a "mirror" that reflects state of affairs in different contexts of education meanwhile giving insights about the teacher's role in the multi-faceted interrelationship leading towards our future change.

1. Interactions between teachers and teachers

Teachers can be considered one of the most dynamic curricular commonplaces. The interactions among teachers themselves have a great impact on the teaching profession and also other commonplaces. Based on Practical Inquiry, the ways how teachers view other teachers, how they encourage and assist one another, and how they respond to their colleagues who try innovative ideas and new teaching approaches are taken into consideration.

1.1 Differences and similarities in practice

"Who are the teachers of English in these two contexts?"

In the context of this Australian school, the teachers are from non-English speaking background (Greek, Macedonian and Chinese) whose bilingualism enables them to walk into the job market in this English speaking country. Similarly, in the context of Thai institutions, most teachers of English are non-native English speakers (Thai, Philippine, and Burmese) whose bilingualism also enables them to get a job as an English language teacher. However, the number of native English teachers is getting higher and higher due to a simple fact that we would like to help our students to experience English speaking environment and English writing genres, noticing that both conversation and writing courses are mainly assigned to the native English teachers.

"How do the teachers encourage and assist one another?"

The major difference observed in both contexts is the act of sharing. In the context of this Australian high school, some teachers of the same subject share their teaching materials and discuss on the lessons. It is rather different from Thai contexts where teachers mainly discuss about their students' performance and study habits. However, they avoid getting into other teachers' business and it is considered intrusive and losing face to ask for someone else's teaching materials, except those in the same accompanying group.

"How do the teachers respond to their colleagues who try new approaches?"

Regarding this issue, it is surprising to notice that some teachers in a Thai context discuss seriously on the disadvantages and ineffectiveness of communicative approach used in the institution. However, it results in the continuation of their preferred style of teaching that they believe suits best their students. Back to the school, in contrast, no evidence on this act is observed. The teachers there may not want to step on the toes of other teachers, and they choose merely to observe the change.

1.2 Evidence of productive issues

The evidence of sharing class materials and discussion on the lessons and the student's study habits and performance is clearly observed in both contexts. This is a good sign for the collaborative culture, which can be initiated and then developed from this voluntary act of sharing and collegiality among teachers (see Hargreaves & Dawe, 1990; Fullan, 1990; 2001).

1.3 Challenging issues towards our future change

As being a "change" agent, I am looking forward to seeing a changing school culture, leading towards a last-long collaborative culture in which teachers not only of the same subject but also of different fields interact with one another for mutually support. The extensive discussion across the teaching fields will help the teachers plan their lessons in more cooperative way enabling the student to see that English is not only a subject separated from their major field of study, but a part of it. If the collaborative interactions among teachers help link different subjects together, the linked subjects will help strengthen one another, and the benefits of this integrative approach will be definitely for all of the shareholders, especially our students. The first step of this success is therefore from the supportive interactions among teachers as Fullan (2001) also claimed that the key of successful change is the improvement of the relationships that it is worth challenging.

2. Interactions between teachers and learners

From my part as a language teacher, the interactions occurred among teachers and learners are actually the core part of education. The achievement in education is not in terms of the content knowledge only, but the valuable attitudes and behaviors that the teacher models on their students are also included. However, oftentimes people are only striving for the "content" knowledge, and it results in a "misshaped" educated person who causes dangerous harm to the society. Based on Practical Inquiry,

the ways the teacher model attitudes and behaviors, what image of an educated person the teacher gives their students and how they convey messages about important and valuable things are taken into account.

On the contrary, if the achievement of the content knowledge is only concerned, the success of teaching and learning also depends greatly on these two important, dynamic shareholders: teachers and learners. Despite possible limitations in terms of facilities, the student's background and background knowledge, the success in learning can possibly happen through the ability of the teacher in bringing out the strong aspects of learners' personalities and their different learning styles to fit with their teaching techniques. Therefore, from the framework of Practical Inquiry, the ways to improve the interactions among persons in a group of teachers and learners are rather challenging and worth trying.

2.1 Differences and similarities in practice

"What aspects of learners' personalities does the teacher bring out?"

In the Australian context, the home language which first seems disadvantage for the migrant students is instead brought out as learners' strong aspect of bilingualism. The native tongue is viewed as a supportive tool in both striving for English proficiency and in maintaining cultural identity. On the contrary, in Thai contexts, the native language is not generally viewed as a supportive tool in acquiring English, but rather a great barrier in achieving good communicative skills in English. It is clearly evidenced by the "English-Speaking Zone" practiced by Thai teachers by which their native language is temporarily blocked out.

"How does the teacher model attitudes and behavior and convey messages about what is important?"

The strength of bilingualism is conveyed visibly to students in both contexts. Regarding the situation in Australia, it is clearly seen that the teachers of English with non-Anglo background are by themselves the good models of those educated migrants whose English proficiency gets them into the mainstream of Australian society. Moreover, these migrant teachers are the source of inspiration for the migrant students in the sense of bilingualism and tolerance in living in a multicultural society. Similarly in Thai contexts, although the strength of bilingualism is not reflected as clearly as in Australia, the non-native English teachers particularly with Thai nationality are the examples of educated persons who are accepted in this competing job market. Their strength in achieving good command of English also has a psychological impact on learners in accepting their teacher as not only a knowledgeable person who can teach them but also a role model.

"How does the "chemistry" of learners affect the teacher?"

The term "chemistry" defined here is the atmosphere created by a group of learners which influences on the teacher's interaction with the whole class. The different "chemistry" between the two parties can also be reflected through the effectiveness of a teaching practice. In this Australian context,

talkative and energetic students are offered a good chance to speak their ideas to the class, which creates a distinctively responsive class. In contrast, no matter due to what reason, the students in a Chinese class are more controlled and rather tense. This “chemistry” is obviously the result of a “teacher-centered” classroom. However, it is skeptical enough to notice that, in the latter case, the undesirable “chemistry” of learners such as being either talkative or inquisitive might be suppressed, and instead the “chemistry” of this Chinese teacher, who is quiet and serious, prevails.

It is not much different in these two contexts in Thailand, most of the teachers who teach English to non-English majored students need to plan different activities for different groups of students. Some teachers are assigned to teach particular groups of “special” students, who have inadequate background knowledge of English, lack motivation in learning it, and have some difficulties in concentrating to class, due to their potential characters in dealing with a variety of unexpected “chemistry” of these students.

2.2 Evidence of productive issues

The role of teachers is not limited to the content knowledge, but they have a great influence on the learner in terms of psychological impacts: learning motivation, life inspiration, and role models of successful educated persons.

Moreover, in the part of the teacher, the acceptance of the “chemistry” of learners and the willingness to adjust their teaching technique and to design more appropriate materials for the benefits of the learner are the challenging parts of the profession.

2.3 Challenging issues towards our future change

It is undeniable that native English speakers are highly esteemed as qualified teachers of English in many countries including Thailand. The need and, of course, the pay for native English teachers is rather high comparing to those competent in English but from non-Anglo background who have the same education qualifications or even higher. In this Australian context, the advantages of ethnic background and strength in bilingualism are promoted. In Thailand, recruiting the teachers who share the same mother tongue and similar background with the student should be reconsidered the strength of the program. According to Fullan (2001), he also emphasizes that the teaching profession needs reform in recruitment and selection of teachers. For me, an efficient teacher is not just “a walking teaching-degree” but it must be a person who is ethical and sympathetic. For that reason, the recruitment criteria should not rely restrictively on the academic qualifications at the expense of finding a person with the “heart’ of a good teacher which cannot be detected by a paper-based test or just simply a usual interview.

Despite different characters the teacher may possess and the preferred “chemistry” expected from the part of the student, the understanding of the need for student analysis: backgrounds, personalities and learning styles, and the act of “negotiation” will improve the interaction between the teacher and the student which can result in better understanding. This positive atmosphere is helpful in

lesson planning and the design of classroom activities to suit learners, yielding in benefits for the two parties.

As being a member of Thai TESOL profession, I perceive the approaching ASEAN not as a threat but the right turning point for "change" so that we are qualified to compete in the "no-frontier" ASEAN English teaching job market.

3. Interactions between teachers and subject matter

Based on Practical Inquiry, the question is on how the teacher's knowledge of a subject and their attitude towards a subject can directly affect the subject matter. Imagine if a teacher who does not prefer reading newspapers or watching news is assigned to teach English in Newspapers, what image of the subject will be conveyed to students and how different will the interpretation of the subject matter be like, comparing to that of an enthusiastic teacher who always reads English newspapers? Likewise, the question is what impact the teacher with broader and deeper knowledge of a subject can give on their class and students.

In contrast, the subject matter including textbooks, materials and curriculum guides can affect the teacher as well. The question here is therefore what constraints the subject matter has on the teacher and how the commercial textbooks and materials control over their teaching.

3.1 Differences and similarities in practice

"How does the teacher's knowledge of a subject and their attitude towards it affect the subject matter?"

In this Australian context, the genre approach is considered an innovative method for the "Write It Right" program in making the rules of the English language noticeable and learned through a great exposure to the English literature. The classroom practice here reflects the teacher's perception on the subject matter in the way that the students will be able to write English accurately if they experience a lot of reading in the target language. However, the exclusive use of English literature on the expense of learning how to write in English is questioned. In a Thai context is alike, the teacher's knowledge and interpretation of the subject matter, to a great extent, affect classroom instruction. It is observed in an English Pronunciation class where jazz chant is used in teaching intonation patterns instead of the intonation line with 4 different levels of voice pitch.

Moreover, the teacher's attitude towards the subject matter can obviously have impact on the subject and definitely on the class as a whole. It is evidenced when a native Thai teacher of English who loves talking and enjoys speaking English can create a productive and interactive conversation class atmosphere. Also, a series of English speaking activities both in and after class reflects highly positive attitude towards the subject and in providing English speaking opportunities for the student. Such productive atmosphere can also be noticed in English for Airline Business and translation classes, of

which one of the two teachers is a training personnel in an airline company and the other is a professional translator respectively.

"How do the commercial textbooks and materials control over the teaching?"

Regarding the control of the teaching materials over the instruction, it is not evidenced in this Australian context because no purchased materials are exclusively used, unlike the Thai contexts where commercial textbooks and teaching materials are extensively used. These commercial materials are usually perceived as the blueprint which controls over the content, teaching plans, class activities and oftentimes teaching style. Moreover, Anglo-culture oriented commercial textbooks cause constraints on the teachers who are from non-Anglo background and of course somehow marginalize their students.

3.2 Evidence of productive issues

The teacher's specialized field of knowledge and relevant experiences are the key criteria used in making decision on the subject allocation. However, the teacher's productive attitude towards the subject matter is also needed to take into account. The attitude here is not what the teacher shows through their "words", but it is what they actually do.

In addition, the teachers with positive attitude towards the subject matter oftentimes come up with some innovative ideas about teaching which is for the learner's benefits. The creativity can reflect through new teaching approach and activities as well as their own teaching materials in which the teacher believe to enhance their learners' knowledge and proficiency in the subject.

3.3 Challenging issues towards our future change

Besides the doubt about the validity and reliability of the criteria in recruiting "reliable" persons to the English teaching profession, the concern is now on the expertise in the subject matter. It is true but hard to accept that once someone is admitted to the teaching profession, it does not mean that he/she is capable of teaching any subjects in the curriculum. One of the most unproductive factors resulting in "incapable" graduates is the subject knowledge and expertise in the part of the teacher. However, worse than having deficient knowledge and expertise in the subject, the teacher who does not dare to accept the cruel fact that they are "less" competent in the matter and continue being in the profession with no significant signs of self-development can cause subtle but harmful disadvantages to the learner. It can be concluded here that the teacher's either false perception of the subject matter, or self-deception together with selfishness will not harm only the student's opportunity in achieving English proficiency, but also their place in the profession.

In assuring a position in TESOL profession, continual self-development such as further studying, doing research or attending seminars and conferences sounds promising, but it is not as concrete as the actual implementation of the useful methods into teaching practice. Then, once the new idea is launched in practice, time and attentive feedback from the involved shareholders, especially the learner, are needed. It is similar to the process of "change" in which tolerance is needed in making "change" happen.

4. Interactions between teachers and milieu

The term “milieu” in this paper is not defined as only a classroom setting and ambiance, but it includes the institution, administrative policies, the principal, parents and the job market. Based on the Practical Inquiry, the way the teacher’s behavior, attitude, and general personality have an effect on the classroom atmosphere and physical classroom settings must be taken into account. On the other hand, the question then focuses on how the milieu affects the quality of teaching and personality of the teacher.

4.1 Differences and similarities in practice

“How does the teacher influence the classroom atmosphere and physical classroom settings?”

This issue is clearly evidenced in the Chinese class, in Australia, where the rigid character of the teacher influences the classroom atmosphere and physical setting. It results in a disciplined, quiet, but in my point of view lifeless classroom atmosphere. Here, the teacher’s general personality prevails and it reflects in a form of a tense and less-interactive class with a traditional facing-to-teacher seating arrangement where the teacher is the sole center of it.

In contrast, a more cheerful classroom atmosphere is observed in English classes. From this observation, it may simply assume that these two teachers have different behavior, attitude, and general personality which seem right with particular groups of students, comparing to the Chinese teacher’s. However, some differences regarding the student’s class participation and their performance can be observed in the two English classes. In LOTE class, where the native language is spoken, and in Write It Right class, where the student is greatly exposed to English literature, a more responsive class with tidily arranged seating and a noisier but less effective class with flexible group seating arrangement are seen respectively.

In Thai contexts, the two different types of classroom atmosphere and physical setting are generally seen. But it is rather interesting to notice that the facing-to-teacher seating is hardly observed in classes of those teachers with Anglo background.

“How does the milieu affect the quality of teaching and personality of the teacher?”

In this Australian context, there is no obvious evidence showing that common teachers have an influence on the school policy and administrators. The school policy on the role of the native language in learning English and the genre approach in teaching English writing, in contrast, affects the quality of teaching as the teacher may or may not have the right interpretation on the issues. In a Thai context is alike, the trend in using communicative approach in teaching is considered a trendy issue in program development and, of course, it becomes the policy. It causes constraints on teachers and oftentimes leads to a misconception on the teaching practice and definitely it results in a poor quality of teaching.

Besides the teaching policy, in Thai contexts, the teacher’s performance is evaluated in a series of writing documents. The teacher therefore spends most time for their own career growth instead of their

students' academic development that also needs time as marking, giving feedback, preparing materials and making some supplementary exercises are by themselves time-consuming but worth doing.

Moreover, a counter-productive culture is observed in both contexts. In a staff meeting, in an Australian school, the principal exclusively conducts the "one-way" talk while the teacher keeps quiet. In Thailand alike, teachers prefer to remain silent in the meeting but to talk about the issues after the meeting in vain. It is the so-called Thai culture which is learned from experiences that those who speak out their ideas will be marked out and oftentimes bring on difficulties. From these incidents, the reason in remaining silent is whether they are not given the opportunity to raise their voice or they are just avoiding in stepping on the toes of the principal or of other teachers.

4.2 Evidence of productive issues

That the teacher's behavior, attitudes and personality can have a great impact on classroom atmosphere is an interesting issue which the teacher who is aiming to develop productive relationship with their students should take in mind. The evidence seen in both contexts is that the more enthusiastic, warm and friendly teachers are more likely able to create a more cheerful and productive learning atmosphere, comparing to distant, cold and inactive teachers.

4.3 Challenging issues towards our future change

For the teacher, the "student-student" interaction model that is claimed for more effective and productive learning outcome is realized and went for. However, the "teacher-student" model is prevailed as observed in both Australian and Thai contexts. Even though students are given opportunities to speak out but the class has been conducted mostly through "teacher-student" model, it then can automatically marginalize some students who cannot step into the class discussion. For me, the cause of an intuitive tendency to "teacher-centered" classroom practice is possibly the traditional classroom culture within which teachers grew up and were exposed to from the very first day of classroom experience. If it is the case, it might be quite challenging for TESOL practitioners to cultivate a productive classroom culture while controlling the counterproductive "teacher-centered" model that standing by in mind.

Another challenge arisen from constraints and limitations the teachers in both contexts are encountering is how to create a new school culture through a "deliberative approach" through which every curricular shareholder is given opportunities to raise their voice in shaping the language curriculum (Fullan, 2001). In striving for a new culture, those in administrative positions need to "listen" more to other stakeholders: teachers, learners, parents, and job market. If this concern could be easily put into practice, the situations in which, for examples, 1) the school principal was conducting a "one-way" talk to teachers at a meeting and to both learners and parents at a parent meeting, 2) the teachers of English, no matter how they view on the new language program development, apply the "top-down" teaching policies: the first language enhances English proficiency and genre approach enhances English literacy, 3) several teachers in Thai contexts are overloaded with papers, needed for a just document-based

evaluation, aiming for their career advancement as so-called "certified" teachers, instead of the time spent on in striving for their learner's English proficiency, 4) the teacher is controlled by the purchased textbooks perceived as the program blueprint, 5) learners and parents remain silent but showing worrying faces during a parent meeting, and 6) employers make complaints about poor communicative competence in English of the graduates, would not have been easily observed in the two contexts of education provider.

Conclusion

The reflection, via the practical inquiry lens, gives a picture of an actual state of affairs in two contexts in which, superficially, it seems totally different. But, when looking at the interactions among shareholders in which teachers are focused, it appears much alike regarding impacts made by teachers and constraints they experience. Both the productive and challenging issues are viewed, in an aspect of local practicality, as guidance in achieving a "change" in a language program.

In seeking for a better understanding in the change, more appropriate practices in teaching, and a more appropriate place to stand as a professional, I then realize it is necessary to get a better understanding of one's own role, for me, as a teacher first, and then to work hard at understanding the situation of other roles, as one of the curricular shareholders who is ready for the changing situations. According to Fullan (2001), the ultimate goal of change is when people see themselves as shareholders. Then, a simple inquiry is "Are you also a shareholder in this teaching profession?" And if your answer is a "yes", then in short, "let's start and just do it, then let's see … there is a change at least."

Acknowledgement

I would like to specially thank Dr. Robert C. Kleinsasser, the School of Languages and Comparative Cultural Studies, University of Queensland, Australia, for giving such a great opportunity in experiencing a language program development in an Australian context, and the Division of Languages, Faculty of Liberal Arts, RUS Suphanburi Campus, to provide the time to complete this work.

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Media Exposure toward Social Responsibility of Students in Government Universities in Bangkok Metropolitan

Chantana Papattha[1*] and Nuttapol Sumataticom[1]

Abstract

The purposes of this research study were (1) to study the socialresponsibility behavior of the students, (2) to study different students' demographics of students in government universities in Bangkok Metropolitan showed different level of social responsibility, and (3) to study the media exposure towards social responsibility of the students in government universities in Bangkok Metropolitan. The data were collected through 400 students from seven government universities out of fourteen universities throughout Bangkok in 2012. Data analysis employed frequency, percentage, arithmetic mean ($\bar{x}$),and standard deviation (S.D.). Statistics used for hypothesis was stepwise multiple regression analysis. The study presented the following results:In general, the student's social responsibility was in high level and all factors were also in high level.Students with different educational achievement, average monthly income per household student had different social responsibility behavior with a statistical significance at .05. The three most influenced factors: newspaper, internet, and billboard had the effect on social responsibility behavior of the students with a statistical significance at .05.

Keywords: Media exposure, Social responsibility, Government Universities

Introduction

The problems of students in a university was the lack ofmoral, ethical and responsibilityof the students such as students committing serious crime for affair, students committing suicide for the failure from study, work, or love, students conducting inappropriate(aggressive, disrespectful, and unmannerly), and students had noresponsibility(WanlapaThephasadin Na Ayutthaya, 2000) [1].Therefore, the personnel in higher education management who was administrator and instructor should consider solving problems of students. Department of Curriculum and Instruction Development, Thailand (1999) [2] showed guideline to develop students' responsibility consisting of working intention, laboriousness, circumspection, work goals, accept the consequences, trying to improve the performance. Five social responsibility elements of students that function in society included family responsibility, university responsibility, community responsibility, national responsibility, and friend responsibility (CharinyaChalaoprakon, 2002) [3].

These research studies were to study the social responsibility behavior of students and study the media exposure towards social responsibility of the students ingovernment universities in Bangkok Metropolitan. The result of this research can be used as a guideline to design educational responsibility

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for students. The campaigns were useful to social responsibility activities for student such as volunteer activities, donation to disabled activities, and running charity activities.

In spite the fact that both public and private universities are working to the same goal on educational management, there are some differences aspects e.g. organizational goal, stakeholder accountability, managerial functions, and decisionmaking process to consider. Conditions, environment, structure, organizational culture, including priority setting of problems and educational management have differentiated universities of the two sectors. Therefore, the author has only focused the studies on students in government universities regardless of those students from the private institutes.

Objectives of the study

The objectives of the research study were (1) to study the social responsibility behavior of the students,(2) to study different students' demographics of students in government universities in Bangkok Metropolitan showed different level of social responsibility, and (3) to study the media exposure towards social responsibility of the students ingovernment universities in Bangkok Metropolitan.

Hypothesis of the study

1. Different students' demographicsincluding gender, grade, educational achievement, and average monthly income per householdof students in government universities in Bangkok Metropolitan showed different level of social responsibility.

2. The media exposure via television, radio broadcasting, newspapers, magazines, billboards, journals, internet, activities media, and personal media influenced social responsibility behavior of the students ingovernment universities in Bangkok Metropolitan.

Research Framework of the study

The research framework of the study in Figure 1 showed relation between Independent Variable and Dependent Variable. The dependent variables was students' social responsibility [3] consisted of five social responsibility elements of students that function in society included family responsibility, university responsibility, community responsibility, national responsibility, and friend responsibility.

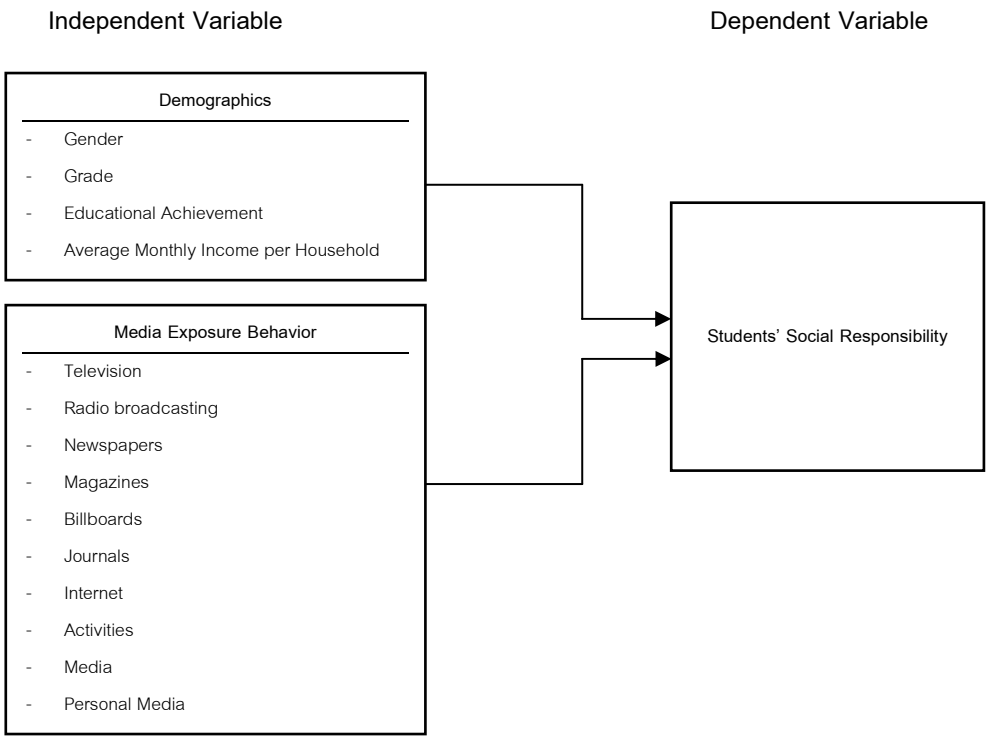

Figure 1: Research Framework

Materials and methods

This research was quantitative study. The questionnaire was used to collect data from the samples in the study. The use of questionnaires was considered as a data-gathering tool with the reliability at .845.The research results were presented in the form of tables and description.

Population in this study included the students ingovernment universities in Bangkok Metropolitan consisting of 400 sampling (Taro Yamane, 1967) [4]. They were students from seven universities in Bangkok includingKasetsartUniversty, Thammasat University, Srinakharinwirot University, Silpakorn University, ChandrakasemRajabhat University, SuanDusitRajabhat University, and SuanSunandha University by using the sample random sampling [5].

The statistics used in the analysis were frequency, percentage, arithmetic mean, and standard deviation. The statistics used in hypothesis testing was the multiple regressions by using stepwise multiple regression analysis method.

Results

The study reported the following results: most of the samples were female (57.80%), study in second-year (35.50%), school-record between 2.51-3.00 (39.00%), and family income between 20,001-25,000 bath (19.80%).

Media types that influenced social responsibility behavior of the students included television, radio broadcasting, newspapers, magazines, journals, brochures, billboards, internet, activity, and personal media. Eighty-eight point twenty percent (88.20%) of samples experienced all media. Twenty-nine point eighty percent (29.80%) had exposed to media approximately three to four days weekly. Ninety percent (90.00%) of sample had exposed to television media.

The student's media exposure behavior was in middle level. Most of the media exposure was television rated in high level ($\bar{X}$=4.17, S.D.=0.976).

The student's social responsibility was in high level and all factors were in high level i.e., national responsibility ($\bar{X}$=4.12, S.D.=0.471), friends responsibility ($\bar{X}$=4.00, S.D.=0.499), family responsibility ($\bar{X}$=3.97, S.D.=0.492), university/school responsibility ($\bar{X}$=3.83, S.D.= 0.539), and community responsibility ($\bar{X}$=3.66, S.D.=0.600).

Results of the hypothesis testing:

Students with different gender and grade had different social responsibility behavior with no significant differencesas shown in figure 2. Students with different educational achievement, average monthly income per household student had different social responsibility behavior with a statistical significance at .05 shown in figure 2.

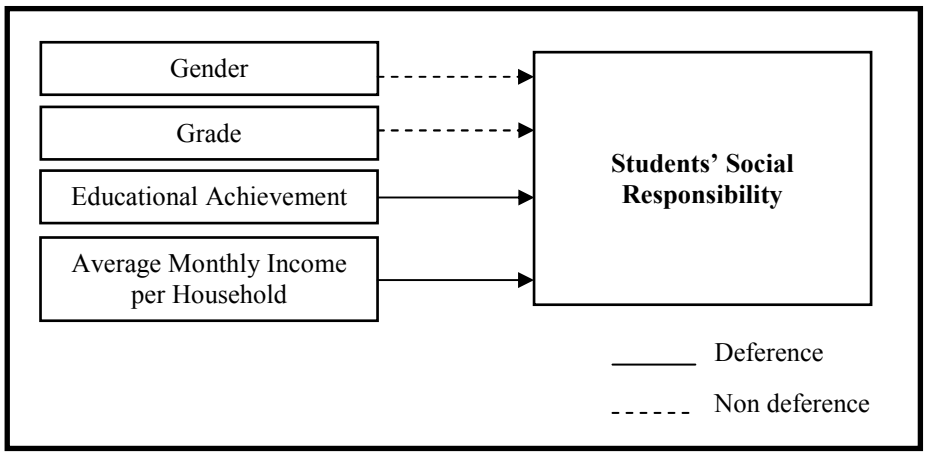

Figure 2: Results of the hypothesis testing

The media exposure behavior had effect on social responsibility behavior of the students with a statistical significance at .05. The newspaper had effect towards social responsibility behavior of the

students at 19.80 percent. The internet had effect on social responsibility behavior of the students at 10.30 percent. The billboards had effect towards social responsibility behavior of the students at 11.70 percentshown in figure 3.

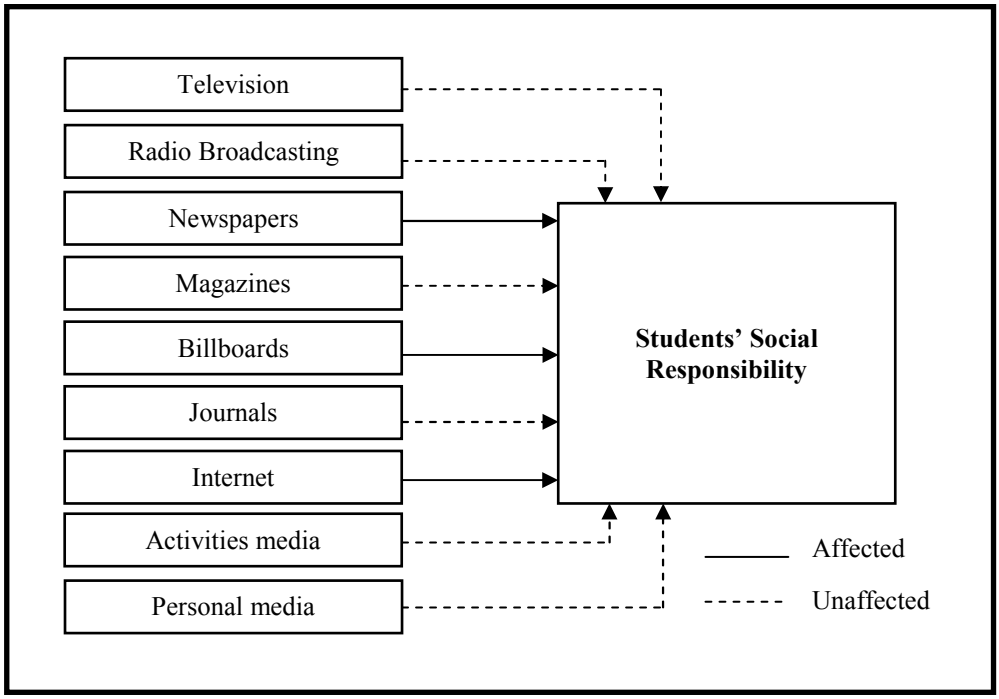

Figure 3: Results of the hypothesis testing

Discussion

Students with different gender had different social responsibility behavior with no significant differences which was according to the studies byParamaSatavetin [6], VakinWutthiwong[7], and MalineeChutopama[8].Even though, male and female were basically different in thoughts, value, and attitude, different gender did not differentiate the social responsibility level of the sampling students. This is because the students from the first to fourth years of university are almost in the same range of ages.

Students with different student grade had different social responsibility behavior with no significant differenceswhich was according to the studies byVakinWutthiwong [7] and MalineeChutopama[8]. It is because students from different grade experienced learning contents and activities unequally in a different way. However, every university had an effort to have their students embrace the spirit of volunteering including self and social responsibility for a better life in society.

Students with different educational achievement had different social responsibility behavior with a statistical significance at .05which was according to the studies byParamaSatavetin [6],MalineeChutopama[8], PacharinPathomwanichka [9], and KanokJankajorn [10].This is because students with better school record performed higher level of self and social responsibility than others.

Students who concentrated well on their studies gave priority on their education and then have more awareness on social responsibility.

Students with different average monthly income per household had different social responsibility behavior with a statistical significance at .05which was according to the studies by ParamaSatavetin[6], MalineeChutopama[8], UraiwanWatcharakumkrong [11]. Students from a family with higher income were found to have higher social responsibility than ones from the lower income. This is because the students from a lower income family were more focused on helping family working, thus, they were less on social responsibility consciousness.

The three factors that included newspaper, internet, and billboard had the effect on social responsibility behavior of the students with a statistical significance which was according to the studies by ParamaSatavetin[6] and Willbur Schramm [12]. The media was connective between sender and receiver. The media were factors towards efficiency of communication behavior. The sender might select appropriate media to send message to receiver that the media types had specific properties (ParamaSatavetin, [6]. The factors that influenced media exposure behavior consisted of experience, purpose, background, education and environment, capacity, personality, and attitude of receiver [12].

Conclusion

The media exposure about social responsibility had experiences to 88.20%, 3-4 days of media exposure to 29.80% weekly, and most of the media exposure to 90.00% was television. The student's media exposure behavior was in middle level. Students with different gender had different social responsibility behavior with no significant differences. Students with different grade had different social responsibility behavior with no significant differences. Finally, the three factors consisting of newspaper, internet, and billboard had the effect on social responsibility behavior of the students with a statistical significance at .05.

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A Comparison of Learning Achievement via Computer Assisted Instruction of Undergraduates with Different Learning Styles

Benchaporn Sawangsri[1*]

Abstract

The study aims to 1) develop a Computer Assisted Instruction (CAI) on the topic of Derivative for students who have different learning styles in order to achieve its efficiency criterion at 80/80, 2) compare students' learning achievement with different learning styles studying via computer assisted instruction, and 3) examine students' satisfaction towards Computer Assisted Instruction. The sample group consisted of 53 undergraduates who enrolled Calculus I in the second semester of the academic year 2013. The instruments in this research are 1) Computer Assisted Instruction, 2) Learning Styles Inventory, 3) Learning Achievement Test, and 4) Questionnaire about Student's Satisfaction towards Computer Assisted Instruction. The data were analyzed by the statistical formula namely frequency, percentage, average, standard deviations, and F-test.

The results, first, considering in terms of Computer Assisted Instruction on the topic of Derivative towards students who have a different learning style, it appears that this CIA's efficiency is 82.75/84.40. Second, regarding the difference of students' learning styles, there is no much difference. Third, students' satisfaction via CAI is at high level $(\bar{x} = 4.17.S.D = 0.75)$

Keywords: Computer Assisted Instruction, Learning styles, Learning Achievement, Satisfaction

Introduction

Student's learning is the most important aspect of education. Teachers and stakeholders in education have tried to look for strategies for education management in order to change students' learning process. It is believed that there are three components for successful education: learner, instructor, and learner and instructor's interaction. Learner is considered the most essential component [1]. Teachers should emphasize on learner's nature especially learner's difference.[2] suggests that learners will find their path of learning by their own identity. They are able to acquire knowledge, learning process, and learning styles. The most essential aspect for teaching development is the understanding in learner's characteristic and learning styles. When teachers realize this aspect, they can respond and support their learners correctly.[3] describes that learning styles consist of mental personal character which indicate learning method and respond to learning environment. This is in line with [4]it is said that learning style is mostly used by learners. It is important to have the great awareness and understanding of learning styles.

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Education today emphasizes on child center. It is said the essential scheme in National Education Act B.E. 2552 [5] issue 22 as all learners are able to acquire knowledge and can develop themselves. In addition, it is considered that learners are the most important. Teaching management has to support learners. So, it implies that teaching material is important for encouraging "child center."

Nowadays, students have a variety of alternatives in terms of learning resources both online and offline such as e-learning, Web-Base Instruction (WBI), and Computer Assisted Instruction (CAI). CAI is one of the educational medium. It is not only making the classroom more vivid, but also interests the students to be more active. CAI refers to a computer delivers instructional contents or activities. CAI is a set of voice, text, graphic, animation, and video which interests the students well. Students learn by interacting with the computer and appropriate feedback is provided as the real time.

[6] examined about the Development of Computer Assisted Instruction Program on Counting Number for Matthayomsuksa 1. The findings show that the students' learning achievement after using the CAI was significantly higher than before using it. In addition, [7] investigated about a Development of Computer Assisted Instruction in Fraction for the Students in Prathomsuksa 6. It appears that the mathematic achievement in Fraction of students' learning with CAI is significantly higher than the students who studied with traditional process. From both studies, it can imply that CAI is useful for both teachers and learners.

Calculus I is a compulsory subject for undergraduates at Faculty of Engineering and Architecture and Faculty of Industrial Education. The content is about important functions, limit and continuity, derivatives, and integrals. In addition, the researcher has taught this course since 2007 and has planned to improve the teaching process, teaching and instruction respectively. A survey of problems found that most learners with moderate till low achievement, students cannot learn successfully according to their own needs. For the reasons stated above, the researcher decided to develop Computer Assisted Instruction for RUS undergraduates because the content is fundamental for the other courses such as multivariate integrals or derivatives. If the students understand the derivative, they can study other subjects better.

The purposes of this research are to 1) develop a computer assisted instruction on the topic of Divertive to follow the80/80 efficiency criterion; 2) compare students' learning achievement with different learning styles studying via computer assisted instruction and 3) to examine satisfaction of students towards computer assisted instruction.

Literature Review

An extensive literature consists of 1) Computer Assisted Instruction, 2) Learning Styles Theory, and 3) Previous Studies.

Computer Assisted Instruction

Computer Assisted Instruction (CAI) began in the mid-1950s as collaboration between Stanford University and IBM. It is one of educational medium in which a computer delivers instructional content or activities, CAI is used to instruct the student and contains the instruction designed to teach, guide, and test students. CAI can make the teaching content more interesting and fascinating. [8]. Students will be enhanced in the participation in learning. In addition, CAI can arouse the students' attention well. There are a number of studies reported that CAI could be one the best resource to achieve the exam scores, improve students attitudes, and reducing the time to master the course materials.

Learning Styles Theory

According to David Kolb (1984), learning styles are divided into four types: the Divergers, the Assimilators, the Convergers, and the Accommodator. First, the Divergers are very good at viewing concrete situations from perspectives. They prefer to have information presented to them in details and systematic. The suitable learning style is the lecture method, hands-on exploration, and brainstorming. The second type is the Assimilator. The strength is creating theoretical models. They are also likely to be interested in abstract concepts. The suitable learning style is the lecture method following by demonstration, including the exploration in the lab. Students in this type are most likely to be in the field of mathematics and basic sciences. Third, the Convergers are good at discovery new thing. They are likely to be good at practical application or idea. They prefer to deal with thing rather than people. Most of learners may be in the field of physical science and engineering. The suitable learning style is to be a hands-on learners and computer assisted instruction. The last type is the Accommodator. They are good at solving problems. They rely on people's information rather than intuitive trial. The proper learning style is being active participants and encouraging them for the independent discovery. [2]

Previous Studies

There are several studies about CAI. [9] conducted a research on "An Examination of the Relationship between Learning Style and a CAI Metric Instructional Unit. The findings indicate that when developing CAI as one of the instructional design stages, it is important to consider the target population. One of the characteristics to consider is the preferred method of learning, or learning style, while there was no statistical significance in the relationship between learning style and performance in the CAI metric instructional unit.

Another research is the study of Adult Learning Styles and Attitude toward Computer Assisted Instruction [10]. The results show that subjects in all four learning style categories have statistically significantly greater negative attitudes on the function subscale, with assimilators also have a significantly greater negative attitude on the creativity subscale, as well as in overall attitude. The increasingly

negative attitude toward CAI in this study may reflect several factors: an evaluation of the CAI software and subject expectations of the CAI that were not met.

Methodology

Participants

The purposive sampling is employed. Participants were 53 undergraduate students who enrolled Calculus I in second semester of academic year 2013.

Instruments

The instruments employed in under this study are 1) Computer Assisted Instruction (CAI), 2) Learning Style Inventory, 3) Learning Achievement Test, and 4) A Questionnaire about student's satisfaction towards CAI. The details of the instrument construction are as follows:

1) Computer Assisted Instruction on the topic of Derivatives: First, the details of CAI i.e. goals and objectives, contents, activities, and evaluation were planned. The content of this topic was divided into six units. Then, they were measured by the experts. After that, they were edited according to the experts' suggestions. Later, CAI was tested with non-sampling group to examine the reliability. Next, the CAI manual was produced. Then CAI was tested with the real sampling.

2) Learning Style Inventory: Kolb's Learning Style[2] is used as a framework of this step. A questionnaire was constructed based on learner's learning experience. The questionnaire's detail is about the adjective words describing learning style. The test consists of 9-multiple-choice items. Learners have to choose the most suitable item for themselves. Then the findings of this step is brought to classify learners' learning styles by means of the coordinate point on the chart, which based on Kolb's theoretical framework [2]. 4 marks refer to the most suitable; 3 marks refer to more suitable; 2 marks refer to less suitable; and 1 marks refer to the least suitable.

3) Learning Achievement Test (30-multiple-choice items):A level of difficulty is 0.55 till 0.80, the discrimination is 0.20 till 0.50, and reliability is 0.75.

4) A questionnaire about student's satisfaction towards CAI: It is a 15-item rating scale divided into five levels: the most, more, fair, less, and the least. This questionnaire was tested with 15 undergraduates in order to prove the language accuracy. Then it was edited and given to the experts. After that, this questionnaire was tested with the sampling of this study.

Data collection

The data collection is as follows:

1) Prepare CAI on the topic of Derivative.

2) Appoint students. They were 53 undergraduates enrolling Calculus I in the second semester of the academic year 2013. The procedure is as follows:

a. Assign students to do Kolb's Learning Evaluation Test [2].

b. Classify students into four groups according to the findings above (a.), then try out CAI.

c. Assign students to do posttest: Learning Achievement Test.

d. Evaluate students' satisfaction towards CAI.

The statistical analysis

1) E_1/E_2 is used for analyzing the effectiveness of CAI.

2) Frequency and percentage are utilized to investigate students' learning styles.

3) F-test is employed to compare student's learning style.

4) Average and Standard Deviation (S.D.) are used to evaluate students' satisfaction towards CAI.

Results

1. 47.17%of students' learning style is the Divergers, following by the Convergers, the Assimilators, and the Accommodator (26.42%, 16.98%, and 9.43% respectively).

2. The effectiveness of CAI, E_1/E_2 is 82.75/84.40, as shown in Table 1.

Table 1 The Outcomes of CAI Effectiveness

The effectiveness of the procedure (E_1)									The effectiveness of outcomes (E_2)	
N	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Score 2,809		Score 1,590	
53	142	443	426	424	419	446	Total score 2,300	82.75	Total score 1,183	84.40

3. Comparing the students' achievement score when doing posttest "Learning Inventory Test", it shows that students' achievement score after doing posttest is not much different although their learning styles are different, as can be seen in Table 2 and 3.

Table 2 Student's Average Score and Standard Derivation Score according to Students' Learning Styles

Learning Styles	n	$\bar{x}$	S.D.	Rank
Divergers	25	42.88	4.43	4
Assimilators	9	42.89	5.21	3

Convergers	14	44.50	3.61	1
Accommodators	5	43.80	2.68	2
Total	53	43.52	3.98	-

Table 3 The Comparison of Students' Achievement Score in concern with Different Learning Styles

Sources	SS	df	MS	F	Sig.
Interval Learning Style Interval	26.85	3	8.95	0.50	0.69
Internal Learning Style	885.83	49	18.08		
Total	912.68	52			

4. Regarding the students' satisfaction score towards CAI, it appears that students' satisfaction towards CAI is high. $(\bar{x} = 4.17.S.D = 0.75)$

Results and Discussion

This study aims to test the effectiveness of CAI. The Standard Effectiveness Criterion of [11] was employed in this study. It appears that the effectiveness of this CAI is 82.75/84.40, which is higher than the fixed criterion. This is because that this developed CAI was evaluated by the experts. Then, it was tried out with non-sampling group. Later, it was edited and tested with the real sampling. All the procedure is planned, constructed, and examined well. In addition, this CAI consists of text, sound, animation, and image. This CAI also responds learner's difference. Learners can learn upon their needs. This is in accordance with [12].

Considering the achievement score among learners whose learning styles are different, the Convergers achievement score is the highest, following by the Accommodators, the Assimilators, and the Divergers. This is in line with [2] that Convergers learning style is the most suitable with CAI. This is due to their own characteristics. They are likely to be practical and independent. They can also solve the problems and make decisions well.

Furthermore, comparing posttest achievement score, it shows that their achievement score is not much different. This is because the researcher constructed CAI, based on [13] and [14] theoretical frameworks. According to [9] and [10], it is said that learning styles does not affect CAI. In addition, based on [15], learners can revise their lessons via CAI as much as they want. Thus, this may be a crucial factor causing the varied achievement score.

Moreover, students' satisfaction via CAI is at high level. This is because the computer developed a component stimuli presented to the learner, assessment needs of individual learners and provide feedback to reinforcement [16], so that students with different learning styles are satisfied at high levels.

Conclusion

In this paper, most students' learning style found is the Convergers. In addition, the criterion of this CAI is 82.75/84.40, which is in accordance with the criterion. In addition, students' posttest score is not slightly different even though their learning styles are different. Moreover, Students has a high satisfaction level towards CAI.

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Comparing Blended Learning with Traditional Approaches of Professional Teacher and Knowledge Management for Teaching License Applicants

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Abstract

Purpose of this study is to compare between blended learning with traditional approaches of professional teacher and knowledge management for teaching license applicants. Using a pretest-posttest control group experimental design model, participants were assigned to experimental and control group purposefully in order to achieve group equivalency. The study was conducted during the fall of the 2012-2013 academic year. Participants were 50 students from the Faculty of Industrial Education, Rajamangala University of Technology Phra Nakhon. The 25students were taught with the blended learning, which involved using both face-to-face (FTF), coaching learning, e-learning and learning package of instruction, the other 25students were taught with traditional approaches alone only. The result showed that learning management and professional teacher by applying the blended learning results that students have reflection and change knowledge extension among students more than the traditional approach significantly at .05.The analysis showed that the blended learning was more successful than the traditional approach in terms of both course achievement and benefit for education and student learning.

Keywords: blended learning group and traditional approaches, learning management and professional teacher, teacher's license applicants

Introduction

The pedagogy of a blended learning provides instructors a unique opportunity to create assignments and activities that facilitate not only retention and comprehension but also higher order learning such as application, analysis, creativity and evaluation. Blended learning has been referred to as the "third generation" of distance education systems. Correspondence education was the first generation and utilized a one-way instructional delivery method, including mail, radio, and television [1]. In addition, by providing students with more control over their learning, blended learning can help foster critical thinking. Given such benefits, blended learning courses combines on-site classroom instruction with an online learning component that is conducted via blackboard and other out-of-class activities.From emphasizing only on learning by giving a lecture with media has been changed to media technology which can be self-learning. Moreover, it is able to communicate with instructors and classmates.Learning environment has been created by using multiple learning approachescombined with technology to be a complement in learning activities. This aims to facilitate students to have the maximum learning and

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respond to the technological advances today which is able to change learning characteristics of students.

In order to determine if blended learning is a best practice, studies should be designed to compare blended learning with other pedagogical styles, and such studies should be conducted with various aspects of courses as well as with different courses in higher education.

Although, there has been little evidence to show that a blended learning environment has tangible benefits as measured by levels of voluntary preparation of weekly work or performance on a final examination. This current study evaluates the difference in student preparation and performance when a blended learning environment is adopted as compared to a traditional approach.

In their recent research, Nikolaos Vernadakis, et al. [2] conducted a comparison of student satisfaction between traditional and blended technology course offerings in physical education. The results reported that the mean satisfaction scores were significantly different between the blended and traditional course. These finding suggests that a blended learning format can be a viable option to maintain and maybe even increase students' satisfaction.

In contrast, Mike Maran, et al. [3] concluded that a blended learning used to changing pedagogical and student needs, the Echo System has added more collaborative features and communication channels to better simulate the live classroom experience aimed at increasing instructor efficiency and student engagement.

Moreover, David K.Larson and Chung Hsien Sung. [4] have reported that student satisfaction learning effectiveness and faculty satisfaction is presented. This research demonstrated that there is no significant difference among delivery modes. Additionally, blended and online modes for this class do very well when measuring student satisfaction, learning effectiveness and faculty satisfaction.

According to the blended learning which emphasizing on technology integration withthe blended learning environment to create learning activities, these encourage students to reflect their thinking and change the interactions between students and other student groups. Thus, we consider that the blended learning helps the instructors to ask students' problems immediately which differs tothe traditional approachthat have many limitations. For example, the difference in people cannot be responded by traditionally learning in large groups, particularly the difference in capabilities, skills, interests or personalities of students.The purpose of this study, the following research question was formulated : Doteaching license applicants ratings of instruction reflect a higher class satisfaction score in the blended sections compared to the traditional face-to-face sections?

Methodology

1. Hypothesis

1.1 Post-test achievements of knowledge management andprofessional teacher ofteacher's license applicants whom taught by the blended learning are higher than pre-test.

1.2 Achievements of knowledge management andprofessional teacher after using the blended learning are higher than post-test achievements of knowledge management andprofessional teacher by the traditional approach.

2. Design of the Study

A pretest-posttest control group experimental design model was used in this study. The independent samples t-test was employed to determine the difference between the sample group and the control group in terms of the professional teacher and knowledge management course. The dependent variables were students' scores form the satisfaction scale.

3. Participants

The participants of this study included 50 students who took the professional teacher and knowledge management course. The course is a required core course for teaching license applicants pursuing a graduate diploma program of teaching profession from faculty of industrial education, Rajamangala University of Technology Phra Nakhon. Of the 50 students, 25 participated in the blended sections was given to the experimental group and 25 participated in the face-to-face sections was given to the control group. One of the two instructors was responsible for teaching 3 hours per day for 15 weeks, with a total of 45 hours.

4. Treatments

In this study, the newly designed instructional course was given to the experimental and control group as follows. The Face-to-Face learning took the course traditionally. The theoretical part of lectures was supported by PowerPoint presentations, books, lecture note and tutorials. Classroom discussions and question and answer techniques were used in teacher and student interactions. Teamwork, classroom discussion and projects were used in order to provide opportunities for collaborative learning.

The blended learning used a could computing that was developed for the course. Additional learning materials consisted of online lecture notes and multimedia components assessment and online tutorials. The students in blended learning were able to access these learning materials through the website. Questions, e-mail and web announcements were used as means of student and teacher interaction. Teamwork, classroom discussions and e-mail were used in order to enhance students' collaborative learning experiences.

5. Data Collection Tools

Data for this research was collected using questions of final exam. The question was used to test students' prior knowledge at the beginning of the study. The same test was used at the end of the course. The test was prepared with five experts who were other instructors of the same course.

6. Procedures

An analysis was conducted at the beginning of the study. Objective were written in light of the information gathered from the needs analysis. After that, the instructional materials were developed. At the beginning of the study, 100 item of the examination paper was given to the control and the experimental group as pretests. The control group and the experimental group were then taught for 15 weeks. At the end of the course, the same test and scale were given to students as posttests. The data collected before the course and after the course were analyzed using Microsoft Excel. An independent samples t-test was used in order to compare the blended sections and the face-to-face sections.

Results and Discussion

An alpha reliability analysis was used to verify the internal consistency of the satisfaction examination paper. Independent sample t-test analysis was conducted to measure teaching license applicants' satisfaction towards the blended learning and traditional learning. Each variable was tested using an alpha level of significance .05. The results of each analysis are presented separately below.

1. Reliability of satisfaction scale

Reliability analysis of the blended learning satisfaction test instrument showed an alpha reliability coefficient of .85 for the examination paper that were designed to measure teaching license applicants satisfaction. According to Green & Salkind [5], the reliability coefficients should be greater than .70 before we can assume sufficient reliability for a research tool. Thus, the determination was made that the satisfaction examination paper.

2. Teaching license applicants satisfaction comparison

2.1 Post-test achievements of knowledge management and professional teacher of teacher's license applicants whom taught by the blended learning and traditional approaches are higher than pre-test at .05 significantly.The pre-test of blended learning has a mean of57.17andthe standard deviationof 8.78. The post-test has a mean of 82.03 andthe standard deviation of 17.75. When comparing these values by the t-test (Dependent Samples t-test) found that t-test is 4.68, and the traditional approach has a mean of 43.20 and a standard deviation of 10.67. For the post-test has a mean of 72.07 and a standard

deviation of 11.47 when comparing the values by t-test (Dependent Samples t-test) found that t-test is 1.14. Therefore, after considering each section found that the teacher's license applicants are able to understand and analyze knowledge management and professional teacher by the blended learning after learning better than pre-learning at .05 significantly as shown in Table 1.

Table 1 Comparison of achievements between the blended learning and traditional approaches

Group	N	Mean	S.D.	df	t
Blended section					
Pre-test	25	57.17	8.78	48	4.68*
Post-test	25	82.03	17.75		
Traditional section					
Pre-test	25	43.20	10.67	48	1.14*
Post-test	25	72.07	11.47		

$p < .05$

2.2 Test results of knowledge management and professional teacher achievements after using the blended learning are higher than post-test achievements of knowledge management and professional teacher by the traditional approach as shown in Table 2.

Table 2 Comparison of final examination in the blended section and traditional section

Group	N	Mean	S.D.	df	t
Blended section	25	82.03	17.75	48	6.65*
Traditional section	25	72.07	11.47		

$p < .05$

As shown in Table 2, the independent samples t-test technique was applied to the mean posttest scores for the blended section and traditional section in order to examine the differences in prior knowledge. According to the test results, there was significant difference in final examination between the blended section and traditional section ($p < .05$). The experimental (Blended learning) group's mean score on the examination paper was higher than the control (Traditional learning) group's mean score.

The results indicate that the blended learning of instructional design, which was the combination of face-to-face and online instruction, had a positive effect on teaching license outcomes. There were statistically significant prior knowledge about professional teacher and knowledge management course and final examination between the blended section and traditional section. After 15 weeks of instruction, the blended learning (Experimental group) received higher scores than the traditional learning (Control group) on the examination paper test. The difference in the mean scores of the group was statistically significant which conform to the study of Chaleenuch Khouse [6] and Saichol Jinjo[7] found that students who learns by the blended learning have learning achievements higher than others learned by

general approach. It is possibly because the blended learning is various learning activities that can respond to different students very well,and it also helps students to review the learning anytime. Moreover, students can communicate to each other facilitating more knowledge exchange and learning assistance.

Conclusion

Comparison the blended learning with the traditional approach in knowledge management and professional teacher forteacher's license applicants found that the blended learning is statistically significant different from the traditional approach. The blended learning is able to reflect students' thinking and change the interactions between students and other groups. Students are also able to review the learning during free time. Therefore, these can be concluded that the blended learning is an effective learning approach which respondsand applies to today technologyto be the most useful for learning activities.

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Readiness for Joining the ASEAN Community of theStudents at Rajamangala University of Technology Isan, Surin Campus

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Abstract

The objectives of this research were to: 1) study the activities in preparing to join the ASEAN community, 2) investigate the readiness levels for joining the ASEAN community of students at Rajamangala University of Technology Isan, Surin Campus (RMUTISR),and 3) compare the students' readiness for joining the ASEAN community with different factors: gender, faculty and year of study. The mixed methods design that integrated qualitative and quantitative was used in this study. The samples were 347 undergraduate students of RMUTISR,and selected by stratified random sampling method based on Krejcie and Morgan table. The statistics used for data analysis included percentage, mean, standard deviation, and One-way ANOVA.

The findings revealed that:

1) There were some activities in preparing to join the ASEAN community during the academic year. These activities included ASEAN Study Centre undertaken by the Office of Surin Campus; Student Exchange Program, Collaborative Research Project, and ASEAN Training Program for Staff and students undertaken by Faculty of Agriculture and Technology; Language and Culture Preparation for ASEAN Community Project, Tourism Knowledge about ASEAN Project and Exhibition and special lecture on ASEAN undertaken by Faculty of Management Technology.

2) The readiness for joining the ASEAN community of the RMUTISR students showed that the knowledge readiness ($\bar{X}$ = 3.29) and the skill readiness ($\bar{X}$ = 3.44) were at the same level, which was moderate, but the attitude readiness was at the high level ($\bar{X}$ = 3.62).

3) There was no significant difference found on the overall mean of the knowledge readiness, skills readiness and attitude readiness of male and female students. However, there was statistical significance at 0.05 levelin each of the overall aspects of readiness includingknowledge readiness, skills readiness and attitude readiness of students who studied in different faculties. There was statistical significant difference in the knowledge readiness and the attitude readiness of students who were in different years of study at the 0.05 level. While there was statistical significance in the overall mean and each aspect of the skill readiness at the 0.05 level, except fundamental skill readiness.

Keywords: ASEAN Community, Readiness of Students, Readiness for ASEAN Community

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Introduction

The Association of Southeast Asian Nations, or ASEAN, was established on the 8th of August 1967 in Bangkok, Thailand, with the signing of the ASEAN Declaration (Bangkok Declaration) by the country members of ASEAN, namely Indonesia, Malaysia, Philippines, Singaporeand Thailand.Brunei Darussalam joined the ASEAN on the 7th of January 1984, then Viet Nam on the 28thJuly 1995, Lao PDR and Myanmar on 23rdJuly 1997, and later Cambodia on 30thApril 1999, making up what is today the ten member countries of ASEAN [1].

As set out in the ASEAN Declaration, the purposes of ASEAN are: [2]

1. To accelerate the economic growth, social progress and cultural development in the region through joint endeavors in the spirit of equality and partnership in order to strengthen the foundation for a prosperous and peaceful community of Southeast Asian Nations;

2. To promote regional peace and stability through abiding respect for justice and the rule of law in the relationship among countries of the region and adherence to the principles of the United Nations Charter;

3. To promote active collaboration and mutual assistance on matters of common interest in the economic, social, cultural, technical, scientific and administrative fields;

4. To provide assistance to each other in the form of training and research facilities in the educational, professional, technical and administrative spheres;

5. To collaborate more effectively for the greater utilization of their agriculture and industries, the expansion of their trade, including the study of the problems of international commodity trade, the improvement of their transportation and communications facilities and the raising of the living standards of their peoples;

6. To promote Southeast Asian studies; and

7. To maintain close and beneficial cooperation with existing international and regional organizations with similar aims and purposes, and explore all avenues for even closer cooperation among themselves.

There are about 600 million people from 10 member countries in ASEAN community at the moment.ASEAN becomes a key factor influencing the trends of the countries and personnel development in several aspects based on the three main perspectives called “a three- pillar ASEAN Community”, 1) the ASEAN Political-Security Community (ASC), 2) the ASEAN Economic Community (AEC), and 3) the ASEAN Socio-Cultural Community (ASCC). [3]

In Thailand, the Ministry of Education has set out the policy according to the ASEAN declaration and those three pillarsin order to develop Thai education and raise the level of awareness among the academic populationas follows: [3]

1. Preparing dissemination of knowledge, information and news about the ASEAN for teachers, faculty staff, students and education personnel in order to increase awareness and be ready to integrate in the ASEAN community by the year 2015.

2. Planning potential development of students and citizens in order to have the appropriate skills for entry into the ASEAN community. The potential development skillsare for example, English language skills, ASEAN member countries' language skills,information technology skills, and the expertiserelated to changing industry and increasing employment opportunity.

3. Increasingeducational standards in order to promote the circulation of students and teachers in ASEAN, as well as to be acceptedin terms of academic qualifications in ASEAN, and promote cooperation between educational institutions and youth exchanges. Besides, the Ministry of Education will focus on developingthe distance learning education system which will support life-long learning education, and improving vocational education and training, both initial stage and continuing in-career stages, as well as promoting and strengthening the cooperation between educational institutions of ASEAN member countries.

4. Preparing for cross-border mobility and internationalization of education in ASEAN in order to support entering into the ASEAN Economic Community (AEC) comprises of building an accepted education agreement and developing important career skills according to international standards.

5. Preparing Thai youths as the importanthumanresourcesfor the ASEAN community in order to raise career opportunities. To support this policy, the main organization has been assigned to prepare the operational plan and appoint the sub-committee by focusing on the education system in ASEAN and neighboring countries' policies in order to achieve actual cooperation in ASEAN.

Thai universities were asked by the education ministry to provide and develop the education standards in 2010 for their students [4] consequently, preparing Thai youths' learning towards ASEAN community requires these three target characteristics; knowledge, skills, and attitudes. Knowledge includes knowledge about ASEAN and ASEAN member countries in political, economics, social and cultural, and knowledge about the ASEAN Charter. Skills include basicskills, citizenship and social responsible skills; and learning and self-development skills. Attitudes include positive attitudeof being Thai and ASEAN, working as a team with other ASEAN member countries across cultures and religions; and following principles of good governance and self-sufficiency economy philosophy[5].

Previous studies [6], [7][8] of undergraduate students in Thailand have shown that the students' knowledge, readiness, and attitudes towards ASEAN community and AEC were at the average level. The undergraduate students of today will be in the front line of the newcomers of the ASEAN community,so universities should help students getting ready for the ASEAN workforce across different cultures. Rajamangala University of Technology Isan(RMUTI) is one of the universities in Thailand, which is

required to play an active role as an information provider and a participant in the process of entering into the ASEAN community. It is undeniable that the main role of the university is to raise the level of awareness among the students and the faculty staff. Therefore, this study aims to 1) study the activities in preparing to join the ASEAN community, 2) investigate the readiness levels for joining the ASEAN community of students, and 3) compare the readiness for joining the ASEAN community of students with different factors: gender, faculty and year of study. With better understanding of undergraduate students' readiness towards ASEAN community, the university can offer supportive information in order to prepare students for the ASEAN community.

Methodology

This study utilizes the qualitative research method to explore experiences of university staff in preparing activities for ASEAN community because this method is useful for exploring complex issues of education. [9]While quantitative method such as questionnaire is very useful to examine the students' attitudes and beliefs. Thus, the mixed methoddesign that integrated qualitative and quantitative was used in this study by conducting both interviews and questionnaire survey. The population was15 administrators, 25 head of departments, and 3,500 students of RMUTI Surin campus. The samplesfor thequalitative data collection were7 administrators and12 head of departments. The quantitative samples for the data collection were 347undergraduate students of RMUTI Surin campus, Thailand. Stratified random sampling method based on Krejcie and Morgan table was used to select the samples.

A qualitative approach was conducted using individual interview with open- ended questions with the 7 administrators and 12 head of department about the activities in preparing to join ASEAN community. Also, observatory participation was used to find out ASEAN-relatedactivities thatwere undertaken in Surin campus. A quantitative approached was conducted through a questionnairesurvey asking to find out the readiness for joining the ASEAN community of students. The questionnaire was divided into three parts; knowledge readiness, procedure skill readiness, and attitude readiness based on a 5-point Likert scale rating from 1 (very low readiness) to 5 (very high readiness). The questionnaires were distributed to the 346undergraduate students at RMUTI, Surin campus during January - February 2014.However, there were only 340 (98.27% out of 346 students) responses returned. Descriptiveanalysis, t-test and One-way ANOVA wereused to analyze the data.

The ranges of readiness of undergraduate students were assigned into 5 levels as follows:

4.50 - 5.00 readiness towards ASEAN at the highest level

3.50 – 4.49 readiness towards ASEAN at high level

2.50 – 3.49 readiness towards ASEAN at moderate level

1.50 – 2.49 readiness towards ASEAN at low level

1.00 – 1.49 readiness towards ASEAN at the lowest level

Research Findings

1. Information about the participants was as follows. The participants for the questionnaire survey were 340 undergraduate students of RMUTI, Surin campus, 94 students in the first year, 85 in the second year, 87 in the third year, and 81 in the last year of undergraduate study. There were 156 male (44.96%) and 191 (55.04%) female students. There were 179(51.59%) students of Management Technology Faculty and 168 (48.41%)students of Agriculture and Technology Faculty.

2. The findings from the interview revealed that there are the clear policies, e.g. education improvement policies and personnel development policies in preparing to join the ASEAN community of Rajamangala University of Technology ISAN, Surin campus.

3. There were several activities in preparing to join the ASEAN community during the academic year 2013 of Rajamangala University of Technology ISAN Surin campus. These activities included ASEAN Study Centre undertaken by the Office of Surin Campus; Student Exchange Program, Collaborative Research Project, and ASEAN Training Program for staff and students undertaken by Faculty of Agriculture and Technology; Language and Culture Preparation for ASEAN Community Project, Tourism Knowledge about ASEAN Project and Exhibition and Special lecture on ASEAN undertaken by Faculty of Management Technology.

Figure 1 Students Exhibition

Figure 2 ASEAN Study Centre in Surin Academic Resource Centre.

4. The findings from the questionnaire survey of the readiness for joining the ASEAN community of students at RMUTI, Surin campus revealed as follows. The overall of knowledge readiness was at moderate level($\bar{x}$= 3.29). When considering each aspect of knowledge, it was found that the knowledge about ASEAN($\bar{x}$ = 3.35)wasathighlevelfollowedbythe politicalknowledge($\bar{x}$= 3.30)and the economic knowledge($\bar{x}$ = 3.2)wereatthe moderatelevelasshowninTable 1.

Table 1 The readiness for joining the ASEAN community of students in terms of knowledge about ASEAN.

Knowledge Readiness	$\bar{x}$	*S.D.*
Knowledge about ASEAN	3.35	.68
Knowledge about political in ASEAN	3.30	.71
Knowledge about economic in ASEAN	3.21	.77
Knowledge about social and culture in ASEAN	3.27	.71
Total	**3.29**	**.63**

The overall readiness of skills was atmoderate level ($\bar{x}$= 3.44). When considering each aspect of skills readiness, it was found that learning and self- development skills were at the high level($\bar{x}$ = 3.51), followedbycitizenship and social responsibleskills and basic skills which were at the moderate level ($\bar{x}$= 3.44) and($\bar{x}$= 3.31)asshowninTable 2.

Table 2 The readiness for joining the ASEAN community of students in terms of skills readiness.

Procedure skillsreadiness	$\bar{x}$	*S.D.*
Basic skills	3.31	.78
Citizenship and social responsibility skills	3.48	.78
Learning and self- development Skills	3.51	.85
Total	**3.44**	**.70**

The overall of attitude towards the ASEAN community was at high level ($\bar{x}$ = 3.62). When considering each aspect of attitudes, it was found that attitudes about sense of strengthening cooperation in the ASEAN community ($\bar{x}$= 3.69)wasatthehighlevel, followed by following the principles of sufficiency economy philosophy ($\bar{x}$= 3.66)andthe average minimum isawareness of ASEAN ($\bar{x}$= 3.66) asshownin Table 3.

Table 3 Attitudes towards the ASEAN communityof students.

Attitudes towards the ASEAN community	$\bar{x}$	*S.D.*
Positive attitude of being Thai and ASEAN	3.65	.98
Awareness of being ASEAN member	3.51	.93
Attitude towards democracy	3.65	.95
Accepting differences in different religious belief	3.64	.97
Following principles of sufficiency economy philosophy	3.66	.91
Sense of strengthening cooperation in the ASEAN community	3.69	.94
Total	**3.62**	**.78**

5. There was no significant difference found on the overall mean of the knowledge readiness, skills readiness and attitude readiness of male and female students as shown in Table 4, Table 5 and Table 6.

Table4 Students' knowledge readiness with different gender

Knowledge readiness	Male		Female		t	sig
	$\bar{x}$	*S.D.*	$\bar{x}$	*S.D.*		
Knowledge about ASEAN	3.25	0.68	3.44	0.66	-2.73*	0.00
Knowledge about political in ASEAN	3.25	0.71	3.25	0.70	-1.47	0.14
Knowledge about economic in ASEAN	3.15	0.76	3.27	0.78	-1.57	0.19
Knowledge about social and culture in SEAN	3.20	0.75	3.34	0.67	-2.00	0.46
Total	**3.21**	**0.66**	**3.35**	**0.61**	**-2.10**	**0.37**

*Statistical significance at 0.05 level

Table 5 Comparing students' procedure skill readiness with different gender

Procedure skill readiness	Male		Female		t	sig
	$\bar{x}$	*S.D.*	$\bar{x}$	*S.D.*		
1. Basic skills	3.23	0.77	3.38	0.78	-1.95	0.05
2. Citizenship and social responsibility skills	3.45	0.77	3.52	0.79	-0.91	0.36
3. Learning and self- development Skills	3.42	0.86	3.59	0.84	-1.96	0.05
Total	**3.37**	**0.70**	**3.50**	**0.70**	**-1.84**	**0.07**

*Statistical significance at 0.05 level

Table 6 Comparing students' attitude readiness with different

Attitudes towards the ASEAN community	Male		Female		t	sig
	$\bar{x}$	*S.D.*	$\bar{x}$	*S.D.*		
Positive attitude of being Thai and ASEAN	3.55	1.03	3.73	0.93	-1.90	0.06
Awareness of being ASEAN member	3.39	0.89	3.60	0.95	-2.79*	0.03
Attitude towards democracy	3.58	1.00	3.71	0.91	0.07	0.19
Accepting differences in different religious belief	3.57	1.00	3.69	0.95	0.21	0.25
Following principles of sufficiency economy philosophy	3.68	0.94	3.63	0.89	0.37	0.57
Sense of strengthening cooperation in the ASEAN community	3.64	0.92	3.72	0.95	0.92	0.41
Total	3.57	0.75	3.68	0.79	0.31	0.15

* Statistical significance at 0.05 level

However, there was statistical significance at 0.05 level in the overall aspects of readiness includingknowledge readiness, procedure skills readiness and attitude readiness of students who studied in different faculties as shown in Table 7, Table 8and Table 9.

Table 7 Comparing students' knowledgereadiness with faculties

Knowledge readiness	Technology management		Agriculture and Technology		t	sig
	$\bar{x}$	*S.D.*	$\bar{x}$	*S.D.*		
Knowledge about ASEAN	3.51	0.63	3.20	0.69	4.61*	0.00
Knowledge about political in ASEAN	3.43	0.67	3.19	0.72	3.41*	0.00
Knowledge about economic in ASEAN	3.35	0.72	3.08	0.80	3.61*	0.00
Knowledge about social and culture in SEAN	3.40	0.64	3.16	0.75	3.41*	0.00
Total	**3.42**	**0.58**	**3.56**	**0.66**	**4.16***	**0.00**

*Statistical significance at 0.05 level

Table 8 Comparing students' procedure skill readiness with faculties

Procedure skill readiness	Technology management		Agriculture and Technology		t	sig
	$\bar{X}$	S.D.	$\bar{X}$	S.D.		
1. Basic skills	3.45	0.73	3.18	0.81	3.53*	0.00
2. Citizenship and social responsibility skills	3.57	0.74	3.44	0.81	2.24*	0.03
3. Learning and self- development Skills	3.62	0.77	3.41	0.91	2.50*	0.01
Total	3.55	0.64	3.33	0.75	3.15*	0.00

* Statistical significance at 0.05 level

Table 9 Comparing students' attitude readiness with faculties

Attitudes towards the ASEAN community	Technology management		Agriculture and Technology		t	sig
	$\bar{x}$	*S.D.*	$\bar{x}$	*S.D.*		
Positive attitude of being Thai and ASEAN	3.75	0.87	3.55	1.07	2.10*	0.04
Awareness of being ASEAN member	3.16	0.86	3.35	0.97	3.37*	0.00
Attitude towards democracy	3.71	0.83	3.59	1.06	1.21	0.23
Accepting differences in different religious belief	3.73	0.87	3.54	1.06	1.96	0.05
Following principles of sufficiency economy philosophy	3.68	0.83	3.64	0.99	0.44	0.66

Sense of strengthening cooperation in the ASEAN community	3.77	0.87	3.59	0.99	1.97	0.05
Total	3.72	0.69	3.54	0.83	2.28*	0.02

* Statistical significance at 0.05 level

There was statistical significant difference in the knowledge readiness and the attitude readiness of students who were in different years of study at the 0.05 level. While there was statistical significance in the overall mean and each aspect of the procedure skill readiness at the 0.05 level, except fundamental skill readiness that was not different as shown in Table 10 and Table 11.

Table 10 ANOVA summary table: comparing students'procedure skills readiness with differentyears of study

Source of variation						
		ss	df	ms	f	sig.
Fundamental skills	Between group	3.923	3	1.308	2.171	.091
	Within group	238.483	396	.602		
	Total	242.406	399			
Citizenship and social responsibility skills	Between group	4.857	3	1.619	2.700*	.045
	Within group	237.497	396	.600		
	Total	242.354	399			
Source of variation						
		ss	df	ms	f	sig.
Learning and self-development Skills	Between group	9.834	3	3.278	4.675*	.003
	Within group	276.942	395	.701		
	Total	286.776	398			
Total	Between group	5.787	3	1.929	3.980*	.008
	Within group	191.428	395	.485		
	Total	197.214	398			

*Statistical significance at 0.05 level

Table 11 Mean difference: comparing students'procedure skills readiness withdifferent years of study

Years	$\bar{x}$	Mean difference			
		First year	First year	First year	First year
		3.31	3.49	3.51	3.44
First year	3.31	-	-0.18	-0.20	-0.13*
Second year	3.49		-	-0.02	0.05
Third year	3.51			-	0.07
Fourth year	3.44				-

* Statistical significance at 0.05 level

Discussion and Conclusion

1. The findings revealed that there were several activities in preparing to join the ASEAN community during the academic year 2013 atRajamangala University of Technology Isan, Surin campus. These activities were, for example, ASEAN Study Centre; Student Exchange Program, Collaborative Research Project, and ASEAN Training Program for Staff and students; Language and Culture Preparation for ASEAN Community Project, Tourism Knowledge about ASEAN Project and Exhibition and Special lecture on ASEAN. This could be said that the policiesunder the Ministry of Education, the Higher Education Commission, as well as the policies of the Rajamangala University of Technology Isan, Surin campus havebeen adopted into practicesbythe faculty staff, and students. Students have been encouraged and raised awareness in preparing to be one part ofASEAN community through different kinds of activities in Surin campus.

2. The readiness for joining the ASEAN community of students showed that the knowledge readiness (= 3.29),and skill readiness (= 3.44) were at the same level, which was at moderate level. The knowledge readiness andskill readiness were at moderate level. This might be because before entering into the ASEAN community, there are no change which affect students' daily life, as well as there is no effect on job search and career qualification directly. Therefore, the students were not aware of the knowledge and skills needed for ASEANworkforce. As the clock ticks towards ASEAN community in the near future, the university has a duty to raise awareness of the need in preparation to be one part of ASEAN community as well as to train students in order to have the standard working skills to be ready for the ASEAN workforce and other skills such as foreign language, technology and communication, and culture in ASEAN community.

However, the finding revealed that the attitude readiness of the students at Rajamangala University of Technology Isan, Surin campus was at high level (= 3.62). This could be said that these students have positive attitude towards ASEAN community. Since the Ministry of Education has set the framework and

guidelines for the Thai education in order to prepare for entering into the ASEAN community and to develop the quality of education [2] so students may be aware of these changes.

3. There was statistical significant difference in the knowledge readiness and the attitude readiness of students who were in different years of study at the 0.05 level. The fourth year students were ready to join the ASEAN community more than the first year students. This could be said that the fourth year students will finish their study in the near future and they see the benefits of knowledge and skill readiness which may help them get into the ASEAN workforce. This finding indicates that education system can improve students' readiness to get ready and to have better skills for the ASEAN community.

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The Development of Web Creative Intelligent Tutoring System

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Abstract

The objective of this research was to develop a Web Creative Intelligent Tutoring System (Web CITS) by study concepts of Expert System and Creative Problem Solving Process (CPS) in order to synthesize a tutoring system in which the contents and the examinations are appropriate and corresponding to students' learning capability. Also, this research is intended to develop the learners' creative problem solving skill in terms of 8 areas of mathematics and learning achievement by means of creative problem solving activity and through the provided learning devices. The Web CITS were designed and developed by using concept of Systems Development Life Cycle (SDLC). The systems wasdivided into 2 parts: 1) Learner system, whichinvolved the presentation of contents and instructional design on the web; and 2) Instructor system, which was a Web Creative Intelligent Tutoring Management System. The sample group included 8 experts in the fields of computer, information & communication technology and electrical & electronic, 4 experts in the quality evaluation in terms of contents and web instructional designof Web CITS, and 4 experts in the efficiencyevaluation in terms of system. The tools used in this research included Web CITS, and quality and efficiency evaluation form of the said developed system. The statistics applied herein was arithmetic mean and standard deviation. According to the results of evaluation, found that the quality evaluation of Web CITS in terms of contents and web instructional design was a very high level; and the efficiency evaluation of in terms of system was a high level.

Keywords: Web Creative Intelligent Tutoring System (Web CITS), Creative Problem Solving Process (CPS), Creative Problem Solving Skill, Learning Achievement

Introduction

The policies of education reform and National Education Act B.E.2542 and Amendments (Second National Education Act) B.E.2545 define it is important that there be such education management that covers education in and out of the system, as well as at the learners' leisure so that the learners can learn anything all their life. To proceed as to the said policies, it is necessary to apply communication and computer network system technology to increase the chances of education [1]. In order to decreaseeducation disparity, some learning models using computer network based learning have been developed, especially in higher education [2] so that the opportunities in this level could be continually enhanced and the learners could learn anything all their life based on the principles of flexibility and accessibility to the efficient network based education management[3].

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The Web-Based Instruction is an education management model that encourages learning process using information technology to search for any knowledge by self. The model satisfies the idea of learner-centered instructional management in which the learners are able to learn anything, anytime and anywhere, based on various methods using information technology [4]. This is corresponding to the basic learning principle that those who are looking for knowledge by themselves, e.g. from the internet, websites, e-mails, chat room, or web board, instead of gaining knowledge only from the instructors, will receive more insight learning. As a result, the learners will express their ideas more often and the instructional activities will proceed in a more effective way. This is the learning process that responds to the differences of individuals and learning potential [5].

Cooperative learning can promote mutual learning better than individual learning. According to many researches studying the integration applied in education field, cooperative learning was found to contribute to the success of instructional management and to be applicable to all subjects and all student groups of all levels[6], especially when combined with intelligent tutoring system that relies on the knowledge of experts. To analyze different possibility of learners as to their potential [7], there have been contents and tests for different level of knowledge by means of group activity and 5 steps of creative problem solving process [8], which is thought to develop creative thinking and very popular in other countries. At present, this method is proved to be one of the most effective problem solving models[9] that promote the problem solving skills of learners.

Referring to the aforementioned concept, the researcher had an idea to develop Web Creative Intelligent Tutoring System (Web CITS) with an aim to improve learning achievement and develop the learners' creative problem solving skill in terms of 8 areas of mathematics in the Digital Circuits I by means of Expert Systemwhich is component of the Intelligent Tutoring System (ITS) that adapted the contents and tests to comply with the different learning, and by means of Student Teams Achievement Division (STAD) as well as Creative Problem Solving Process (CPS) so that the learners could work together, exchange their knowledge, and have problem solving. This is to comply with and satisfy the education reform policies and National Education Act B.E.2542 and Amendments (Second National Education Act) B.E.2545,defining that the learners must be able to learn anything all their life thanks to the flexibility and the application of communication technology and computer network system, which enhance the education opportunities and cover education in and out of the system, as well as at the learners' leisure so that the instructional management could be effective as much as possible to the learners.

Objectives

1. To develop Web Creative Intelligent Tutoring System (Web CITS)

2.To evaluate quality and efficiency of Web Creative Intelligent Tutoring System (Web CITS)

Scope of Research

1. The sample group to evaluate the suitability of Web Creative Intelligent Tutoring System was derived by purposive sampling, including 8 experts in the fields of computer, information&communication technology for education, and electrical & electronics.

2. The tools used in this research included Web Creative Intelligent Tutoring System and quality&efficiency evaluation form of the said developed system, whereby the said form consisted of 5 rating scales.

Methodology

The methodology of this research relied on the designs and development of Systems Development Life Cycle (SDLC) [10], thereby the system development included the following steps:

1. Studying the concepts and theories, and then collecting data to develop Web CITS by means of studying, analyzing, and synthetizing documents, concepts, information, and tools relevant to the development of Web CITS, as well as asking users about the conventional teaching systems and their desirable ones.

2. Analyzing the data derived from the study of concepts, theories, information, and demand of users about the development of Web CITS in order to set up scopes and functions of the whole system with the aid of Context Diagram and Data Flow Diagram.

3. Designing the system and the structure of Web CITS using the structure plan of Web CITS before writing the program for practical use, and using Entity Relationship Diagram (ERD) to design the database.

4.Developing Web CITS by means of PHP and creating the database by using MySQL as database management system.

5. Testing and correcting the system by means of Black Box Testing to evaluate quality and efficiency of the system, Unit Testing to check for the errors within modules, and having the developers perform Integration Testing and System Testing.

6. Evaluating the quality and efficiency of the developed system by the eight experts in the fields of computer, information & communication technology and electrical & electronics.

Results of Research

1.Instructional process of Web Creative Intelligent Tutoring System (Web CITS) consists of 4 steps: Pretest, Presentation using intelligent content, Conclusion and Evaluation, and Posttest, as shown in figure 1.

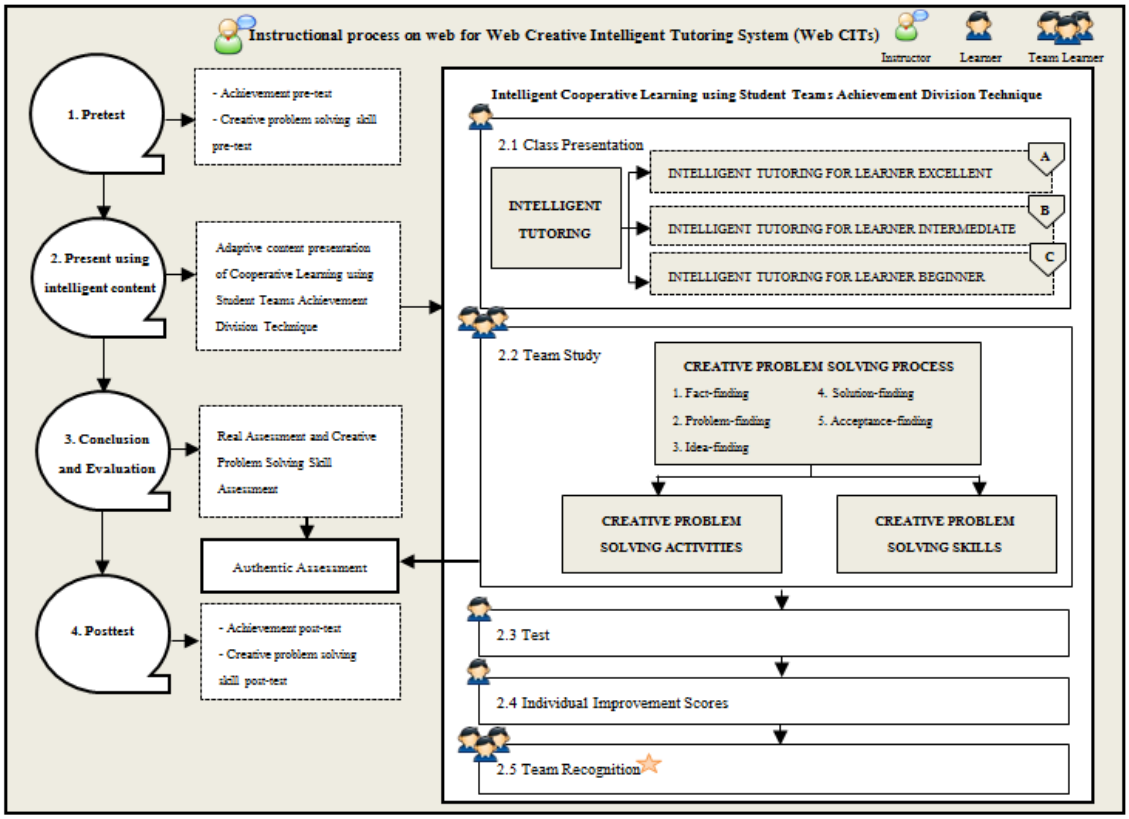

Figure1 Instructional process of Web CITS

2.The overall functions and scopes of the system are defined by Context Diagram, and there are two user groups: learners and instructors, as shown in figure 2.

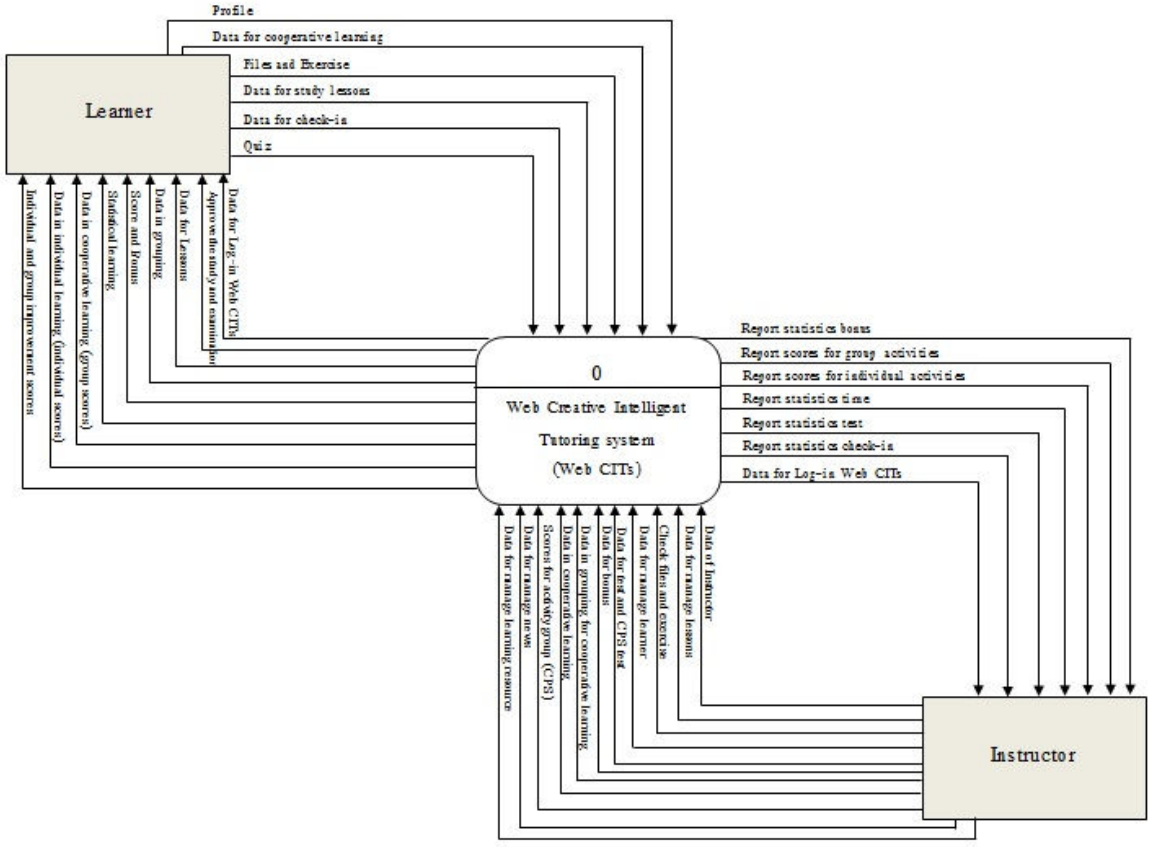

Figure2 Context Diagram

3. Structure plan of Web Creative Intelligent Tutoring System (Web CITS) and Entity Relationship Diagram (ERD) for the design of the database before writing the program for practical use.

3.1Structure plan of Web CITS presents all elements in the Web CITS based on Web Creative Intelligent Tutoring Model as seen in figure 3.

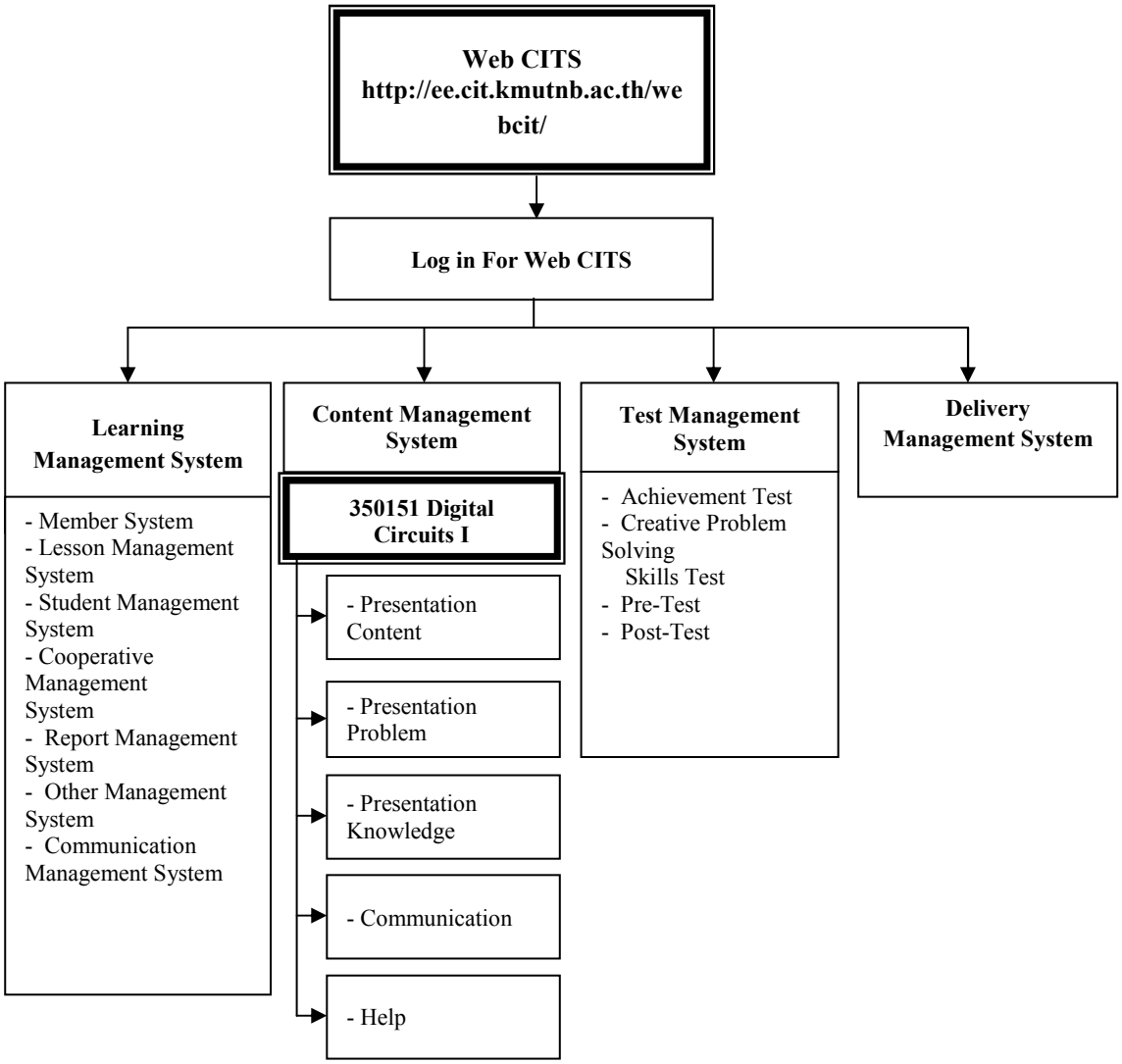

Figure 3 Structure plan of Web CITS

3.2 Structure plan of lessonspresents the elements of lessons[11] in Web CITS as seen in figure 4.

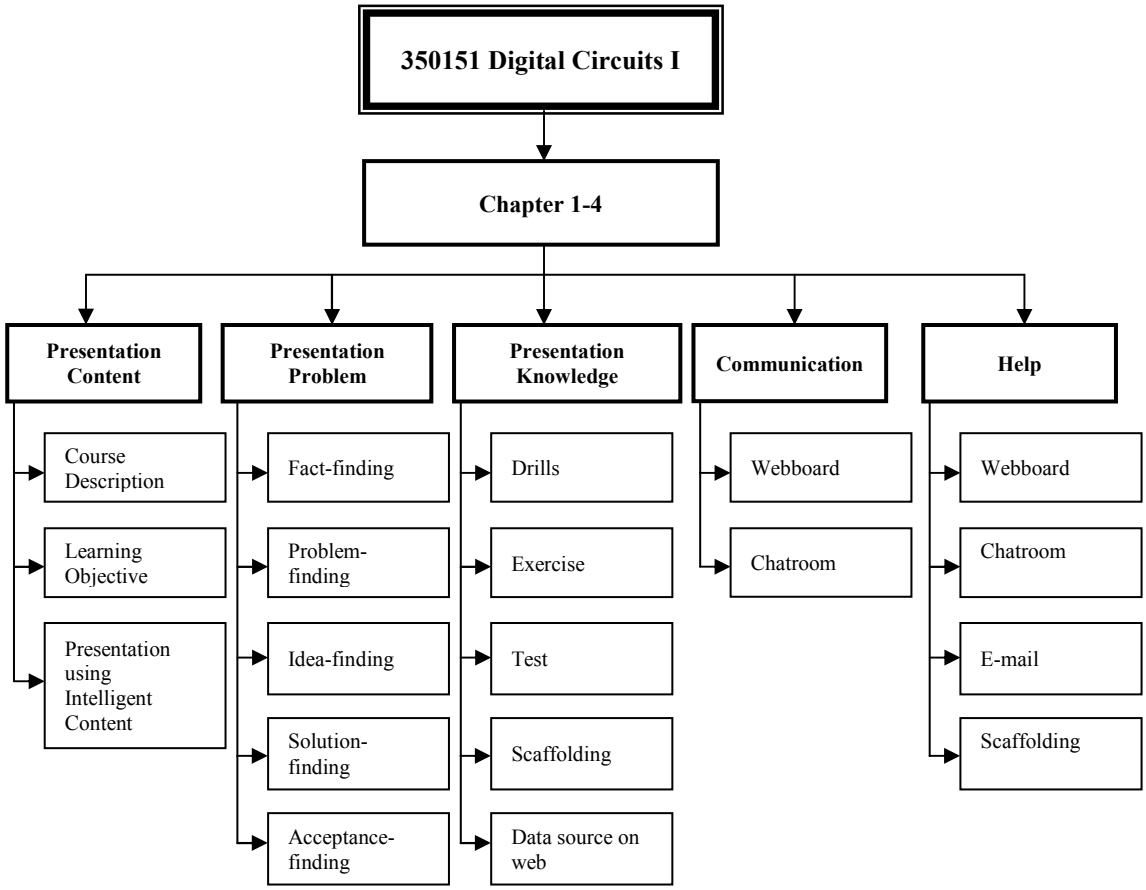

Figure4 Elements of lessons in Digital Circuits I

3.3 Entity Relationship Diagram of learner and instructor system in the design of database shows the relationship of 13 entities within the system: user profile, user time, score, star point, test_name, test, student point, grouppoint, news, link_url, file test chapter, file test, file index, and exercise, as shown in figure 5.

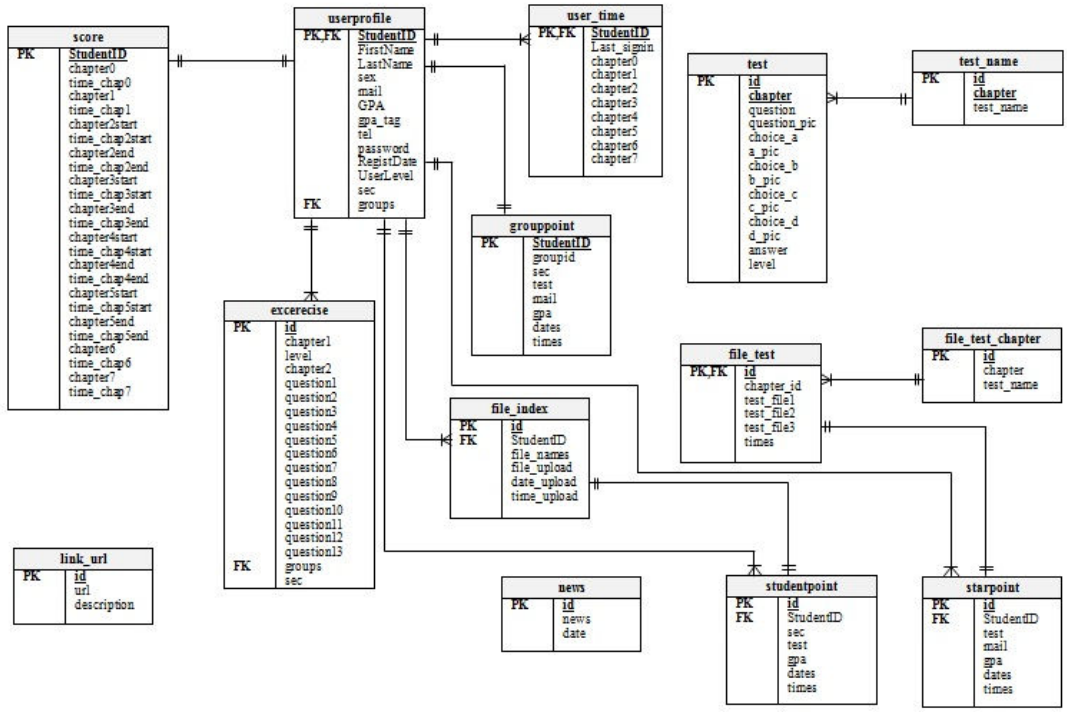

Figure 5 Entity Relationship Diagram

4.There are two elements in Web Creative Intelligent Tutoring System (Web CITS): Learner System and Instructor System

4.1Learner System is the Content Management System (CMS) that the presentation of intelligent contents and Web-Based Instruction by means of Cooperative learning and Student Teams Achievement Division technique combined with expert system and creative problem solving process, including 3 menus: Main menu, Access to the lessons, and Learner management system.

4.2Instructor System is the Web Creative Intelligent Tutoring Management System including 6 main menus: Lesson Management System, Student Management System, Cooperative Management System, Report Management System, Other Management System, and Communication Management System.

5. Results of quality and efficiency evaluation on the Web Creative Intelligent Tutoring System (Web CITS)
The quality and efficiency of Web CITS were evaluated by 8 experts in terms of 1) quality of contents, 2) quality of instructional design, and 3) efficiency of Web CITS.

5.1 Results of the quality evaluation on Web CITS involves the quality of Learner System and it was conducted by the experts in the field of contents and web instructional design. The 6 criteria of thisevaluation include: contents, creative problem solving activity, images and languages, letters and colors, tests, and adaptive testing, as shown in Table 1.

Table1 Results of the quality evaluation on Web CITS in terms of contents (overall elements)

Details	Results		Level of Suitability
	$\bar{X}$	S.D.	
1.Contents	4.79	0.41	Very high
2. Creative problem solving activity	4.75	0.44	Very high
3. Images and Languages	4.65	0.49	Very high
4. Letters and Colors	4.75	0.45	Very high
5. Tests	4.75	0.44	Very high
6. Adaptive Testing	4.78	0.42	Very high
Quality of the overall system (contents)	**4.75**	**0.43**	**Very high**

According to Table 1: Quality evaluation on Web CITS in terms of contents (overall elements), the overall suitability is at very high level ($\bar{X}$= 4.75, S.D.=0.43). Once considering separately, the Contents has the highest suitability ($\bar{X}$=4.79, S.D.=0.41), followed by Adaptive Testing, Creative problem solving activity, Letters and Colors, Tests, and Images and Languages, respectively.

5.2 Quality evaluation on Web CITS in terms of instructional design is an evaluation of Learner System and Instructor System, which was conducted by the experts in the field of content and web-based instructional design. The criteria herein include 1) design of contents, 2) instructional design, and 3) design of Web Creative Intelligent Tutoring System (Web CITS), as seen in Table 2.

Table2 Results of the quality evaluation on Web CITS in terms of instructional design (overall elements)

Details	Results		Level of Suitability
	$\bar{X}$	S.D.	
1. Design of Contents	4.85	0.37	Very high
2. Instructional Design	4.71	0.46	Very high
3. Design of Web Creative Intelligent Tutoring system (Web CITs),	4.94	0.25	Very high
Quality of the overall system (instructional design)	**4.83**	**0.39**	**Very high**

According to Table 2: Quality evaluation on Web CITS in terms of instructional design (overall elements), the overall suitability is at very high level ($\bar{X}$= 4.83, S.D.=0.39). Once considering separately, all of the three items have very high suitability; thereby the design of Web CITS has the highest suitability ($\bar{X}$=4.94, S.D.=0.25), followed by design of contents , and instructional design, respectively.

5.3Efficiency evaluation on Web CITS is an evaluation of Instructor System in terms of efficiency, which was conducted by the experts in the field of Web CITS. In this case, the researcher used Black-box Testing with the following 5 criteria for consideration: Functional Requirement Test, Functional Test, Usability Test, Security Test, and Performance Test, as shown in Table 3.

Table3 Results of the efficiency evaluation on Web CITS (overall elements)

Details	Results		Level of Efficiency
	$\bar{X}$	S.D.	
1. Functional Requirement Test	4.53	0.50	Very high
2. Functional Test	4.28	0.58	High
3. Usability Test	4.10	0.45	High
4. Security Test	4.70	0.57	Very high
5. Performance Test	4.58	0.51	Very high
Efficiency of the overall system	**4.47**	**0.54**	**High**

According to Table 3: Efficiency evaluation on Web CITS (overall elements), the overall efficiency is at high level ($\bar{X}$= 4.47, S.D.=0.54).Once considering separately, Security Test has the highest efficiency ($\bar{X}$=4.70, S.D.=0.57), followed by Performance Test, Functional Requirement Test, Functional Test, and Usability Test, respectively.

Discussion

The developed Web Creative Intelligent Tutoring System (Web CITS) is a cooperative learning management using Student Teams Achievement Division technique, based on the principles of 5-step learning ofSlavin [12], combined with Intelligent Tutoring System, which relied on expert system and 5 steps of creative problem solving process of Torrance. Thereby, the creative problem solving activity was held with an aim to let the learners exchange their opinions among each other and interact one another through learning tools in the sub-group activity. The creative problem solving skills in terms of 8 areas of mathematics consist of 1) retrieval, definition, and summary of searched issues, 2) understanding the problems, 3) linking the problems, 4) finding solutions, 5) choosing methods of solution, 6) mathematic working and calculating, 7) checking problem solving process, and 8) reviewing the solutions and learning achievement. This is corresponding to the research of Wilawan[9], who found out the use of creative problem solving technique to create web-based instructional design. The creative problem solving technique brought about the most suitable solution to any particular situation by means of creative skills that logically led to the brand new and different solutions. Thereby, creative problem solving skill of any individual is the skill that can be enhanced and developed to its utmost potential, which is in

compliant with Basadur [13], who said creative thinking was an advanced problem solving skill [14] and advanced cognition [15]. Besides, it is also in accordance to the research of Phongsak [16], who found that the use of intelligent tutoring system concepts based on expert system to promote web-based cooperative learning could lead to the instruction design that was suitable to the competent of learners, and eventually lead to the more efficient learning.

Conclusion

The elements of the developed Web Creative Intelligent Tutoring System (Web CITS) consist of 2 main parts: 1) Learner System, which is the presentation of intelligent contents and Web-Based Instruction by means of Cooperative learning and Student Teams Achievement Division technique combined with expert system and creative problem solving process, under the experiment in the subject of Digital Circuits I, Vocational Certificate, Department of Electrical&Electronics, 2) Instructor System, which is concerning the instructional management including 6 main menus: Lesson Management System, Student Management System, Cooperative Management System, Report Management System, Other Management System, and Communication Management System.According to the results of evaluation, it is found that the quality of the contents of overall elements is at very high level of suitability ($\bar{X}$=4.75, S.D.=0.43), the quality of instructional design is at very high level of suitability($\bar{X}$= 4.83, S.D.=0.39), and the overall efficiency of Web CITS is at high level ($\bar{X}$=4.47, S.D.=0.54)that considering separately, Security Test has the highest efficiency ($\bar{X}$=4.70, S.D.=0.57), followed by Performance Test, Functional Requirement Test, Functional Test, and Usability Test, respectively. .

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A Development of an E-Book on "Writing English Expressions for Business Communication" for the Students of Rajamangala University of Technology Rattanakosin

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Abstract

The purpose of this study was to develop an e-book on "Writing English Expressions for Business Communication" for the students of Rajamangala University of Technology Rattanakosin. The study was undertaken through a research study using a one-group pretest-posttest design. The purposive sampled group consisted of 31 students who volunteered to participate in this project. The research instruments included a developed e-book and a questionnaire on students' satisfaction with the developed e-book. The developed e-book contained eleven units: Unit 1: Invitations, Unit 2: Expressing Thanks, Unit 3: Apologizing, Unit 4: Congratulations, Unit 5: Condolences, Unit 6: Requests/Inquiries, Unit 7: Orders, Unit 8: Complaints, Unit 9: Adjustments, Unit 10: Application, and Unit 11: Collection. The results were as follows: 1) the value of the effectiveness of the developed e-book was 88.68 /86.23; 2) the average posttest score was significantly higher than the average pretest score at a significant level of .05; and 3) the sample group expressed their high level of satisfaction with the developed e-book.

Keywords: E-book, Writing English Expressions, Business Communication

Introduction

According to the Office of the Higher Education Commission (OHEC), the roadmap for higher education quality development has a prime objective of producing high quality graduates and researchers who will contribute to the country's social and economic development [1]. In addition, as stipulated in the National Qualifications Framework for Thailand's Higher Education, graduates from higher eduational programs should have the ability and commitment to engage in lifelong learning, capacity for effective communication including communication through use of information technology and the ability to take the initiative in individual and group activities [2]. As for the capacity for effective communication, it should be taken into consideration that Thailand will enter the ASEAN Economic Community (AEC) at the end of 2015 pursuant to the ASEAN Charter, and the working language of ASEAN will be English [3]. Thus, graduates from higher eduational institutions should also be capable of using English for both written and verbal communication.

Accordingly, at present, under the Commission on Higher Education, universities serve the policy of improving students' English proficiency by increasing the number of credits for English language learning

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to at least 12: the first 6 credits emphasizing English communication and learning skills, while the rest can consist of English for specific purposes or English for academic purposes depending on the requirements of each individual institution [4].

The emerging progress of Information and Communication Technology (ICT) in recent times has resulted in a wide use of teaching and learning processes through modern media of ICT and e-learning because it is believed to be beneficial to learners as learners can learn at their own learning pace, which could lead to possessing their own self-directed learning [5]. Additionally, findings from the studies undertaken by S. S.C. Young [6], Robinson J. S. and Zaitun A. B. [7], Li H. [8], Ting S. E. [9], and Melor M. Y., Maimun A. L. and Chua P. L. [10] showed that utilization and integration of ICT tools in promoting English language teaching and learning had positive impacts on the learners' learning. Meanwhile, an objective of National Education Act B.E. 2542 (1999) and Amendments (Second National Education Act B.E. 2545 (2002)) states that the learning process should aim at inculcating the learners' capability of self-learning on a continuous basis [11]. Accordingly, some studies on e-learning showed positive results on promoting student interest in self-directed learning [12].

With regard to ICT and e-learning, an e-book is referred to a text that is available on electronic format [13], and is in fact a tool of ICT and e-learning. Apparently, e-books can be used for students' self-learning in support of their acquisition of knowledge in different subjects at any place and any time. Nowadays, e-book utilization in various subjects is widely spread. Besides, language learning applications on mobile phones have been invented to facilitate language learners' learning [14]. Furthermore, positive results from e-book utilization for EFL learning have been reported in studies conducted by several educators such as Yanjie S. and Robert F. [15] on "Using PDA for undergraduate student incidental vocabulary testing", Chih-Cheng L. [16] on "E-book flood for changing EFL learners' reading attitudes" and Chen, C. [17] on "The Relationship between E-book Users' Learning Performance and Related Factors."

English for communication in the world of business employs not only listening, speaking and reading skills, but also includes writing skills. Nowadays, written work in the form of e-mails and letters is commonly used for official contacts in business since written work can be referred to. The language use in the written work should be correct and acceptable according to the language pattern and usage. Especially, Business English is considered English for Specific Purposes, purposively used in business communication [18]. Learners are required to practice correct use of written expressions in Business English. A study conducted by Betsy S. [19] found that employers need graduates with strong writing skills. Therefore, if some written expressions in Business English for business communication can be sorted out and provided for students to learn and practice through the use of an e-book, a tool of ICT and e-learning, it could stimulate the students' learning progress at their own learning pace at any time and

any place. A positive effect on the students' English writing competence for business communication should prevail.

From what has been mentioned above, the researcher believes that some ways of English teaching and learning processes through ICT and e-learning should be applied in order to enhance students' English writing competence for business communication. As an English teacher at Rajamanagala University of Technology Rattanakosin, the researcher has started this study of which the purpose is to develop an e-book on "Writing English Expressions for Business Communication" for the students of Rajamangala University of Technology Rattanakosin.

Materials and Methods

The study process was carried out by using a research design employing a one-group pretest-posttest method. The procedure was as follows:

1. Research group

The research group consisted of 31 fourth year students majoring in Business English at Rajamangala University of Technology Rattanakosin, Bophitphimuk Chakkrawat Campus, who volunteered to take part in this project in the first semester of academic year 2013.

2. Research instruments

The research instruments consisted of: 1. "E-book on Writing English Expressions for Business Communication for the Students of Rajamangala University of Technology Rattanakosin", and 2. "Questionnaire on Students' Satisfaction with the Developed e-Book".

The e-book was constructed through the use of Adobe Activate Program available on the internet. The contents were selected from related texts and documents to comply with the course description of English for Business Communication in the curriculum of Bachelor's Degree Program in Business Administration provided in the Faculty of Business Administration at Rajamangala University of Technology Rattanakosin. The selected contents consisting of written expressions for business communication in various topics for the e-book were verified with the course description to ensure the content validity before being sequenced and divided into 11 units: Unit 1: Invitations, Unit 2: Expressing Thanks, Unit 3: Apologizing, Unit 4: Congratulations, Unit 5: Condolences, Unit 6: Requests/Inquiries, Unit 7: Orders, Unit 8: Complaints, Unit 9: Adjustments, Unit 10: Application, and Unit 11: Collection. In each unit, the content of "Writing English expressions for business communication" was presented in sentences, 2-5 sentences per page depending on the sentence length. The content was followed by an exercise of 10 items of 4-multiple choice questions. The full score for the unit exercise of 10 items would be shown as 100 per cent. The construction of the e-book was based on the method of drill and practice design for learning [20].

A pretest and a posttest covering all contents in 11 units were later constructed and tested with another group of 30 students in order that test items with the difficulty index (P) in the range between 0.20-0.80 and with the discriminantion index (R) in the range between 0.20-1.00 were selected. As a result, out of 40 items, 30 items with the content covering all 11 units (about 3 items for each unit) were selected to be included in the pretest and the posttest. That is the pretest and the posttest were the same, and the full score of each test would be 30 points.

In the preliminary stage, the e-book was tried out with a sample group of 10 students who volunteered to use it. They were not the students in the research group. The purpose of the try-out was to see if there were any problems while the e-book program ran on the computer. It was found that the program could run as designed. As for the criteria value of the effectiveness of the developed e-book before the research study, it was set at 80/80 according to the common criteria for educational software innovation of drill and practice design [21].

The Questionnaire on Students' Satisfaction with the Developed e-Book was constructed by the researcher through studies from related literature, especially from the guidelines of Suwimon T. [22], about how to construct a rating scale questionnaire. The constructed questionnaire was a 5-point rating scale type with an open ended question at the end for the answerers to freely give opinions and suggestions. The meanings of satisfaction levels to be interpreted from the scale were set according to Boonchom S. [23]:

Average Mean	Level of Satisfaction
4.51-5.00	The most satisfaction
3.51-4.50	High satisfaction
2.51-3.50	Moderate satisfaction
1.51-2.50	Low satisfaction
1.00-1.50	The least satisfaction

After the questionnaire was constructed, it was tried out with one volunteer student, majoring in English for International Communication in the fourth year in the Faculty of Liberal Arts, to see if the messages in the content items were clear before some minor revisions of the wordings were undertaken.

3. Research process

In the process of the research study, the researcher first gave the pretest to the research group before asking them to use the e-book program in the CD at their own learning pace outside of class. Each student of the research group was then given a CD of the e-book program and a handout in Thai version describing how to use the program in the CD. The CD also had a file giving instructions about how to use the program. The researcher additionally informed the research group that the objectives of having them use the e-book in the CD were for helping them learn about "Writing English expressions for business communication" and for encouraging them to learn on their own, which could lead to their gaining ability of

self-directed learning. It was clarified to them that self-directed learning ability, which integrated self-managent with self-monitoring, could be derived from being responsible for learning on their own [24], and that the ability of self-directed learning would be useful for them in pursuing further study or gaining progress in their professional careers in the future. The program was designed for the user's review and repetition of reading the contents and doing the exercises in all 11 units. In the program, the user was asked to read the contents and do the exercise in each unit. While doing the exercise in each unit, the user was allowed to give an answer for three times to each question. If the first attempt and the second attempt were not successful, he or she could try the third time. After finishing an exercise, the user was allowed to go back to repeat doing it if he or she was not satisfied with the results. This practice followed the method of drill and practice design for learning as earlier mentioned. The focus was to help the user learn the specific written expressions presented in the unit. The research group were asked to record the final results from doing the exercises in the sheet provided. They were then asked to complete using the e-book in one month, and hand in the record sheets of the e-book exercise results to the researcher upon their completion of using the e-book.

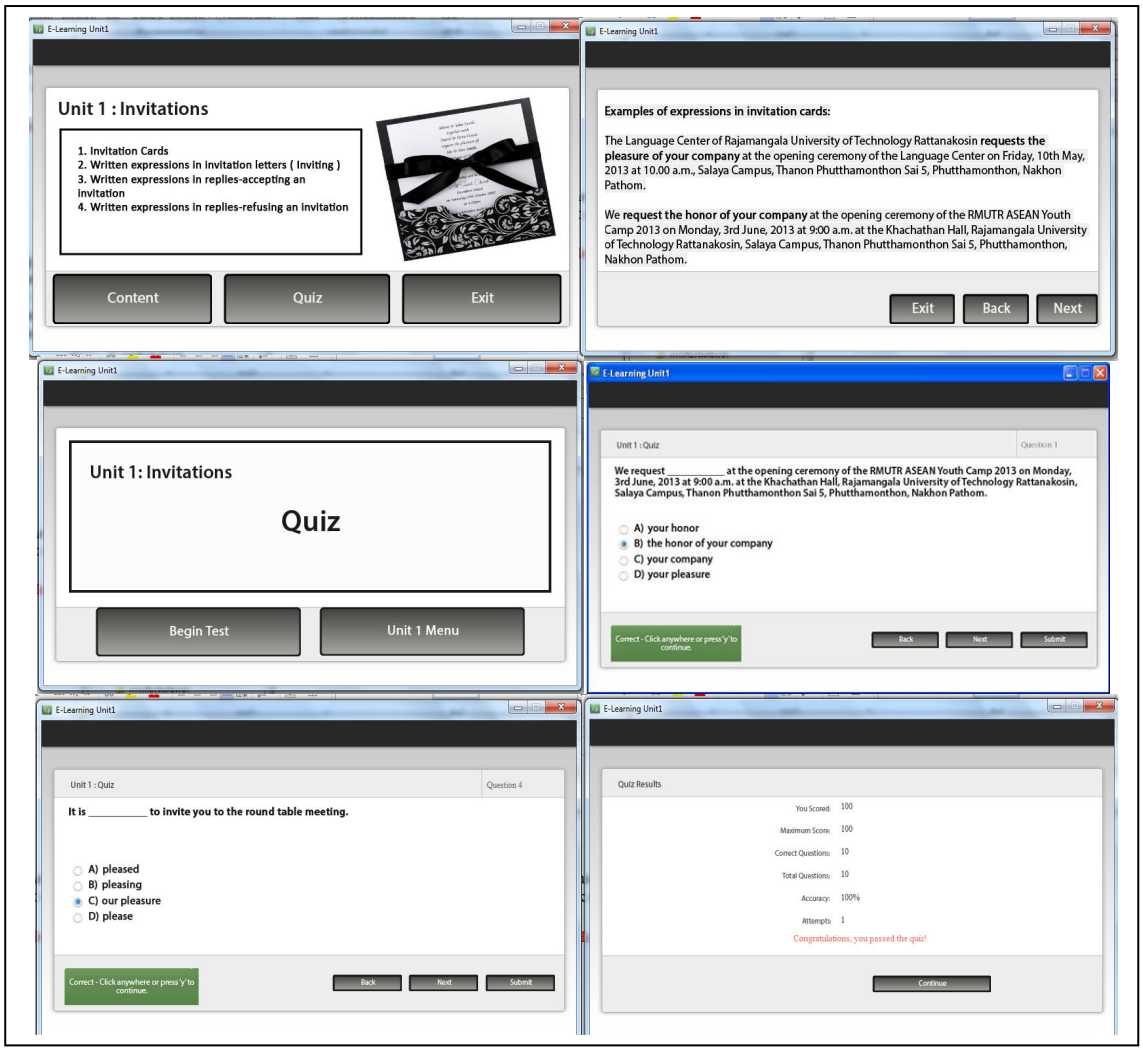

Figure 1: Examples of the content and exercise in the e-book in the CD

After using the e-book for one month in the research study period, the research group handed in their record sheets of the e-book exercise results to the researcher. On that day (September 18, 2013), the researcher gave them the posttest, which was the same as the pretest. After they finished the posttest, the researcher distributed copies of the questionnaire to them to complete and then collected the completed copies of the questionnaire.

In the data analysis, the total exercise score resulting from the research group's use of the e-book and the posttest score were compared to find out the value of the effectiveness of the e-book. The analysis of Paired Dependent Sample Test was used to find out the differences between the average scores of the pretest and the posttest of the research group. The researcher also analyzed the results of the answers to the Questionnaire on Students' Satisfaction with the Developed e-Book to find out scores of mean and S.D.

The steps in the research process and data collection can be summed up as shown below.

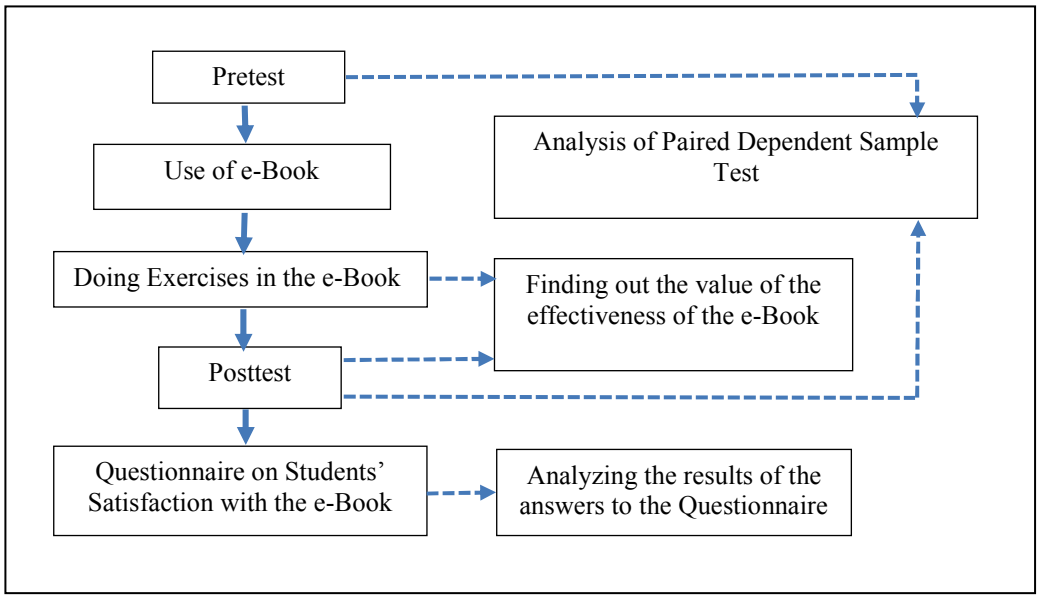

Figure 2: Steps in the quasi-experiment process

Results

The results from the research study were as follows:

1. The value of the effectiveness of the e-book, resulting from comparing the research group's e-book exercise score and the posttest score, revealed as shown below:

Table 1: Data for the value of the effectiveness of the e-book at the set criteria of 80/80

No. of Samples	Exercise Score (Percentage)											Posttest Score (30)
	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Unit 9	Unit 10	Unit 11	
1	90	100	90	100	90	80	80	90	90	100	90	30
2	90	80	100	90	90	80	80	90	90	90	80	30
3	90	80	90	80	80	80	80	90	80	100	80	24
4	90	80	80	90	90	90	80	90	90	90	80	30
5	90	100	90	80	80	80	80	100	100	80	80	30
6	100	90	100	100	100	90	80	80	90	90	80	25
7	80	80	90	90	80	90	80	90	80	80	90	28
8	80	90	90	80	80	90	90	90	80	80	80	24
9	90	90	100	90	80	80	90	90	90	90	80	30
10	90	80	90	80	100	80	80	90	80	80	80	23

Table 1: (Continued)

No. of Samples	Exercise Score (Percentage)											Posttest Score (30)
	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Unit 9	Unit 10	Unit 11	
11	100	90	100	80	90	100	90	80	100	80	80	29
12	80	100	80	80	80	80	100	90	100	80	80	27
13	80	100	80	80	80	80	100	90	80	80	80	26
14	80	80	100	100	90	80	90	100	90	80	100	16
15	80	90	90	90	80	80	80	100	90	100	80	22
16	90	90	100	80	100	90	80	90	80	100	100	27
17	100	100	100	90	80	80	90	80	100	90	80	24
18	90	80	90	90	90	90	90	90	80	80	80	25
19	90	80	100	90	80	80	90	100	90	80	100	26
20	100	100	90	100	100	80	90	90	100	100	100	26
21	80	90	100	90	80	90	90	90	90	100	90	28
22	80	80	80	80	90	80	90	80	80	80	80	20
23	90	80	90	80	80	90	100	90	100	90	90	20
24	100	100	100	90	90	90	100	90	100	100	100	29
25	80	80	90	80	90	80	80	80	90	80	100	29
26	100	100	100	100	90	90	90	90	100	100	90	29
27	90	90	90	100	80	90	80	80	100	90	80	23
28	90	100	100	80	90	80	90	100	100	90	90	22
29	100	80	100	90	90	80	100	80	80	90	100	29
30	100	90	100	100	100	90	90	100	80	100	100	29
31	100	90	90	80	80	90	90	80	80	100	80	22
Total	2790	2760	2890	2730	2700	2630	2720	2770	2780	2770	2700	802
Grand Total						30240						

From the data above, the value of the effectiveness of the e-book can be analyzed as in the following:

$$E_1 = \frac{\sum X1}{NxA} \times 100 = \frac{30240}{31 X 1100} \times 100 = 88.68$$

$$E_2 = \frac{\sum X2}{NxB} \times 100 = \frac{802}{31 X 30} \times 100 = 86.23$$

"E_1" means the effectiveness of the process. "$\sum X1$" means the total sum of the exercise score or the activity scores in the units of the e-book. "N" means the number of the samples. "A" means the full score of the exercise scores or the activity scores in the units of the e-book. In the meantime, "E_2" means the effectiveness of the results. "$\sum X2$" means the total score of the posttest. "B" means the full score of the posttest.

From Table 1 above, the research group's average score from doing exercises in 11 units of the e-book was 88.68%, whereas their average posttest score was 86.23%. Therefore, the value of the effectiveness of the e-book (E_1/E_2) was 88.68/86.23.

2. The results from the analysis of Paired Dependent Sample Test to find out the differences between the average pretest score and the average posttest score of the research group after their completion of using the e-book were found as follows:

Table 2: Average scores of the pretest and the posttest of the research group, using the e-book

No. of Samples	Pretest Score (30)	Posttest Score (30)
1	14	30
2	10	30
3	11	24
4	9	30
5	15	30
6	9	25
7	12	28
8	8	24
9	12	30
10	12	23
11	16	29
12	10	27
13	15	26
14	11	16
15	17	22
16	9	27
17	14	24
18	16	25
19	14	26
20	15	26

21	11	28
22	17	20
23	16	20
24	6	29
25	17	29
26	16	29
27	12	23
28	15	22
29	16	29
30	17	29
31	10	22
Average	12.97	25.87

From Table 2 above, it is shown that the average pretest score and the average posttest score of the research group who used the e-book for the period of one month were 12.97 points and 25.87 points respectively from each full score of 30 points.

Table 3: Differences between the average scores of the pretest and the posttest of the research group

	Differences of Average Scores	No. of Samples	Std. Deviation	t	Sig. (2-tailed)
Posttest Score-Pretest Score	12.90	31	4.915	14.617	.000

Table 3 above shows that the average posttest score was significantly higher than the average pretest score at the significant level of .05, resulting from the research group's use of the e-book.

3. The results of the analysis in the answers to the Questionnaire on Students' Satisfaction with the Developed e-Book are shown below:

Table 4: Mean, SD and level of satisfaction of the research group after using the developed e-book

Item	Content	Mean	SD	Level of Satisfaction
1	The program of the e-Book is easy to use.	3.84	0.76	High

2	The difficulty of the content in each unit is at the suitable level.	3.77	0.72	High
3	The sequence of the content is suitable.	3.84	0.82	High
4	The exercises are relevant to the contents in the lessons.	4.32	0.70	High
5	Doing the exercises can help you recall the English written expressions in the contents.	4.10	0.87	High
6	Doing the exercises as designed can make you understand the contents.	4.03	0.75	High
7	The program of the e-Book provides opportunities for interactions while learning.	4.19	0.79	High
8	Taking interactions in the program of the e-Book can help you learn the contents.	4.16	0.58	High
9	Taking interactions in the program of the e-Book can make you enjoy the lessons.	3.58	0.67	High
10	The program provides opportunities for the learners to go back to the lessons and review the contents.	4.35	0.61	High
11	The program provides flexibility for the learners' learning.	4.10	0.70	High
12	The program designed for the learners to go back to the lessons can make the learner to be more accurate in the contents learned.	4.16	0.64	High
13	The contents learned can enhance your confidence in writing English expressions for Business communication.	4.00	0.78	High
14	The lessons enhance your basic knowledge about English sentence writing.	3.77	0.76	High
15	The lessons can supplement your learning in the classroom.	3.87	0.76	High
16	The program of the e-Book has been designed for the learners to learn the contents at their own learning pace.	3.90	0.83	High
17	The immediate feedback of your learning results is good for your learning.	4.39	0.62	High
18	The lessons can stimulate your learning interest.	3.71	0.97	High
19	The program can enhance your self-directed learning ability.	4.03	0.88	High
20	The program is good for your English learning.	4.06	0.81	High
	Average	**4.01**	**0.47**	**High**

From Table 4 above, it can be seen that the research group expressed their high satisfaction with the developed e-book at the level of 4.01 points out of the rating scale of 5 points, with an S.D. of 0.47 point. For itemized score, it is shown that item 17 "The immediate feedback of your learning results is good for your learning." was highest rated at the level of 4.39 points, with an S.D. of 0.62 point, meaning high satisfaction. Other items were also rated at the level of high satisfaction, of which the points were more than 3.50. Among all items, item 9 "Taking interactions in the program of the e-book can make you enjoy the lessons." was lowest rated at the level of 3.58 points with an S.D. of 0.67 point despite its being rated at the level of high satisfaction. As for the open ended question at the end of the questionnaire, it was found that there were no answers expressing opinions in sufficient frequency to be summarized.

Discussion

Some major points from the results of the research study as mentioned above can be raised for future discussions as follows:

1. The research group's average score from doing exercises in 11 units of the e-book was 88.68%, whereas their average posttest score was 86.23%, showing that the value of the effectiveness of the e-book (E_1/E_2) was 88.68/86.23. It is clearly seen that this value of the effectiveness of the e-book was higher than the earlier set value of 80/80, which had been set according to the common criteria for educational software innovation of drill and practice design [21].

This finding could have been caused by the designed program of the e-book, which was set for the learners to learn at their own pace through their repetition of reading the contents and doing the exercises. As designed, the research group could go back to read a previous page of the content in each unit. During an exercise, when they submited their answer, the feedback button showed them whether the answer was correct or incorrect. In this way, they could see which choice was the correct answer to each question. This can help them learn and recall the written expressions in the unit.

In addition, the finding on the value of the effectiveness of the developed e-book mentioned above is in accordance with the results from other studies conducted by some educators as follows: Santhana S. [25] carried out a study on "A Comparative Study on Achievements of the Students Studying by Using an e-Book and the Students Studying through the Conventional Method at the Level of Short Polytechnic Courses at Udonthani Polytechnic College", and found that the value of the effectiveness of the developed e-book was 82.20/86.00 which was in the range of the prior set value of 80/80. Similarly, Suchart J.'s study [26] on "The Development of Electronic Book Entitled Using Information and Communication Technology Ethics for Students" showed that the value of the effectiveness of the developed e-book was 80.91/80.75. In the same way, Pennapa P. [27] undertook a study on "Development of Electronic Book on Fundamental Graphic Design", and the finding revealed that the

value of the effectiveness of the e-book was 90.92/96.67, which was significantly higher than the set value of 80/80.

2. The average posttest score was significantly higher than the average pretest score at the significant level of .05, resulting from the research group's use of the e-book.

As mentioned earlier, the design of the e-book program in the form of drill and practice could have led to such a result. This practice is in accordance with Judith A. C.'s views on drill and practice software [28]. She states "…drill and practice software does have some benefits. It provides the student with individualized practice; the student must answer every question." In addition, she says that applications for drill and practice software include many areas where basic skill mastery is desired, and that memorization of math facts, grammar practice, and foreign language vocabulary practice are examples of appropriate use of this software. The design of drill and practice for the e-book program was used for the research group due to their limited background knowledge about writing English expressions for business. This idea was also consistent with Robert M. G.'s theory of learning, especially on the condition of learning, focusing on intentional or purposeful learning [29].

Apart from what has been mentioned, this finding was also in accordance with the results from studies undertaken by some educators such as Wachira W. [30], Suchart J. [26] and Achara Ch. [31]. The results from their studies showed that the average posttest scores were higher than the average pretest scores at their specified statistical significant levels.

3. The research group expressed their high satisfaction with the developed e-book.

This finding could have resulted from the design of the e-book program, which provided interactions between the research group and the program, and allowed them to learn at their own learning pace to encourage their self-directed ability. The opportunity to learn on their own can encourage their self-directed learning. It can also lead to their satisfaction as Judith A. C. [28] says "Learners using the software also report that they feel more comfortable because they can set their own pace (if the software allows), and their answers and feedback received are private." Besides, it can be pointed out that this satisfaction of the research group is relevant to Maslow's Hierarchy of Needs [32]. According to Maslow, the esteem needs are of two versions: a lower one (the need for the respect of others, the need for status, fame, glory, recognition, attention, reputation, appreciation, dignity, and dominance) and a higher one (the need for self-respect, including such feelings as confidence, competence, achievement, mastery, independence, and freedom). So, the research group's feeling of independence while learning on their own through the use of the program of the e-book could increase their satisfaction with the program.

Conclusion

From the findings, the research group's average posttest score was significantly higher than their average pretest score at the significant level of .05. This resulted from using the developed e-book, and also the research group expressing their high level satisfaction with the developed e-book. It can be concluded that the developed e-book as designed was useful for the research group. The research group enhanced their knowledge of writing English expressions for business communication through the use of the developed e-book. In addition, it is hoped that being equipped with such knowledge of writing English expressions for business communication included in the developed e-book, students can further build up their writing ability for better preparation to enter the future business world where real business communication through writing prevails.

With regard to further study, the researcher would like to suggest the following:

1) Blend e-learning with classroom instruction for "English for Business Communication" in order to maximize use of new technology of ICT for students' learning.

2) Develop E-book and e-learning for "English for Business Communication" including interactive aspects between students, program and instructors via mobile phone to facilitate students' interest in learning English.

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The Study on Reading Comprehension Utilizing Intensive Reading of Simplified Stories, St Theresa International College

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Abstract

This research aimed to study reading comprehension utilizing intensive reading of Simplified Stories among students at St. Theresa International College. The subjects of this study were 46 first-year students majoring in Nursing (21 students) and Public Health (25 students) in the Second Semester of Academic Year 2013. All of them are Thais and are enrolled in the course of College English II (Reading and Writing), which is a requirement for further English study. Ten elementary-level simplified stories, with the range of headwords between 500-1,900 words, were selected for students to read as supplementary material to enhance their reading ability and reading comprehension. The instruments used in this study were the pre/post test of basic reading comprehension and attitude-test questionnaires. The findings of the study revealed that, in both pretest and posttest, the reading comprehension of Nursing students is higher than the Public Health students. However, after the use of Simplified Stories, both groups have increased their scores in reading comprehension with a significant difference at .05 level. For the attitude questionnaires, both groups thought their reading was better than before the use of Simplified Stories. Most students expressed their desire to read more Simplified Stories. Most students realized the importance of a teacher as a person who helped them have more understanding on the stories. Students preferred reading in pairs or in groups rather than reading alone. They thought the questions and answers about the stories inside the classroom made them have better understanding on the content of the stories. Most students wanted the teachers to use Simplified Stories in the higher reading classes.

Keywords: Reading Comprehension, Simplified Stories

Introduction

English has played a vital role in Thailand for many years; yet, Thai students are still lagging behind in the language usage, compared to other countries. The importance of the English usage is more frequently mentioned among country leaders and educators nowadays due to the coming of ASEAN Economic Community (AEC) in 2015 wherein a certain level of the flow of workforce and trade among the 10 nations of the Association of Southeast Asian Nations (ASEAN) is expected. Academicians and politicians predicted that Thai people will be losing in the job-seeking competition due to lack of English language proficiency.

One reason for the deficiency in English skill is the lack of reading habit among Thais. Reading habit is a big problem in Thailand. The Thais read only around 2-5 books per year despite having great efforts by governmental and private sectors to push people to read. Reading habit is somehow related to

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the level of people's education and economic development in a country [1]. People in developed countries are often found to be reading more books than those in the less developed ones. Singaporeans, for example, read around 17 books per year while Americans read 50 books [2]. Singapore with the population of around 4 million sells 8 million newspapers everyday because they read 2 newspapers per day, one in English and another in the Chinese language. The books Thai people read are mostly fashion and entertainment magazines. The Thais are fond of spending most of their leisure times watching TV and listening to radio.

Even if Thailand is known as a tourist hub in the region due to the diversity of cultures and natural heritages, with as many as 20 million tourists visiting the country each year, most Thai students lack the chance to speak to foreigners. Their daily life does not involve the English language except in reading form. If reading can be ideally promoted throughout the country, Thai students will be directly benefited and it will help enhance their language skills faster.

Many first-year students who are Thais at St. Theresa International College are found to struggle with the new environment of English usage in the college. Most of them did not study in the English program in high school and have limited level of reading comprehension. Hence, the college sees the importance of upgrading their English to a level that they can fairly communicate with foreign teachers and friends. This experimental research was then developed in order to see the differences before and after the use of Simplified Stories as a supplementary reading. The researcher also wanted to evaluate the change of student's satisfaction towards the use of Simplified Stories after the study.

Research Objectives

The objectives of this study were to: 1) study the reading comprehension of students of St. Theresa International College, 2) compare reading comprehension of students before and after the use of Simplified Stories, and 3) study the attitude of students towards reading through Simplified Stories

Research Questions

1. Can students develop reading comprehension through Simplified Stories?

2. Will the students develop positive attitude towards reading English books after the use of Simplified Stories?

Related Literature

Researchers have pinpointed that the more second-language students read, the faster they can enhance their language skills [3]. Undeniably, the best way to develop the second language is to have chance to live in a society surrounding that language. The second best way is to read as many books of that language as possible [4]. For those who are struggling with the starting point of learning English,

reading simplified books or Graded Readers, using simple words and not-so-complicated grammar, with the range of 3,000 words will encourage them to develop the love of English and read further by themselves. By ladder-climbing reading through the Graded Readers, students will be able to upgrade their English to the similar level of the native speakers, who normally know around 20,000 words.

However, students should start reading books of their level first. Reading as many books as possible will help them learn new words without the need to recite them. Nuttall [5] suggested three rules for the English language study: 1) read the books you really want to read, 2) use the dictionary only when absolutely necessary or if possible, none at all, and 3) stop when you are bored with the book or feel that it is too difficult for you.

The more students read, the better their English is [6]. The reading effectiveness can be evaluated from the vocabulary stock they have. However, students should be allowed to read the books they really want to and read a great deal of them. It will be better if they started reading since their childhood.

Thai people do not read much. The National Statistical Office [7] has surveyed 53,000 households in the country and found that 68% of the Thais aged above 6 years old do some reading. 69% of males and 68% females read. Bangkok people are found reading the most at 89%, while people in the northeast read the least, at 62%. Newspapers are read the most at 63%. Second to this are textbooks, novels, cartoons, magazines, at around 32-36%. Books read the least are religious ones, at less than 30%. By average, Thais read 35 minutes a day. Children and teenagers read around 40-41 minutes a day. The elderly and working people read 31-32 minutes a day.

Academicians believe the youths have a tendency to read less because they prefer games, chatting on social networking programs or surfing the Internet. Since reading habit is crucial to individual and national development, many governmental and private organizations involved are trying to promote reading in the country.

Bangkok was named World Book Capital by the United Nations Educational, Scientific and Cultural Organization (Unesco) in 2013, wherein local authorities in Bangkok have organized a number of reading campaign activities and built new libraries across the city in order to encourage people to read. However, the Bangkok administration was criticized as lacking clear guidelines to truly promote reading [8].

English level among Thais is still lagging behind among ASEAN countries. The average scores of TOEIC (Test of English for International Communication) of Thai students, for example, have pointed to the language weakness. Out of possible 990 full scores, Thai test takers got average scores of 524, while Cambodians got 606, Singaporeans 628, and the Philippines 751 [9].

Other studies have confirmed this language weakness. A research by Fahmongkolchai [10] found that CIMB tellers still lack the English skills to properly handle foreign customers. Aunruen [11] also found that tourist companies have problems communicating in English with foreign customers. Preechawat [12]

found that Thai office workers have problems in English writing when they have to communicate with foreigners.

Nevertheless, there is a drive among Thai academics and researchers to find ways for English studies, especially through the supplementary reading of English books. The study by Prathonthep [13] found that students can develop their love for English reading if they can freely choose the books for reading by themselves. They may opt to read the books with English level lower than their actual level. After reading 1-2 books continuously, they will show their development in language ability. The schools should have books of all levels to answer the demand of all levels of students and teachers. Students should be encouraged to read for pleasure without framing them with time limit. By nature, students have different speed level.

Through the teaching and learning of extensive reading activities, teachers of the second language should provide activities before the reading, during the reading, and after the reading, in order to enhance the effectiveness of reading [14]. Before the reading, students should know the goal of their reading. They should ask themselves how much they know about the story and its structure. During the reading, they should connect the similar ideas or events or guess for the future events. They should try to understand the difficult parts and write down notes on the empty space of the books or underline the sentences they particularly like. After reading, students should summarize the story into their own words and briefly look back at some important parts. With all these activities, they will develop long-term memory about the book.

Khirin [15] has conducted an experimental study for 2 years with students at Nakhon Pathom Rajabhat University and found that students reading extra books outside class have developed better English. After reading the first book, students will find it easier and faster to read other books. Because of this, they are encouraged to read more. Eventually, students became more confident in reading leading to a more positive attitude towards reading. In the past, students thought reading English books was too difficult for them. However, their attitude has changed after they were able to read some books by themselves.

Bell [16] did a study in Yemen comparing two groups of students. The first group was freely allowed to read the books which they think match their level. The second group was taught to read short passages in great details slowly. The study found that the first group developed their reading speed better and had better comprehension than the second group. However, both groups have the same comprehension level in their reading and the same vocabulary level.

Hitosuki and Day [17] of University of Hawaii experimented their extensive reading with 14 American students enrolled in basic Japanese. The subjects were asked to read Japanese children literature where there were 200 books to choose from. Teachers had to read all books at the same time, without asking students about their comprehension of the books. The aim for reading was for pleasure

only. However, the researchers tested the student's attitude after finishing the 10-week reading program. After the exam at the end of the course, the researchers found that the students reading more than 50 books would get A. The more the students read, the better grade they got. Their attitude towards studying Japanese was also more positive at the end of the program.

Reading easy books will allow students to see the same vocabulary repeatedly until they can memorize the words. Knowing the meaning will also help them on pronunciation and grammar which will lead to effective English studies [18]. Students will enjoy reading more when they understand the meaning of most words. Students will be able to guess the meaning of some unknown words only when they know the meaning of at least 95% of the words in the story.

Putting college students to read simple stories in this research may sound strange, however, students will not be expected to stay in their level for long. Reading Simplified Stories will eventually help increase their reading speed and confidence. Most of all, the researcher expects to see change in their attitude in reading English books, especially to the fact that they enjoy reading more English books at their free time without the teacher having to assign them to. Moreover, those students who lacked the access to English books in their old schools are expected to catch up in their reading speed and skill with their classmates.

Methodology

The research utilized the descriptive method, with purposive sampling. The population of the study was two groups of 46 first-year students, enrolling in College English II (Reading and Writing) in Semester 2, Academic Year 2013 (November 2013 – March 2014) at St. Theresa International College. The two groups were 21 Nursing students and 25 Public Health students. All of them are Thais.

Ten simplified stories, with the range of headwords between 500-1,900 words, were selected for students to read for the whole semester. Here is a list of stories used in this research.

Table 1 List of Simplified Stories Used in the Study.

	Titles	No. of Headwords	Level	No. of Pages	Publishers
1.	Black Beauty (UK)	500	Elementary	30	Oxford
2.	The Blind Beggar Boy (China)	1,000	Elementary	11	Macmillan
3.	Urashima Taro (Japan)	1,000	Elementary	15	Macmillan
4.	The Magic Mirror (Turkey)	1,000	Elementary	10	Macmillan
5.	Tse-ring Learns His Lesson (Tibet)	1,000	Elementary	8	Macmillan
6.	The Magic Lamp (India)	1,000	Elementary	15	Macmillan
7.	A Christmas Carol (UK)	1,100	Elementary	63	Macmillan

8.	The Love of a Busy Businessman (US)	1,400	Elementary	4	Oxford
9.	Little Girls are Wiser than Men (Russia)	1,900	Elementary	4	Oxford
10.	The Imp and the Farmer's Bread (Russia)	1,900	Elementary	6	Oxford

Two research instruments used to collect data for this study were the pre/post test of reading comprehension and a 5-scaled questionnaire of 18 questions. The 18 questionnaires were divided into four topics, which are 1) reading skill 2) learning process 3) group learning, and 4) loving to read.

Three validators were asked to check the content validity of the designed questionnaire. The reliability of the questionnaire was statistically analyzed, using the formula of Cronbach alpha coefficient and was at the level of .80. The questionnaire was pre-tested with 30 respondents who were not included in the actual study.

Results and Discussion

The pre/post test for reading comprehension has the total score of 10. Below is the result of pre/post test of the two groups of the population.

Table 2 Pre/post test scores of 25 Public Health students

Students	Pretest	Posttest	Increment
1	9	9	0
2	10	10	0
3	10	8	-2
4	9	7	-2
5	5	7	2
6	10	8	-2
7	9	9	0
8	10	10	0
9	10	10	0
10	6	7	1
11	9	8	-1
12	3	4	1
13	7	10	3
14	8	10	2
15	5	9	4
16	8	9	1
17	8	9	1
18	8	10	2

19	7	10	3
20	5	6	1
21	7	10	3
22	3	7	4
23	3	6	3
24	7	9	2
25	5	8	3
Net	181	210	
Mean ($\bar{x}$)	7.24	8.4	1.16

The pre/post test was the unseen story and it was not one of the 10 simplified stories given to students in this study. For 25 Public Health students, 16 of them have increased their scores at the posttest, while 4 of them have lower scores. Five of them have the same scores of both pre/post tests. The mean for pretest score was 7.24 and the posttest was 8.4. The average score increment was 1.16.

Table 3 Pre/post test score of 21 Nursing students

Students	Pretest	Posttest	Increment
1	7	10	3
2	7	9	2
3	8	10	2
4	10	9	-1
5	7	6	-1
6	8	8	0
7	8	8	0
8	5	9	4
9	8	9	1
10	8	8	0
11	9	10	1
12	8	9	1
13	9	9	0
14	10	10	0
15	10	9	-1
16	7	9	2
17	9	8	-1
18	8	8	0
19	10	10	0

20	8	10	2
21	10	8	-2
Net	174	186	
Mean ($\bar{x}$)	8.28	8.85	0.57

The 21 Nursing students have the mean score for pretest at 8.28 and the posttest at 8.85. The average score increment was 0.57. Nine of them have increased their scores at the posttest, while 5 decreased. Seven of them have the same scores of pre and post tests.

In general, the Nursing students have higher scores than those in the Public Health major. However, the Public Health major has higher score increment than the Nursing students.

Table 4 Group Score Increment

Students	Pre-test	Post-test	t	p
Public Health	181	210	-	-
Nursing	174	186	-	-
Net (N=46)	355	396	-	-
Mean ($\bar{x}$)	7.71	8.60	1.2	2.02

Out of 46 students, the mean score of pretest was 7.71 and the posttest 8.60. The score increment was 0.89. The computed *t-test* value obtained is 1.2 (t = 1.2) indicating that there is a significant difference at .05 level between the pretest and posttest. It can be concluded that the experimental use of Simplified Stories for this research is effective.

Students have generally shown their interest in the use of Simplified Stories and they even want the teachers in higher level of reading class to include the Simplified Stories. There are 18 statements asking students to rate their satisfaction level in the five class interval scales of *Very High (4.51-5.00), High (3.51-4.50), Moderate (2.51-3.50), Low (1.51-2.50),* and *Very Low (1.00-1.50)* [19].

The collective data is from 46 students of both Nursing and Public Health major. The 18 statements were separated into 4 parts, which are grouped accordingly.

Table 5 Student's Satisfaction on Reading Skill

	Opinions	$\bar{x}$	S.D.	Level
1	After reading 10 simplified stories, you think your reading skill is better	3.54	0.72	High
2	You have more confidence in reading	3.39	0.68	Moderate
3	You understand the stories	3.37	0.68	Moderate
4	You know how to read English better	3.77	0.68	High
5	You know more vocabulary	3.59	0.58	High
	Average	3.53	0.67	High

For question 1, most of the respondents thought their reading skill is getting better at High Level after the use of Simplified Stories ($\bar{x}$=3.54). However, they showed their confidence in reading at Moderate Level ($\bar{x}$ = 3.39). Most respondents said they understood the stories at Moderate Level ($\bar{x}$ = 3.37). This might reflect that they have limited reading experience in English. It was also in line with some of their comments that they thought the stories given were too difficult and they had limited time to read due to the burden of homework in other subjects. Most of them, however, expressed that they knew how to read English better ($\bar{x}$ = 3.77), given at High Level, and learned more vocabulary from this reading activity ($\bar{x}$ = 3.59), also at High Level. The average score for the topic of Reading Skill is at High Level ($\bar{x}$ = 3.53).

Table 6 Satisfaction on Learning Process

	Opinions	$\bar{x}$	S.D.	Level
6	You have satisfaction in teaching and learning using Simplified Stories	4.06	0.68	High
7	You are satisfied with the difficulty level of the stories	3.98	0.83	High
8	You feel that you want to read more stories	3.61	0.77	High
9	Teacher always encouraged you to develop reading habit	4.48	0.66	High
10	Teacher talked to you about the stories	4.46	0.55	High
11	Teacher played a core part in helping you to understand the stories	4.54	0.66	Very High
	Average	4.19	0.69	High

The respondents are satisfied with the teacher's use of Simplified Stories at High Level ($\bar{x}$ = 4.06). They are satisfied with the difficulty level of the text at High Level ($\bar{x}$ = 3.98). Students want to read more stories at High Level ($\bar{x}$ = 3.61). On Q9, Q10 and Q11 which are related to the role of the teacher, the high scores indicated that they were happy with the teacher who was helping them. The Very High Level goes to Q11 ($\bar{x}$ = 4.54) where students thought the teacher played a core part in helping them understand the stories. The average score for Learning Process is at High Level ($\bar{x}$ = 4.19).

Table 7 Group Learning

	Opinions	$\bar{x}$	S.D.	Level
12	You read with friends in order to understand the stories	3.76	0.67	High
13	You like reading in pair or in group	3.96	0.99	High
14	Discussion and Q&A about the stories in class help you understand more	4.09	0.56	High
	Average	3.93	0.74	High

The respondents preferred to read stories with friends in order to understand the stories, at High Level (Q12, $\bar{x}$ = 3.76 and Q13, $\bar{x}$ =3.96). Most of them thought the discussion about the stories in class helped them understand more, at High Level ($\bar{x}$ = 4.09).

The average score for Group Learning is at High Level ($\bar{x}$ = 3.93).

Table 8 Loving to Read

	Opinions	$\bar{x}$	S.D.	Level
15	You like reading Simplified Stories more than before	3.65	0.67	High
16	You are happy reading stories	3.56	0.69	High
17	You now can read English stories for pleasure	3.61	0.83	High
18	You want to have Simplified Stories in a higher reading classes	3.96	0.81	High
	Average	3.69	0.75	High

The respondents like reading Simplified Stories more than before, at High Level ($\bar{x}$ = 3.65). When asked if they are happy reading stories or not, the answer is at High Level ($\bar{x}$ = 3.56). They feel that they now can read English stories for pleasure at High Level,

($\bar{x}$ = 3.61). The students want to have Simplified Stories in higher reading classes, at High Level ($\bar{x}$ = 3.96). The average score for Loving to Read topic is at High Level ($\bar{x}$ = 3.69).

Table 9 Student's Satisfaction by Topics

Topics	$\bar{x}$	S.D.	Level
Reading skill	3.53	0.67	High
Learning process	4.19	0.69	High
Group learning	3.93	0.74	High
Loving to read	3.69	0.75	High
Average	3.83	0.71	High

The Learning Process which involved the teaching and learning activities, as well as the students' perception on the teacher, received the highest scores at High Level ($\bar{x}$ = 4.19). Second to that, also at High Level, is Group Learning ($\bar{x}$ = 3.93) which reflected that students preferred reading in pairs or in groups rather than reading stories alone. The topic of Loving to Read comes third, at High Level ($\bar{x}$ = 3.69). Reading Skill comes last, still at High Level ($\bar{x}$ = 3.53). The average score of their satisfaction is at High Level ($\bar{x}$ = 3.83).

The overall picture of student's satisfaction with the use of Simplified Stories has portrayed that they somehow like reading the stories. Students have positive attitude towards the use of the stories and they have more confidence in pursuing the reading by themselves after class. While some students may struggle to understand the content of the stories, most students still want the teacher to include Simplified Stories in a higher reading class, reflecting that they see the value of this extensive and independent reading. The students however still want to receive assistance from the teacher to help them understand the stories more. This group of first year students just entered the college less than a year.

They may not have high confidence in studying alone; so they preferred reading in pair or in group and also still expect some help from the teacher.

Conclusion and Implications

The findings of this study can be summarized in accordance with the research questions. The first question asked whether or not the students can develop reading comprehension through Simplified Stories after the program. The pre/post test scores indicated that the reading comprehension of students got better. Even if the average score increment between the pretest and posttest at this study is 0.89 (Table 4), the result is in line with other researches [20] which also indicated that extensive reading helped improve student's reading comprehension.

The second question asked whether or not the students will develop positive attitude towards reading English books after the use of Simplified Stories. Overall scores by topics (Table 9) at High Level ($\bar{x}$ = 3.83) have reflected that they have developed positive attitude towards the use of Simplified Stories.

However, there are several points which are needed to be addressed for future research.

First, this study did not allow students to choose the stories to read by themselves as suggested by Day and Bamford [21], whose principle was to allow students to choose the books and its difficulty level at their free will. The 10 Simplified Stories in this study were selected by the teacher. Some students might not have appreciated some stories, for example, the plot, length, or language level might not match their taste and they might have felt that they were 'forced' to do the reading. Hitosuki and Day [22] did a similar study at the University of Hawaii where they had a variety of 266 extensive reading books for students to choose from. The result of the study at St. Theresa International College may be different if students have a wide variety of reading materials which match their taste and level.

Second, the pre/post test needed to be arranged similar to an actual exam to avoid students copying their friends' answer, which will give the unreal result to the research. The researcher suspected that some students who copied their friends at the pretest showed a poorer score at the posttest, probably because they had to do the posttest without their close friends around. However, poorer scores at the posttest could also reflect that some students did not like reading Simplified Stories given by the teacher since the beginning of the program and did not want to cooperate in reading them.

Third, the difficulty level of the stories has affected the student's satisfaction to continue reading. Almost 30% of students in this study reflected that the difficulty level of the given stories did not match their level (Q7, Table 6). This was similar to the finding by Tinawong [23] which concluded that the difficulty level of the stories will stop students to read further. To solve this problem, the teacher should allow students to freely choose the stories they want to read. The library, for instance, should provide enough Simplified Stories for the reading program to go on.

Fourth, this study was only 4 months long. The 10 Simplified Stories of around 100 pages added on top of the regular textbook of College English II (Reading & Writing) turned to be a nightmare to many students. The timing constraint of regular study and reading the given extensive stories made the studying environment become tense inside and outside the classroom. Extensive reading can also be done during the semester break when students have no regular class to attend. That means the research study should be done at least 8 months.

Fifth, the researcher showed a cartoon animation film "A Christmas Carol" which was one of the 10 stories given to students. They liked it and commented that they wanted to watch more films of the same stories they were reading. Other comments were blaming the time limit for reading and that they had homework of other subjects to do at the same time. Some students complained about the difficulty of vocabulary.

In summary, the researcher strongly wants to see the change in reading habit among Thai students, especially in reading of English books. There are some positive signs showing the effort to promote reading in the country, for example, the naming of Bangkok as a Unesco's Reading Capital in 2013. Moreover, from the researcher's experience, even if most students can have access to the Internet

easily today, they tend not to use this opportunity to build up their reading capacity. Entertainment seemed to be the core part of the Internet use. Hence, it is necessary for teachers and parents to bring children back to the reading track. The reading habit can be instilled among students only when they are given the right books according to their level, and with the content that match their taste.

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Behavior in Laurel clock vine (Thunbergialaurifolial) Used for Reduce Toxic Chemical Residues in Blood

Kraisri Srithupthai,[1*] Sineenart Sriling[1] and Jittita Pisuwan[1]

Abstract

This research was descriptive study aim of the research is to knowledge and how to use Rangchued relief of symptoms and different toxic resistance of 80 sugarcane agriculturists and record data of behavior in Medical Herbs Laurel clock vine*(Thunbergialaurifolia)* usage for Hauyphueng Hospital. The data were collected by questionnaires.

The data was analyzed by descriptive analysis frequency distribution by percentage.

The result found that the majority repliers 51.25 % were females, 48.75 % were males, 61.25% with average age 41-50 years old and 26.25 % were 31-40 years old. There were 62 peoples were 50-60 kgs, weight 77.50 % and 10 repliers were lower than 50 kgs12.50 % ,75 % were married, 25 % were single, 75 % had primary school level of education and 17.50 % had secondary school level of education. There were farmers (80 %), 18.75 % were contractors, 53.75 % with average monthly income of Baht 5,000-10,000 Bath./month. and 20 % were 10,001-15,000 Bath./month. There were 80 repliers has knowledge of Laurel clock vine color, odor change and moldy 100% There were 75 repliers has knowledge of herb mean plants with medicinal properties to cure diseases 93.75 %. The attitude towards the usage of herbal medical was the folk wisdom should help preserve it .97.50 % .There are 75 replieds that the folk healers should use Laurel clock vine for preserve it 93.75 %. The rules about the use of Laurel clock vine found that they can discuss who has knowledgeable about herbs. When they were in trouble 88.75 % followed by using of Laurel clock vine to reduce chemical residues in the body 83.75%.

Keywords: behavior, laurel clockvine, toxic chemical residues in blood

Introduction

Thai people have used herbs to treat a disease since the ancient time. The method of choosing herbs of Thai ancestors is considered the very valuable science and cultural heritage. However, western medicine or modern medicine has become to play a major role in Thailand which caused Thai medicine, using herbs to treat a disease, to lose popularity and also limit the methods of Thai medicine. Therefore, the knowledge of Thai medicine which had been inherited generation after generation broke off, so many Thai people started using more of modern medicine gradually. On the other hand, especially people living on the countryside where the modern medicine hasn't reached still use herbs to treat a disease very often. Later, when Public Health Development Plan by the 5th National Economics and Social Development Plan (2525-2529) (RujinatAttasit and group, 2532) refer to supporting policy to use herb instead of modern medicine by encouraging people to know how to treat themselves with herbs when

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having minor illness and not having side effects to stay in the herbal project for primary health information in the initial period which specified 44 types. Moreover, two of medical national policies have specified to support the study and research to learn about the potential of the prevention, the treatment and encourage to use herbs economically and efficiently. Ministry of Public Health tries to develop the herbs completely. The purpose is to use in public health for medical supply basis both normal and war time, industry and export. Then the 7th Economics and Social Development plan (2535-2539) clearly specified about supporting people to have good health , knowledge, disease prevention, know about basic first aid with local knowledge such as Thai medicine which uses herbs having regular massage , hot press massage with herbs. Government has tried to combine both Thai and modern medicine together. Agriculture is the main career of the people in Kalasin Province. To do this, there is using chemical substances to kill the pest especially insecticides which have caused agriculturists to get diseases. Most of diseases are from the high amount of the residues of the insecticides in the blood. Government has the idea of encouraging people to help themselves by employing the knowledge of Thai medicine such as replace some of modern medicine with Thai medicine in hospitals. Employing people and building Thai medicine clinics for those mentioned reasons above result in people learning to know about the attitude and behavior about using Laurel Clock vine to decrease the residues of the chemical in the blood of the sugarcane agriculturists. The results will bring the solutions to solve this problem by using Laurel clock vine, local knowledge about the herbs to take care of their own health, families, and communities especially promoting their health more aggressively. Moreover, it can decrease the excessive modern medicine usage to help the economy and promote the herb using to treat a disease and sickness along with modern medicine.

The purpose

To learn about the behavior of the attitude of how to behave in using the Laurel clock vine to decrease the residue of chemical

The learning process

The sample groups of 80 sugarcane agriculturists at Ban Koksri Moo 3 Hauyphueng District, Kalasin Province. There are criterions to detect the chemical in blood which have risks and not safe for 80 people. The specified groups drink tea mixed with the Laurel clock vine one tea spoon three times a day before meal for seven days for about three weeks and have blood tests. The tool used to collect data is questionnaire. The reason is to specify the limit of the content. There are three parts. They are

About population such as gender, age, weight, height, marital status, education, career, and income.

1. About the general knowledge of the Laurel clock vine to decrease the residues of chemical.

2. About the attitude of using the Laurel clock vine to decrease the residues of chemical.
3. About how to behave to use the Laurel clock vine to decrease the residues of chemical.

Analyzing data with the excel program using statistical analysis

1. Frequency and percentage using descriptive personal data of all sample groups

2. Mean and S.D. using descriptive data about behavior of using the Laurel clock vine to decrease the residues of chemical of sugarcane agriculturists.

Results

General information

The behavior of using the Laurel clock vine to decrease the residues of chemical of sugarcane agriculturists. Most of them are female 51.25 % male 48.75%. About age,most of them were in 41-50 years old 61.25% then 31-40 years old 26.25% and the youngest age is 20-30 years old 12.05%. About status, most of them are married 75% single 25.00%. About education, most of them graduated from primary school 75% high school 17.50%. About career, most of them are agriculturists 80% work as employees 18.75%. About monthly income, most of them have 5,001-10,001 baht 53.75% 15,001-20,000 baht 20%

Knowledge about the Laurel clock vine

From the level of the knowledge about the herbs of sugarcane agriculturists at Ban KoksriTumbonKumbongHuayPeung District, KalasinProvince , we found that most of them know about the types of deteriorating Laurel clock vine. Its colors changed and had fungus 100%. The least was the Laurel clock vine could replace the modern medicine because it could substitute some types which have the same properties 13.33%

The attitude about using the Laurel clock vine

Most of the sugarcane agriculturists at Ban KoksriTumbonKumbongHuaypeung District, Kalasin Province have the highest attitude of using the Laurel clock vine which has been inherited local knowledge for generations. It should be conserved and it is the herb which helps to decrease the residues of chemical 97.50%. The least is local people tend not to use the herbs because of slow result 26.25%

What to do when using the Laurel clock vine

About using the herb, most of the sugarcane agriculturists at Ban KoksriTumbonKumbongHuaypeung District, Kalasin Province consulted with people who has known about herb when having problems 88.75% and do sometimes mostly is people who use the Laurel clock vine to treat a disease from local doctors 93.75% and not doing it mostly is the symptoms after using the Laurel clock vine are stomachache, rash all over body, feeling dizzy 86.25%

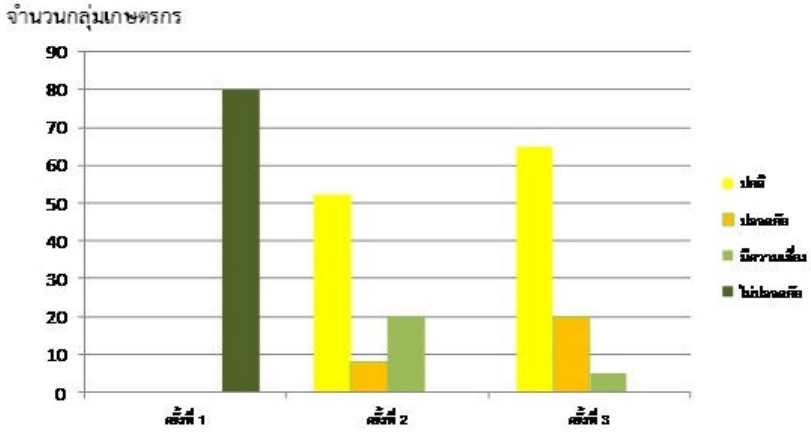

Figure 1 Blood test to find the chemical in blood of sugarcane agriculturists.

Results and discussion

From the study, the questionnaires from most of the agriculturists who use the Laurel clock vine find that this herb is the local knowledge inherited generations after generations which should be conserved. It is to believe that most of the herb can treat a disease. Most of people who answered the questionnaires using this herb regularly to decrease the residue of chemical which confirms to PaisarnDunkum who has studied the efficiency of the Laurel clock vine to decrease the insecticides left in the blood of the agriculturists in Pothong District, Angthong Province (2551) where they found that this herb had the ability to decrease the level of insecticides left in the blood.

Acknowledgments

We would like to thank the Ban Koksri sugarcane agriculturists who dedicated time to express opinions on the questionnaires and co-operations. We hope that this research would be beneficial for people who study the behavior of using the herb to treat the health and organizations related more efficiently. At last, we would like to thank research group for the great help.

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Understanding of Science and Technology towards Society and Problem Solving Ability in Science of Undergraduate Students using Learning Activities based on Science Technology and Society Approach (STS)

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Abstract

This research purposes to study and compare students' understanding of science and technology and problem solving ability in Science of undergraduate students using learning activities based on Science Technology and Society Approach. The samples consisted of 94 students from 2 sections enrolled in the science for quality of life subject in the second semester, academic year 2013, selected by cluster random sampling. Sample size was determined using Yamane's formula with reliability at 95% and deviation at 10%. The instruments consisted of 4 Science Technology and Society learning activities plans of chapter 4: Energy and Life 12 hours, 3 hours/week based on Bryant (1995) consisting of 6 steps; 1) wondering 2) planning 3) investigation 4) reflecting 5) sharing and 6) acting, the 20 items implementation and understanding of science and technology True-False test adapted from The National Science Foundation (2001) and 30 items problem solving ability multiple choices test focused on energy problem from various media. The one-group pretest-posttest design was employed for data collecting and the t-test for dependent sample was applied for data analysis. The research resulted that the posttest score of understanding of science and technology and problem solving ability in Science of undergraduate students using learning activities based on STS was significantly higher than pretest score at the 0.05 level

Keywords: Science Technology and Society Approach, Understanding of Science and Technology, Problem Solving Ability in Science

Introduction

Science plays an important role in our present and future world communities, as it concerns all of us in our daily lives and livelihoods. Science also involves technologies, instruments, devices and various products at our disposal which facilitate our life and work. All these benefits from our scientific knowledge are combined with creativity as well as other disciplines. Science enables us to develop our thinking skills in various respects; logical, creative, analytical and critical and also enables us to acquire essential investigative skill for seeking knowledge, and allows the ability for systematic problem-solving, and for verifiable decision-making based on diverse data and evidences. In addition, science is essential to the modern world since it is intrinsically a knowledge society. All of us ;therefore, need to be provided with scientific knowledge as acquire knowledge and understanding of nature and man-made technologies that can be applied through logical, creative and moral approaches [1]. In order to make human being have a better understanding of the nature of science and technology, education is the first aspect to be recognized. The education should focus on the conditions and nature of the learners that all of them are able to learn and develop themselves and the learners are regarded as the most important in classroom.

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The education process must encourage students to develop with full potential naturally together with emphasize the importance of moral and the learning process. The educational institutes should develop an efficient teaching process; provide activities in accordance with the interests and aptitudes of the learners with regard to the individuals' differences; practice cognitive and management skills to handle the situation as well as apply of knowledge to prevent and solve problems appropriately; make effective decisions with regard to the impact on individuals and their social and environment and to enable the learners to apply scientific knowledge in real-life situations appropriately [2]. Along the same line, the Institute for the Promotion of Teaching Science and Teaching (IPST) stated that science teaching should promote the learner in ethics, values, attitudes towards science, technology, society and the environment with a goal to apply the understanding of science and technology for society and living [3].

Recent teaching and learning in science is not complying with daily lives, because it emphasizes on scientific achievement rather than concern about science as a way of knowing and apply in real-life situations. Due to this, science seems to be difficult, complex and abstract but in reality science is a nature and part of our daily lives: all day and every day. Although science reform which emphasis to enable the student to search for knowledge and practice in the process of science including lean by doing lab, such doing is done to prove prior knowledge mentioned in the book only. The overall of science teaching has focused only on memorizing which made students do not like and inactive to learn science and unable to apply scientific knowledge to solve any problems in their daily lives [4]. The problems in the undergraduate teaching of Thailand in the field of science and technology teaching methods were lecture-based, memorizing, lacking of critical thinking, irrelevant teaching with real-life situations and lacking of interactive between teacher and the learner. In addition, the learners lack of perseverance, patience and creativity in learning [5]. According to, Yager the traditional science teaching cannot provide learners to connect the knowledge they have learned into everyday lives hence, the teaching method should be changed to meet the society needs and promote the learners to apply knowledge to their daily lives [6].

One of an appropriate teaching methods to help the learners link knowledge into everyday lives is a science, technology and society approach (STS) which is a science instruction that integrated science, technology and social studies to the class that focus on science in learners' real life situations and develop student understanding of science and technology, problem solving, practicing, science process skill as well as applying scientific knowledge [7] as Pojanatanti indicated that a major benefit of learning based on the STS is to make student experience in learning, critical thinking, problems solving and integrating science, technology and society with student and social interaction from cooperative learning result in good attitude toward science of the students since it focused on current public events or issues and motivate students investigate an answer from various resources [8]. The instruction starts from asking the question of social problems then allows student to learn and investigate a way to solve the

problem by evaluating the pros-cons of solution applied or the most effective solution then the results were presented to share experiences and applied practically in everyday lives [9] as Sakdiyakorn stated that the STS emphasize on social issues related to technology or experience relevant to students introduced into lessons to support students asking questions upon personal interest [10]. The students will plan and execute to investigate the answer from various resources by themselves and they will summary results of research answer and share experiences with friends then enable to apply knowledge and skills into practice for the benefit of themselves and society as a responsible citizen.

From the above-mentioned the researcher was aware of the role and importance of science and technology as well as teaching science related to formulation content with real lives, thus the researcher conducted the research to compare students' understanding of science and technology and problem solving ability in Science of undergraduate students using leaning activities based on the STS in the content of chapter 4: Energy and Life was applied to the learning activities based on Bryant (1995 cited in [9]). The results of such research will benefit teachers in the learning activities in order to link course content to meet their daily lives, promote problem solving ability and provide the knowledge of science and technology, promote the ability to solve problems, provide students with the knowledge and understanding of science and technology from human creation and make students apply the knowledge in reasoning, creative and understanding in accordance with changes in society and the world.

Methodology

1. Population and Sample Groups

1.1 The population of this research were 1,449 students from 40 sections enrolled in the science for quality of life subject in the second semester, academic year 2013.

1.2 The sample for this research were 94 students from 2 sections enrolled in the science for quality of life subject in the second semester, academic year 2013, selected by cluster random sampling. Sample size was determined using Yamane's formula with reliability at 95% and deviation at 10%. [11]

2. Variables

2.1 Independent variable was learning activities through Science Technology and Society learning activities plans

2.2 Dependent variable was the understanding of Science and Technology towards Society and Problem Solving Ability in Science

3. Instruments

3.1 The 4 Science Technology and Society learning activities plans of chapter 4: Energy and Life 12 hours, 3 hours/week based on Bryant (1995 cited in [9]) consisting of 6 steps;

3.1.1 wondering: a teacher use the social problems related to everyday life or experience that relevant to learners to encourage the learners doubts and questions in what they are interested in.

3.1.2 planning: a learner makes a plan together with others or individually to find to answer the questions they have wondered by using various knowledge sources.

3.1.3 investigation: the learner investigate answers from various sources as set in the planning step with teacher guidance.

3.1.4 reflecting: the learners reflect their thinking on such investigation and summarize information from the investigation step which scaffolding of the teacher in a summary and link ideas.

3.1.5 sharing: the students share what they have learned with friends by providing interesting research presentations.

3.1.6 acting: the learners are able to apply their science knowledge into practice which benefit themselves and society in various ways, such as a brochure, a bulletin board, a scientific corner and the voice lines.

The instruction learning activities were evaluated by three experts to check its content validity then was tried out with a normal class and adapted for an experimental class. Item of Objective Congruence (IOC) of the plans was 1.00.

3.2 The understanding of Science and Technology towards Society test was composed of 20 items implementation and understanding of science and technology True-False test adapted from The National Science Foundation [12]. Index of objective Congruence of each item was 1.00, the difficulty was 0.50-0.77, the item discrimination was 0.20-0.80 and reliability was 0.88

3.3 The problem solving ability in Science test was composed of 30 multiple choice items, each of the questions has 5 choices focused on the energy problems derived from various news and media. Index of objective Congruence of each item was 1.00, the difficulty was 0.33-0.67, the item discrimination was 0.33-1.00 and reliability was 0.92

4. Procedures

One Group Pretest - Posttest Design was applied for data collecting and the t-test for dependent sample was applied for data analysis [13].

T_1 X T_2

Symbol meaning

T_1 = Pretest

X = Science Technology and Society learning activities plans

T_2 = Posttest

5. Data collection

5.1 A pretest was conducted to test students' understanding of Science and Technology towards Society and problem solving ability in Science using understanding of Science and Technology towards Society test and problem solving ability in Science test which validated by experts and item analysis.

5.2 The Science Technology and Society learning activities plans were instructed with 4 plans, 12 hours, 3 hours/week.

5.3 At the end of experiment the implementation and understanding of science and technology test (original) was employed to test students again (posttest). The results of the test were statistically analyzed.

6. Data analysis

The data obtained from student's understanding of Science and Technology towards Society and problem solving ability in Science test was analyzed by mean ($\overline{X}$), S.D. and pretest to posttest comparison using t-test dependent sample.

Results and Discussion

The result of comparing students' understanding of Science and Technology towards Society of undergraduate students using learning activities based on The STS as shown in the following table 1.

Table 1 Pretest to posttest comparing students' understanding of Science and Technology towards Society based on the STS.

	n	$\overline{X}$	S.D.	t	p
Pretest	94	10.31	1.49	14.31	.000
Posttest	94	13.17	1.99		

From Table 1, the results demonstrate that that understanding of Science and Technology towards Society was at the .05 level of significance. The understanding of Science and Technology towards Society after study ($\overline{X}$ = 13.17) was higher than before ($\overline{X}$ = 10.31).

The result of comparing student's problem solving ability in science of undergraduate students using learning activities based on the STS as shown in the following table 2.

Table 2 Pretest to posttest comparing students' problem solving ability in science based on the STS

	n	$\overline{X}$	S.D.	t	p
Pretest	94	12.91	2.84	15.98	.000
Posttest	94	18.47	2.97		

From Table 2, the results demonstrate that that problem solving ability in Science was at the .05 level of significance. The problem solving ability in Science after study ($\overline{X}$ = 18.47) was higher than before ($\overline{X}$ = 12.91).

The understanding of Science and Technology in Science of the students of the science for quality of life subject after study was higher than before. This may cause from the reasons as follows:

First, the learning activity based on the STS complied with real-life contents which making the students realize the value and importance of the learning process. This can lead the learners to pay attention and willing to practice successfully. In accordance with Kowtrakoon indicated that to manage the activity similar to real-life allowing learners to learn in a meaningful way and making the learners have commitment and willingness to practice successfully [14]. Similarly, Sitthichote mentioned that the learning process is linked to real-life situations by stimulating learners with interesting activities could make learners are fun and happy, eager to learn and realize the value or the benefits of what they have learned in the term of making use in everyday lives [15]. Same as Tipchoi and Narjaikaew said that to promote learners to realize the value and the importance of teaching could lead the learners have a commitment and willingness to do activity in order to make used of the knowledge and experience constantly. As a result, the students acquire and understand the content and the scientific process which raise from the direct experience of acting on their own through investigate knowledge from a variety of learning resources linked to their prior knowledge. Due to this, the learners can create new knowledge in order to apply in daily lives which is benefit of themselves and society [16].

Second, the learning activity based on the STS provides an opportunity for learners to develop the thinking process and participate in activities at all stages as same as Office of the Basic Education Commission of Thailand , the scientific learning focuses on promoting learners to learn by linking knowledge with the process, doing in a variety of activities, participate in learning process at all stages starting from setting questions arising from the interest of the learners, planning to search for answers and find solutions, reflection, knowledge exchanging and apply such knowledge into practice. As a result, the learners understand course content and enhance their ability to have rational, creative,

analytical and critical thinking [1]. In accordance with Wanherm mentioned that providing opportunities for learners to engage in learning activities can make learning more effective, the more learners are interested in the activity, the more learner are eager to learn. This is because they have learned what they are interested in, participate in discussion forum, accept the opinions of others and cooperate more which lead the students to understand the lessons better. This activity was considered as a student-centered learning. In addition, a classroom friendly atmosphere makes the learners absorb knowledge and experience in different way which enhance the class with exciting, lively and interesting atmosphere [17].

Third, according to changing role of the teacher from setting experiences to be a guidance which enabling learners to learn at their full potential based on their interests and aptitudes which in the goals of the education reform underlie the National Education Act BE 2542, Section 24 states that the content and activities should be constructed in accordance with individual differences [15]. Similarly, Sakdhiyakorn stated that teachers were responsible for planning activity in liking prior knowledge to new knowledge [10] and constructed appropriate situation that fit the ages and interests of learners these lead to encourages learners wonder and eager to learn the questioning leads students doubt and desire to seek answers (Lall and Lall ,1983 cited in [18].) this make the students to be creative and be a solving thinking person as well as enable to link the relationship of science to everyday lives and aware of the value of science [19] same as Yudadom stated that teaching based on the STS, a teacher is responsible for preparation and planning in teaching using the current issues in today society and should be an issue that students are informed and familiar. The class will begin with students' discussion with the questions or experience created by the teacher and then the teacher must wait for answers from the students that compiled their thoughts and discussion. Therefore, the teacher plays an important role as a facilitator of learning with well prepared and good management skills in order to reach the goal [20].

From the above-mentioned results in the understanding of Science and Technology in Science of the students of the science for quality of life subject after study was higher than before.

Problem Solving Ability in Science of Undergraduate Students in Science of the students of the science for quality of life subject after study was higher than before. This may cause from the reasons as follows:

First, the learning activity based on the STS complied with real-life contents since a teacher motivate learners by using current science and technology situations such as the energy situation in the country and impacts of energy use. The teacher allow the learners to make a question which raise the curious and want to search for answer by setting the way to find that answer and search the answers by themselves from various resource in local such as a campus library, the public library, internet or even ask the guru in the issues that they cannot find the answer. In similar, Tonsinon stated that students who have been taught by STS, doing experiment on their own by setting the experimental problems, collecting

data and summarizing in the stage of investigation. They also have freedom to study according to their interests. A teacher motivates by questions or situations in everyday lives which could help students become curious, doubts and interested to search for answers. As a result, the students realize the relationship of science and technology which occur in society and can connect to classroom learning with everyday lives [21]. In accordance with Yutakom Teaching based on the STS was the teaching and learning in the context of human experience which was the concept of integrating science, technology and society by focusing on the study of science in the real world, aimed to develop students' knowledge and understanding about science and technology and could make decisions in various issues and problems [20].

Second, according to the learning activity based on the STS, the teacher provide teaching and learning resources using a variety of learning activities to prevent students' boredom and help stimulate development in increasing scientific solving problems [22]. Moreover, modern and interesting teaching aids which appropriate learning age enable to encourage learners to learn better. According to Temiyakarn (1990) indicate that to select media for learning activities must be determined the relationship of the media toward learning or helping to change the behavior as set or not. The rich media employed in the learning activities provide an opportunity for students to learn more and also provides the opportunity for students to demonstrate the ability and aptitude better. This will enable learners easy to learn, do not get bored with the lesson and develop in scientific solving problems increasing. This is because the learning activities based on STS motivate students to think to solve problems at all-time [23].

Third, the learning activity based on the STS aimed at encouraging learners searching for knowledge which encouraged the students to investigate on their own with making decision and problem solving skills [24] which was a consequence of the leaning activities based on the STS that begin with teaching by identifying the problem, understanding the problem or issue that want to study including information for learners to describe the problem. Due to this it could make the students practiced the ability to identify the problem from information acquiring which help the learner enable to solve the problem in solving problems more effective and reasonable. This leads to learning, the concepts in science, understanding themselves and society, the problem solving skill as well as decisions making in everyday lives situations. Along the same line, Carin mentioned that the leaning activities based on the STS provided learners identify problems related to science, technology and society in daily lives. This promotes the learners to solve and make decisions smarter and more accurate, especially the stage of the acting that let students hands-on and face the real event. Due to this the students discover on their own as result in ability to solve the problem more efficiency [7].

From the reasons above results in problem solving ability in science of undergraduate students of the science for quality of life subject after study was higher than before.

Conclusion

Learning the Science, Technology and Society provides an opportunity for the students to participate in activities through implementation, investigation from various sources by setting question, making plan, investigation, reflection, knowledge sharing and acting. This was considered as an activity inconsistent with learning aptitudes and interests of learners that take into account individuals' differences, it also emphasized on learner-centered which promote the learners understand the content, improve scientific problem solving skill as well as enable the learners to apply such knowledge in daily lives.

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Effect of the drying methods on antioxidant properties from ripe *Carissa carandas* Linn. (Ma nao ho) fruit power

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Abstract

The effect of drying methods (tray, drum and freeze drying) on total phenolic content and antioxidant capacity of ripe *Carissa carandas* Linn. (Ma nao ho) fruit powder were investigated. There was significant effect of the drying methods on total phenolic content from dried ripe Ma nao ho fruit powder. The highest total phenolic content of sample prepared by drum drying method (temperature 120 ^{o}C and speed for 80 rpm) with the value of 9.26 mg GAE/g sample was obtained. However, no different effect of tray and freeze drying methods on total phenolic content of samples were found. For antioxidant assay, there were significant effects of the drying methods on ferric reducing antioxidant power (FRAP), DPPH scavenging activities and $ABTS^{\bullet+}$ radical scavenging activity of the dried ripe Ma nao ho fruit powder. Drum drying method showed the highest FRAP value followed by freeze drying and tray drying methods which were non-significant difference as the values of 2.005, 1.573 and 1.495 mmole/g sample, respectively. Based on DPPH scavenging and ABTS radical cation decolorrization assays, the highest inhibition capacity at 50 % (IC_{50}) and Trolox equivalent antioxidant activity (TEAC) of dried sample powder prepared by drum drying method were obtained. However, there was no different effect of freeze and tray drying methods on DPPH scavenging activities and $ABTS^{\bullet+}$ radical scavenging activity of samples were showed.

Keywords: Drying Method, *Carissa carandas* Linn., antioxidant properties

Introduction

Carissa carandas Linn. commonly known as Karanda belong to family Apocynaceae and English name: Black cherry (Prakash et al., 2011). The *Carissa carandas* (Ma nao ho in Thai) is fruit stiff, zig-zag branches, opposite green leaves, white and fragrant flowers in terminal cymes, ovoid to spherical, smooth and reddish small berry fruits with bitter and sour taste (pH 3-4), but the flavor can be modified by enzymatic treatment and use as additives has shown wide acceptability. These fruits have been used in Indian system of medicine (Mitra et al., 2010), because of their curative properties. Ma nao ho fruit is considered source of hydrocarbon and phytochemicals. There are contain a mixture of volatile principles like 2-phenyl ethanol, linalool, β-caryophyllene, isoamyl alcohol and benzyl acetate and a novel (Carissol) triterpenic alcohol (Balakrishnan and Bhaskar., 2009). The unripe Ma nao ho fruit extract was done using in methanol shown the potential on diabetic control (Prakash et al., 2011). Loganayaki and Manian (2010) have been reported that the proximate component of Ma nao ho fruit consisting of total phenolics content (3.3±0.4), tannins (0.2±0.1) GAE g/100 g extract and flavonoids 9.8±2.6 RE g/100 g extract.

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Drying foodstuffs consists in taking out a large part of the water contained in a product in order to reduce considerably the reactions which lead to the product's deterioration (Rozis, 1997). Drying causes irreversible structural damage to the cellular structure of foods. The structure of dried foods depends on the drying methods and conditions, such as temperature, relative humidity, air velocity and initial physico-chemical characteristics of the foods (Rahman et al., 2005). The processes used are numerous, according to the type and quantity of product to dry, the amount of water to eliminate, the final desired quality or functionality of the dried product (Bonazzi and Dumoulin, 2011). Tray drying is a simple technique, which is in similar to solar drying. The drying process takes place in an enclosed, heated chamber. The drying medium in most cases, hot air is allowed to pass over the product, which has been placed on open trays. Convection drying is often a continuous process, and is often used for products that are relatively low value. Drum drying is technique removes water from a slurry, paste or fluid that has been placed on the surface of a heated drum. The dryer may comprise either a single or a double drum. Drum drying is typically a continuous operation. Care must be taken to ensure that the product that is to be dried well to the drying surface; thus, in some cases, it may be necessary to modify the liquid product by the addition of other substances to change its surface tension or viscosity. Temperature and concentration should both be controlled during drum drying (Cohen and Yang, 1995). Freeze drying, utilizes the principle that, under high vacuum, frozen water can be removed from a food and collected without going through a liquid phase. Because the material remains frozen, no heat damage occurs. In addition, there is little or no loss in sensory qualities of the product, and because the removal of ice crystals leaves a porous honeycomb-type structure, the product tends to rehydrate rapidly. However, freeze drying is a slow and expensive process and mainly used for producing high value products when protection of functional components in fruit is desired (Cohen and Yang., 1995).

Anthocyanins are the largest group of water soluble natural pigments that give red, violet, and blue color to many fruits, vegetables, and cereal grains. Anthocyanins are found in plants as glycosylated forms, generally linked with glucose, galactose, arabinose, rhamnose, xylose, and fructose. Cyanidin is the most common anthocyanidin (aglycone) followed by delphinidin, peonidin, pelargonidin, petunidin and malvidin (Hosseinian et al., 2008). The stability of anthocyanins and all pigments found in foods decreases during processing and storage as temperature rises. Eventually thermal degradation leads to brown products, especially in the presence of oxygen. The influences of temperature for the anthocyanins stability from different sources proving that heating have a detrimental effect on the anthocyanin content (Cavalcanti et al., 2011). Daud et al. (2008) reported that the ripe Ma nao ho fruit are very rich anthocyanin (pelargonidin, cyaniding and delphinidin type of glycoside). Natural antioxidants, particularly in fruits and vegetables have gained are interest among consumers and the scientific community because epidemiological studies have indicated that frequent consumption of natural

antioxidants is associated with a lower risk of cardiovascular illnesses, cancer and diabetes. Recent studies have shown that anthocyanin and polyphenolic contribute significantly to total antioxidant properties of many plants (Wan-Ibrahim et al., 2010). However, there have been no published reports on the effects of drying methods (freeze drying, drum drying and drum drying) on chemical properties of ripe Ma nao ho fruit powder. Therefore, the aims of this study were to investigate the influence of these drying methods on chemical properties of ripe Ma nao ho fruit powder with respect to phenolic compounds and antioxidant properties.

Materials and Methods

1. Sample and chemicals

1.1 Sample and sample preparation

Fresh ripe Ma nao ho (*Carissa carandas* Linn.) was purchased from local market in Kalasin province, Thailand and kept at -40 °C until used. The frozen ripe Ma nao ho was thawed at 5 °C for 24 hours separated seed off and then pulped. The pulped samples were used to study the effect of drying methods on antioxidant properties.

1.2 Chemicals

2,2-Diphenyl-1-picrylhydrazyl radical, 2,2'-Azina-Bis(3-Ethylbenzthiazoline-6-sulfonic acid and 2,4,6-tris (2-pyridyl)-s-triazine (TPTZ) were purchased from Sigma Chemical Co. Gallic acid and 6-hydroxy-2,5,7,8-tetramethylchromane-2-carboxylic acid (Trolox) were purchased from Panreac (Barcelona, Spain) and Acros organics., respectively. Folin-Ciocalteau reagent, Iron (III) chloride anhydrous, Potassium persulfate, sodium carbonate anhydrous and sodium acetate anhydrous were purchased from Panreac (Barcelona, Spain).

2. Dried ripe Ma nao ho powder preparation

Dried ripe Ma nao ho powder was prepared by divided the pulped sample to three groups. The first group was dried using tray drying method. The pulped sample was dried at 50 °C for 48 hours or until the moisture content ≤14 %. The second group was dried using drum drying method. The pulped sample was mixed with water at a ratio of 1:2 (w/w). The mixtures was blended using a waring blender (model 800 BU, USA) for 1 minutes, after that the mixtures was fed to drum dry roller at temperature 120 °C speed for 80 rpm. For The third group, the pulped sample was ground using electrical grinder (DAMING, DMF-10A, Taiwan). The fine pulped sample was dried using a laboratory freeze-drier (Heto-Holten A/S PL3000, Czech Republic). Dried ripe Ma nao ho derived from three drying methods were ground into the powder using electrical grinder. The powder samples were vacuum packed in laminated aluminum bags and deep freeze at -40 °C for antioxidant properties analysis.

3. Sample fruit powders extraction

Ten grams of each fruit powder from different drying methods were macerated with 100 ml of distilled water in the dark place for 1 hour, except tray dry sample used for 6 hours at room temperature and then, the sample was centrifuged at 10,000 rpm for 20 minute at 4 ^{o}C to collect the supernatant. These supernatants were called stock solution. The stock solution was stored at -19 ^{o}C until antioxidant properties determination.

4. Determination of total phenolic content and antioxidant property assays

4.1 Measurements of total phenolic content

The total phenolic contents of extracted samples were analyzed using the Folin Ciocalteu assay as described by Singleton and Rossi (1965) with some modifications. A 0.5 ml properly diluted extract or a standard solution of varying concentrations was mixed with 2.5 ml of ten-fold diluted Folin Ciocalteu reagent. The distilled water was used for dilution and control. After incubation for 10 min at room temperature, 2 mL of 7.5% Na_2CO_3 solution was added then immediately mixed and incubated in the dark place for 2 hours at room temperature. The absorbance was read at 760 nm on a UV-visible spectrophotometer (UV-7504C, single beam, China). Gallic acid of 1 mg/mL was used as the standard and the total phenolic content of the fruit samples were expressed in milligram gallic acid equivalent per g sample powder (mg GAE/g).

4.2 Ferric Reducing Antioxidant Power (FRAP assay)

The antioxidant capacity of sample extracts was determined using a modification of the ferric reducing/antioxidant power (FRAP) assay as described by Benzie and Strain (1999). FRAP reagents: acetate buffer, 300mM/L, pH 3.6 (3.1g sodium acetate $3H_2O$ and 16 mLconc.; Acetic acid per 1L of buffer solution); 10 mM/L TPTZ (2,4,6-tripyridyl-s-triazine) in 40 mM/L HCl; 20 mM/L $FeCl_3.6H_2O$ in distilled water. FRAP working solution: 200 mL acetate buffer, 20 mL TPTZ solution and 20 mL $FeCl_3$ solution. The working solution must be always freshly prepared and warmed at 37 ^{o}C. Aqueous solution of known Fe (II) concentration was used for calibration, in a range of 0.1-0.8 mM/L. For the preparation of calibration curve 0.5 mL aliquot of 0.1, 0.2, 0.4, 0.6, 0.8, 1.0 mM/mL aqueous Fe(II) (100–1000 µM) as Mohr salts solution (1mM) were mixed with 4.5 mL FRAP working solution. For the sample extract, in briefly, 4.5 ml of FRAP reagent was mixed with 0.5 ml of sample extract solution and reaction mixtures incubated at room temperature for 30 min. Absorbance at 593 nm was determined with reference to a reagent blank containing acetate buffer pH 3.6, a reagent control using distilled water which was also incubated at room temperature for 30 min. Aqueous solutions of known Fe (II) concentrations in the range of 100–1000 µM ($FeSO_4.7H_2O$) were used for calibration. The FRAP assay of the sample extracted were expressed in millimole per grams sample powder.

4.3 DPPH scavenging assay

The DPPH scavenging assay was performed according to the method developed by Brand-Williams et al. (1995) slightly modified. A stock solution of 0.5 mM DPPH$^{\bullet}$ in methanol acetate buffer (pH 5.5) was stirred for 40 min. Absorbance of the solution was adjusted to 1.000 at 515 nm using methanol acetate buffer (pH 5.5). For each sample, seven serial dilutions in distilled water 100 µL were added to 4 mL of a DPPH$^{\bullet}$ solution in methanol acetate buffer (pH 5.5). Decrease of absorbance was monitored at 515 nm in the dark place at room temperature after 0, 10, 20, 30, 40, 50 and 60 min and every 10 minutes thereafter until the reaction reached the steady state or until the absorbance declined less than 10% of the last reading. The percent DPPH radical scavenging was calculated as follows:

$$\% \text{ DPPH radical scavenging} = \left(1 - \left(\frac{A_{515\text{ nm sample}}}{A_{515\text{ nm Control}}} \right) \right) \times 100$$

Where:

$A_{515\text{ Sample}}$ = Sample absorbance at 515 nm

$A_{515\text{ Control}}$ = Control sample absorbance at 515 nm

The TEAC values of different extract aliquots were plotted in order to obtain the kinetic curves. A plot of the % DPPH radical scavenging versus condition of each sample was prepared and the concentration at 50% radical inhibition (IC_{50}) was determined from the linear regression equation. Regression equations had correlation coefficient $\geq$0.98. The IC_{50} was expressed as mg solid/ml DPPH solution and the antioxidant activity of the sample was reported a $1/IC_{50}$. Hence, the higher the $1/IC_{50}$ value, the higher the radical scavenging activity. Samples and standards were analyzed in triplicate.

$$\% \text{ DPPH Inhibition} = [(A_0 - Ae) / A_0] \times 100\%$$

Where:

A_0 = absorbance of the control

A_e = absorbance of the extract/standard

4.4 ABTS radical cation decolorization assay

The ABTS radical cation decolorization assay (Re et al., 1999) was employed to measure the antioxidant activity of the sample extracts. ABTS was dissolved in distilled water to 20 mM concentration, and potassium persulphate added to a concentration of 70 mM. The reaction mixture 1:1 (v/v) was left to stand at room temperature overnight (24 h) in the dark place before usage. The resultant intensely-

coloured $ABTS^{\bullet+}$ radical cation was diluted with 5 mM PBS (phosphate buffered saline, pH 7.4), to give an absorbance value of ~0.70 at 734 nm. Different aliquots of the sample extracts 40 µL were added 4 mL of $ABTS^{\bullet+}$ solution. The decolourization reaction was complete after 6 minutes, therefore reading taken at 6 min were used to calculate percent inhibition values. The percentage inhibition of absorbance of the sample was calculated as follows:

$$\% \text{ ABTS}^{\bullet+}\text{radical scavenging} = \left(1 - \left(\frac{A_{734\text{ nm sample}}}{A_{734\text{ nm Control}}} \right) \right) \times 100$$

Where:

$A_{734\text{ Sample}}$ = Sample absorbance at 734 nm

$A_{734\text{ Control}}$ = Control sample absorbance at 734 nm

For each sample, seven serial dilutions in distilled water 40 µL were added 4 mL of $ABTS^{\bullet+}$ solution and stand in the dark place at room temperature for 6 minutes. The decrease of absorbance was monitored at 734 nm after 6 minutes. The assay was performed in triplicates. Controls without $ABTS^{\bullet+}$ were used to allow for any absorbance of the extracts themselves. The assay was first carried out on Trolox, the water-soluble α-tocopherol (vitamin E) analogue, which served as a standard. The results of the assay were expressed relative to Trolox in terms of TEAC (Trolox equivalent antioxidant capacity). The efficient concentration (IC50 = mg/ml) was determined as the amount of sample extract necessary to decrease the initial $ABTS^{\bullet+}$ concentration by 50%.

$$\% \text{ ABTS}^{\bullet+} \text{ Inhibition} = [(A_0 - Ae) / A_0] \times 100\%$$

Where:

A_0 = absorbance of the control (t= 0 min)

A_e = absorbance of a test sample extract/standard at the end of the reaction (t= 6 min)

6. Statistical analysis

A completely randomized design was used through out this study. The experiments were done in triplicate. Data were subjected to analysis of variance and mean comparison was carried out using Duncan's multiple range tests. Statistical analysis was conducted using the Statistical analysis system software (v 9.0, SAS Institute, Cary. NC).

Results

1. The effect of drying methods on total phenolic content from ripe Ma nao ho fruit powder

There was significant effect of drying methods on total phenolic content of ripe Ma nao ho fruit powder ($p < 0.05$). The sample prepared by drum drying method showed the highest total phenolic content followed by those with tray and freeze drying methods with the value of 9.26, 6.40 and 6.00 mg GAE / g sample, respectively (Table 1). However, no different effect of tray and freeze drying methods on total phenolic content of samples were found.

Table 1 Total phenolic content of samples as dry basis from the different drying methods

Drying methods	Total phenolic content (mg GAE/g sample)
Freeze drying	6.00 ± 0.14^{b}
Drum drying	9.26 ± 0.37^{a}
Tray drying	6.40 ± 0.12^{b}

Values are given as mean value ± standard deviation from triplicate observations. Different superscripts within the same column are significantly different ($p < 0.05$).

2. The effect of drying methods on antioxidant properties from ripe Ma nao ho fruit powder

2.1 Effect on ferric reducing antioxidant power (FRAP)

Table 2 Ferric reducing antioxidant power of samples as dry basis from the different drying methods

Drying methods	FRAP (mmole/g sample)
Freeze drying	1.573 ± 0.107^{b}
Drum drying	2.005 ± 0.048^{a}
Tray drying	1.495 ± 0.078^{b}

Values are given as mean value ± standard deviation from triplicate observations. Different superscripts within the same column are significantly different ($p < 0.05$).

FRAP method depend upon the reduction of ferric tripyridyltriazine complex to the ferrous tripyridyltriazine by a reductant at low pH. This ferrous tripyridyltriazine complex has an intensive blue color and can be monitored at 593 nm (Benzie and Strain, 1999). The significantly effects of drying methods on FRAP value of ripe Ma nao ho fruit powder were observed ($p < 0.05$). From the results of this study showed that the highest FRAP value of ripe Ma nao ho fruit powder prepared by drum drying

method with the value of 2.005 mmole/g sample was found. However, no different effect of freeze and tray drying methods on FRAP value (1.573 and 1.459 mmole/g sample, respectively) of samples were obtained (Table 2).

2.2 Effect on DPPH scavenging activities

Hydrogen atom – or electron-donation ability of the corresponding medicinal herbs was measured from the bleaching of the purple-colored ethanol solution of DPPH. This spectrophotometric assay uses stable 2.2'diphenylpicrylhydrazyl (DPPH) radical as reagent (Brand-Williams et al., 1995). The DPPH scavenging activities of samples are expressed as IC_{50} and TEAC values which defies as fifty percent of free radical inhibition mg per ml and the microgram of trolox equivalents per gram of sample, respectively. For the result from Table 3, drum drying method showed the lowest IC_{50} value (p<0.05) with the value of 196.40 mg/g sample. No different effect of freeze and tray drying methods on IC_{50} value of samples were found (p>0.05). The IC_{50} value indicates high antioxidant activity. In the case of TEAC, the sample prepared by drum drying method showed the highest TEAC value (4.03 μg/g sample). However, no different effect of freeze and tray drying methods on TEAC value were found (p>0.05).

Table 3 DPPH scavenging assay as IC_{50} and TEAC values of samples as dry basis from the different drying methods

Drying methods	IC_{50}*(mg/g sample)	TEAC *(«g/g sample)
Freeze drying	250.41±8.25^{a}	3.30±0.11^{b}
Drum drying	196.40±21.41^{b}	4.30±0.61^{a}
Tray drying	250.30±2.63^{a}	3.29±0.03^{b}

Values are given as mean value ± standard deviation from triplicate observations. Different superscripts within the same column are significantly different (p < 0.05).

2.3 Effect on $ABTS^{\bullet+}$ radical scavenging activity

There was significant effect of drying methods on $ABTS^{\bullet+}$ radical scavenging activity of ripe Ma nao ho fruit powder (p < 0.05). From the result, the $ABTS^{\bullet+}$ radical scavenging activity of all ripe Ma nao ho fruit powders expressed as IC_{50} and TEAC values showed the similar trend with DPPH scavenging assay (Table 4). The lowest of IC_{50} value was observed in the sample prepared by drum drying method with the value of 177.13 mg/ml. No different effect of freeze and tray drying methods on IC_{50} value as 239.47 and 231.20 mg/g sample, respectively of samples were found (p>0.05). The sample prepared by drum drying

method showed the highest TEAC value (6.46 μg/g sample). However, no different effect of freeze and tray drying methods on TEAC value was obtained (p>0.05).

Table 4 ABTS radical cation decolorization assay as IC_{50} and TEAC values of samples as dry basis from the different drying methods

Drying methods	IC_{50}*(mg/g sample)	TEAC *(«g/g sample)
Freeze drying	239.47±6.76[a]	4.70±0.13[b]
Drum drying	177.13±28.20[b]	6.46±0.86[a]
Tray drying	231.20±12.19[a]	4.78±0.26[b]

Values are given as mean value ± standard deviation from triplicate observations. Different superscripts within the same column are significantly different (p < 0.05).

Discussions

From the result, the sample prepared by drum drying method showed the highest total phenolic content and antioxidant capacity. This result was probably due to the temperature used in drum drying process (120 °C) higher than freeze and tray drying processes. Martinez-LasHeras et al. (2014) suggested that thermal processing can affect the phytochemicals by thermal breakdown, which affects the integrity of cell structure, thereby resulting in the migration of components, leading to breakdown by various chemical reactions involving enzymes, light and oxygen. This result could be related to an increase in the extractability of such compounds as consequence of the matrix changes during the drying process. Lou et al. (2014) reported that heat treatment might change the amount of extractable phenolic compounds and antioxidant activity of citrus peel. Naturally existing phenolic compounds in fruits and vegetables are usually covalently bound to insoluble polymers Therefore, heat treatment may be used to release bound phenolic compounds from citrus as well as increasing their antioxidant activity. High temperature heating (150 °C) can enhance the extraction of phenolic acids from both soluble and insoluble form, and flavonoids from soluble form. After heat treatment, the increase phenolic acids, both from soluble and insoluble forms, might contribute to the increase antioxidant activity (Lou et al., 2014). Another study reported that the antioxidant activity of citrus peel extract increased as heating temperature increased (Jeong et al., 2004). Total phenolic content of orange peel was low during low temperature heating (50–60 °C) and increased by a higher drying temperature (70–100 °C) (Chen et al., 2011). Jeong et al. (2004) reported that phenolic compounds of immature calamondin can be released by simple heat treatment, since several low molecular weight phenolic compounds were newly formed at 150 °C for 0.5 h. This indicates that the release of phenolic acids by hot water extract could be enhanced

by heating at 150 °C for 1.5 h. This might be due to the degradation of cell wall structure or that some bound status of phenolic acids was broken down during heating treatment (Choi et al., 2011).

Conclusion

Total phenolic content and antioxidant capacity of ripe Ma nao ho fruit powder were affected by drying methods. The sample prepared by drum drying method showed the highest total phenolic content and antioxidant capacity. However, no different effects of freeze and tray drying methods were observed.

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Protoplast culture of *Anthurium and raeanum*

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Abstract

In this experiment, isolation of protoplasts from young leaves of in vitro *Anthurium andraeanum* cv Tropical and Pitache was carried out using various types and concentrations of enzymes and osmoticums. High yields 4.25 x 10^6 and 3.83 x 10^6 protoplasts per milliliters, respectively, of isolated protoplasts were obtained from young leaves of *Anthurium andraeanum* cv Tropical and Pitache. Types and concentrations of enzyme, periods of incubation, sources and concentrations of osmoticum were important in obtaining high viability of preparations as determined by 2,3,5-triphenyltetrazolium chloride (TZ). Culture of protoplast in liquid medium resulted in the highest yield and cell division percentage were observed when using MS with 2,4-D and Kinetin in combination with BA at 1 mg per liter, 3% glucose for 4 weeks and medium for Tropical and Pitache were MS and ½ MS respectively.

Keywords: Protoplast culture, *Anthurium andraeanum*, Tropical, Pitache

Introduction

Anthurium (Araceae), native to Central and South America, is one of the most popular ornamental crops. The attractive characteristics including vibrant inflorescence with straight spathe, candle-like spadix, exotic foliage, and particularly the long lasting 'flower' of of anthurium have ensured its great commercial importance, and therefore anthuriums have currently occupied a large part in flower industry, especially in terms of cut-flower and potted ornamentals. Now, demand for new good quality varieties of anthuriums is increasing. Many attempts have been made to increase the diversity of anthuriums to meet preferences of different groups of people (Ge et al., 2012). The development of protoplast systems has increased the versatility of plants for use in both biochemical and genetic research. They have become indispensable tools in genetic engineering and crop breeding. Of all the possible starting points for plant genetic manipulation, only protoplasts offer the opportunity to take advantage of all the technologies now available (Rao and Prakash, 1995). The development of protoplast systems has increased the versatility of the plants for use in various researches. The success of a protoplast culture system primarily lies with consistent yields of a large population of uniform and highly

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viable protoplasts. Several protoplast isolation and purification protocols have been published to optimize the yield and reproducibility. They are often procedures of elaborate nature, labour-intensive involving too many explants or protoplast handling steps, and require extended exposure of explants to digestion environment. Further, the efficacy of such protocols or that of enzyme combinations used therein could be limited to a few plant species (Rao and Prakash, 1995; Te-chato and Sriphakdi, 2000).

The enzymes and techniques used for isolation of protoplasts have a bearing on their subsequent behavior and development. Methods with too many steps involved often result in the introduction of cell contamination at some stage or the other (Rao and Prakash, 1995). An important factor affecting yield and viability is the first step toward this goal. In this paper, the author present a method in which a set of enzymes that are efficiency at optimum temperatures have functioned synergistically to release protoplasts with relative ease in *Anthurium* species. Here, we present protoplast isolation and culture from *Anthurium andraeanum* in order to establish protoplasts and further fusion between two species.

Materials and Methods

1. Plant materials

Anthurium andraeanum cv. Tropical and Pitache were used as plant materials for protoplast isolation. The leaves from multiple shoots were cut off and used as plant materials for protoplast isolation and culture. The leafs were surface-sterilized by 20% Clorox solution for 20 minutes, 10% Clorox solution for 10 minutes, followed by successive washing for three times with sterile distilled water. After surface sterilization, leaves were excised and used as plant material for protoplast isolation.

2. Protoplast isolation

2.1 Enzyme solution

In this experiment, cellulase and hemicellulase were used in combination with pectinase at various concentrations. For all combinations, enzymes were dissolved in 0.7M manitol in the presence of major and minor salts of MS (Murashiga and Skoog medium). The pH of the solution was adjusted to 5.7 by 1N NaOH or 1N HCl. Sterilization of the enzyme solution was carried out by passing through sterilized Millipore filter of pore size 0.45 μm.

2.2 Washing solution

Washing solution was composed of 0.7M mannitol, major and minor salts of MS. The pH of the solution was adjusted to 5.7 using 1N NaOH or 1N HCl before autoclaving at 1.07 kg/cm^2, 121 ^{o}C for 15 minutes.

2.3 Purified solution

In this work, we used two-phase layer technique to isolate protoplast. According to the processes, 20% sucrose was selected and use as the lower phase solution. The solution was sterilized by autoclaving at 1.07 kg/cm^2, 121 ^{o}C for 15 minutes.

2.4 Isolation of protoplast

One gram leaf tissue was stripped and incubated in centrifuge tube containing 10 ml of various enzyme combinations. Incubation was carried out in the dark on a rotary shaker at 50 rpm for 4 hours. At the end of the incubation period, the mixture of enzyme solution and leaf protoplasts was passed through a nylon mesh and centrifuged at 800 rpm for 5 minutes. Supernatant (enzyme solution above the pellet) was discarded and the pellet was re-suspended in 5 ml of washing solution composed of 0.7M manitols, major and minor salts of MS. Crude protoplast suspension together with debris was then floated on 5 ml of 20% sucrose acting as purified solution. The two-phase solution was again centrifuged at 1,000 rpm for 5 minutes. Complete protoplasts at the mid phase between sucrose and manitol were collected by Pasteur pipette and transferred to a new centrifuge tube. The protoplasts were washed two times with washing solution and aliquots were taken to measure protoplast yield and viability. Protoplast counts were made with a heamacytometer. Viability was assessed using 2,3,5-triphenyltetrazolium chloride (TZ). After 24 hours in 1% (w/v) TZ in 0.1M citrate buffer pH 5.0, protoplasts were observed under light microscope. The percent viability was calculated as a number of protoplasts pink per total number of intact protoplastx100.

2.5 Determination of optimum types and concentrations of enzyme

Cellulase at concentration of 1, 2, 3, 4 and 5% v/v combined with hemicellulase and pectinase at the same concentration were used in combination for isolation of mesophyll protoplasts of *Anthurium*. The osmoticum of all the enzyme combinations were adjusted to 0.7M by manitol. After incubating one from leaf tissue in enzyme solution for a 4 hour period, protoplasts were isolated according to isolation processes and the numbers of released protoplasts were compared statistically.

3. Protoplast cultures

3.1 Plant growth regulators on division of protoplasts

MS (Murashige and Skook, 1962) medium was used in the presence of various combinations between 2,4-dichlorophenoxyacetic acid (2,4-D), benzyl adenine (BA) and Kinetin. Protoplasts at density of $1x10^5$ were suspended in those media and placed in cultured bottles. After incubation under dark conditions at 25 ^{o}C for 2 and 4 weeks, protoplast from each age was counted and compared their number and viability statistically.

3.2 Effects of sugar types on division of protoplasts

Three typed of sugars; sucrose, glucose and fructose at level 3% w/v, in MS medium plus 2,4-D 1 mg/l plus kinetin 1 mg/l, were employed to test the division of protoplasts. Protoplasts at density of $1x10^5$ were suspended in those media and placed in cultured bottles. After culture under dark conditions at 25 ^{o}C for 2 and 4 weeks, division of protoplasts was counted and compared in each experiment separately.

3.3 Medium culture on division of protoplasts

Four types of culture media, MS, ½ MS, VW (Vacin and Went, 1949) and ½ VW combined with 3% w/v glucose, 2,4-D 1 mg/l plus kinetin 1 mg/l, were used to test the division of protoplasts. Protoplasts at density of $1x10^5$ were suspended in those media and placed in cultured bottles. The cultures were incubated at 25 °C in the dark condition. At 2 and 4 weeks of culture, divided protoplasts were counted and compared among each experiment.

4. Statistical analysis

The results are presented as mean values with five replicates. The data on protoplast yields and protoplast divisions were subjected to analysis of various (ANOVA) with the means separation ($p<0.05$) by Duncan's multiple range test (Duncan, 1955)

Results and Discussions

1. Effect of various combinations of enzymes on yield of protoplasts

Cellulase at low concentration of 1% in combination with 1% hemicellulase and 1% pectinase was enough to macerate leaf tissue and release protoplasts of anthurium Tropical and Pitache (Table 1). Increase in concentration of the cellulase, hemicellulase and pectinase from 1% to 5% could release a large number of protoplasts. Maximum yield of Tropical and Pitache protoplasts obtained from this combination of enzyme (5% cellulase, 5% hemicellulase and 5% pectinase) was $42.53x10^5$/ml and $37.93x10^5$/ml, respectively. Cellulase at 4%, hemicellulase 4% and pectinase 4% was the best combination for high viability in both anthurium cultivars. Effects of enzyme concentrations on yield and viability were different. As the concentration of enzyme increased, viability of the protoplasts decreased (Table 1).

Table 1 Effect of various combinations of enzyme on yield and viability of protoplasts isolated from leaf of *Anthurium andraeanum* cv. Tropical (T) and Pitache (P)

Enzyme (%)			Average Yield		Average Viability	
Cellulase	Hemicellulase	Pectinase	(10^6/ml)		(%)	
			T	P	T	P
1	1	1	1.45c	1.23c	78.18b	81.14ab
2	2	2	3.47b	3.12b	90.09a	88.87a
3	3	3	4.08a	3.84a	89.73a	87.67a
4	4	4	4.93a	3.75a	93.72a	92.27a
5	5	5	4.25a	3.79a	89.31a	90.58a

Means indicated by different letters are significantly different ($P < 0.05$) of yield and viability by DMRT

Successful isolation of protoplasts from leaves and embryos of *Spathiphyllum wallisii* and *Anthurium scherzerianum* was obtained (Duquenne et al., 2007). The best results were achieved when 1.5% cellulase, 0.5% macerase and 0.5% driselase were used for *S. wallisii* leaves and 0.5% cellulase, 0.3% macerase and 0.5% driselase for *A. scherzerianum* embryos. Every gram of somatic embryos yielded 10^5 PP. Isolation of protoplasts of leaves was more reproducible, resulting in a mean yield of 10^6 PP g^{-1} FW for *S. wallisii* and 10^5 PP g^{-1} FW for *A. scherzerianum*. Similar results were reported by Kuehnle (1997) with a mean yield of $3.8x10^5$ PP g^{-1} FW of leaves from *A. andraeanum*. In Duquenne et al., (2007), the yield of protoplasts from *A. scherzerianum* leaves was much lower than for *S. wallisii*. Their results indeed show that embryo-derived protoplasts were more suitable for regeneration purposes than the ones isolated from leaves. Also other reporte demonstrated that the nature of the protoplast source is an important factor for protoplast culture (Nassour and Dorion, 2002). Te-chato and Sriphakdi (2000) reported that cellulase at 1.5% and macerozyme R-10 1.5% was the best combination for high yield and viability from shogun leaves protoplasts.

2. Effect of plant growth regulators on division of protoplasts

Type of auxin and cytokinin used in culture of protoplasts played a significant role on division of protoplasts. A concentration of 2,4-D at 1 mg/l in combination with BA at concentrations 1 mg/l promoted an increment in division of the protoplasts (Table 2). 2,4-D at concentration of 1 mg/l in combination with Kinetin at concentration 1 mg/l produced yield higher than 2,4-D combined with BA. Division of protoplasts from those combination of 2,4-D with Kinetin was obtained. Different results were obtained when cytokinin in the presence of BA was applied. Kinetin provided greater percentage of protoplasts division than BA and provided percentage both in frequency and time consumed. Optimum concentration of 2,4-D and Kinetin as 1 and 1 mg/l, respectively. In the medium containing Kinetin, first division of protoplasts could be seen at week 2 of culture. After culture for 4 weeks, division of protoplasts was greatly increased at two week of culture. Even 2,4-D and Kinetin still provided division of protoplasts but percent division was far higher than BA.

Table 2 Effect of plant growth regulators on division of protoplasts isolated from leaf of *Anthurium andraeanum* cv. Tropical (T) and Pitache (P)

Plant growth regulators			% protoplast division			
2,4-D (mg/l)	BA (mg/l)	Kinetin (mg/l)	week 2		week 4	
			T	P	T	P
1	1	0	10.93c	19.26b	14.39c	20.20b
1	0	1	18.98b	25.39a	22.84b	26.46a

Means indicated by different letters are significantly different ($P < 0.05$) of yield and viability by DMRT

A higher percentage division of mesophyll protoplasts of *Anthurium* was obtained in a MS medium supplemented 2,4-D and Kinetin. 2,4-D in combination with Kinetin provided a higher percentage of protoplasts division. The result was contrast to the culture of young mangosteen leaves (Te-chato, 1998) which developed of both direct shoots and meristematic nodules when cultured on the medium containing BA or BA combination with TZD (thidiazuron). The phenomenon provides supporting evidence that young mangosteen leaves contain a high concentration of auxin. Addition of exogenious auxin produced an inhibitory effect on both callus formation and division of protoplasts. In the case of mesophyll protoplasts of *Anthurium* protoplast divided rapidly in culture medium containing 2,4-D and Kinetin. The same result was also obtained when young leaves were cultured in that phytohormone containing medium. The major growth regulators, auxin and cytikinins, are normally essential for sustained protoplast growth, although exceptions exist where only auxin is required, as in carrot and *Arabidopsis thaliana* (Dovzhenko et al., 2003). In contrast, auxins and cytokinins are detrimental to growth in citrus (Vardi et al., 1982). The growth requirements of protoplasts often change during culture, necessitating modification of medium composition, typically involving a reduction of the auxin concentration.

3. Type of sugars on dividing protoplasts

The type of sugar for protoplasts divided trend to increase as fructose, sucrose and glucose (Table 3). There was significant effect of sugar types on dividing protoplasts ($P<0.05$). In this experiment, it was observed that divided protoplasts were mainly from glucose. It was clearly seen that fructose provided a low frequency of division. Culturing protoplasts by using glucose promoted a rapid division of protoplasts. The best result in division of protoplasts of glucose was obtained in the medium followed by

sucrose and fructose. However, the culture medium containing sucrose also gave a high percentage of protoplasts undergoing division (21.65%). Our results indeed show that leaves-derived protoplasts were more suitable for culture in MS medium with glucose than the ones culture in MS with sucrose and fructose. Sucrose and glucose are the regular choices of carbon sources in most media, although a change in the carbon source from sucrose to maltose promoted shoot regeneration for protoplast-derived cells of cereals (Jain et al., 1995).

Table 3 Type of sugars on division of protoplasts isolated from leaf of *Anthurium andraeanum* cv. Tropical (T) and Pitache (P)

Type of sugars	% protoplast division			
	week 2		week 4	
	T	P	T	P
Sucrose	14.21d	16.98c	19.28d	21.65c
Glucose	29.37b	31.90a	33.46b	37.52a
Fructose	12.56d	17.14c	16.56d	18.25d

Means indicated by different letters are significantly different ($P < 0.05$) of yield and viability by DMRT

4. Type of culture medium on dividing protoplasts

Mesophyll protoplast released from Tropical and Pitache leaves. After cultured in ½ MS promoted a better result on dividing of protoplasts. At 3 weeks of culture first division of some the protoplast was observed (data not shown). Percent division of protoplast in ½ MS was 23.31 while ½ VW medium gave only 15.03 (Table 4). The other types of culture medium have not provided more than ½ MS and VW.

Table 4 Type of culture medium on division of protoplasts isolated from leaf of *Anthurium andraeanum* cv. Tropical (T) and Pitache (P)

Type of culture medium	% protoplast division			
	week 2		week 4	
	T	P	T	P
MS	13.35c	18.65a	18.22b	19.41b
½ MS	12.26c	19.83a	16.39c	23.31a
VW	11.98c	15.87b	14.81d	20.47ab
½ VW	9.87d	12.22c	10.75e	15.03d

Means indicated by different letters are significantly different ($P < 0.05$) of yield and viability by DMRT

Protoplasts from different species and from different tissue of the same species may vary in their nutritional requirements. Consequently, the optimum medium for long-term culture must be determined empirically. Many media have been based on the MS (Murashige and Skoog, 1962) and B5 (Gamborg et al., 1968) formulations, with addition of an osmoticum, usually a non metabolisable sugar alcohol, such as manitol, or the somewhat more soluble, sorbitol. Ideally, media should be simple and fully defined to ensure reproducibility between laboratories.

Conclusion

Protoplasts were successfully isolated from *A. andraeanum* cv Tropical and Pitache leaves. It was seen that all combinations of cellulase, hemicellulase and pectinase gave a result on protoplast isolation. Protoplasts were released under those conditions of enzyme solution. Yield of protoplasts obtained from the lowest cellulase, hemicellulase and pectinase. Increasing concentration of cellulase, hemicellulase and pectinase to 5% gave the best result of release protoplasts. Concentration of those enzyme at 4% provide maximum viable protoplasts. In order to optimize protoplast culture, plant growth regulators, type of sugar and culture medium should be modified. 2,4-D in combination with kinetin was found effective for dividing protoplasts. The highest percentage of dividing protoplasts formation was obtained in MS and ½ MS medium supplemented with 3% w/v glucose and 2,4-D 1 mg/l and kinetin 1 mg/l.

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Effect of Varying Concentration of Dietary Metabolizable Energy and Calcium-Available Phosphorus Ratio on Productive Performance and Egg Quality of Laying Hens in The Late Phase of Production

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Abstract

This study was conducted to evaluate optimum dietary concentration of metabolizable energy (ME) and calcium-available phosphorus ratio (Ca:Avai P) for productive performance and egg quality of laying hens in the late phase of production . In a 2x2 factorial arrangement, 360 Dekalb Brown hens (60 wk of age) were randomly assigned to experimental diets with 2,800 and 3,000 kcal of ME/kg of diet, each containing 3.75:0.45 and 4.0:0.48 % Ca:Avai P, respectively. Each dietary was replicated 6 times, and feed and water provided *ad libitum*. However, another nutrients in experimental diets were met requirement as recommended by NRC [4]. Experimental birds were raised in laying cage and received 16 h of light throughout the study period (60 to 76 wk of age). The birds were observed for feed intake (FI), hen-day egg production (HDEP), egg weight (EW), egg mass (EM), feed conversion ratio per dozen eggs (FCR per dozen eggs), internal egg quality and shell thickness (ST) at the end of each 28-d lay period. Mortality rate (MR) was recorded as it occurred. Mean HDEP, EM and FCR were improved ($P<0.05$) in hens receiving diets with 2,800 kcal of ME/kg of feed than those fed diets containing 3,000 kcal of ME/kg of diets. Hens on 3.75:0.45% Ca:Avai P diets also exhibited higher ($P<0.05$) ST than those fed diets containing 4.0:0.48% Ca:Avai P diets. Differences in FI, BW, internal egg quality and MR among dietary ME and Ca:Avai P concentration were not significant ($P>0.05$). Overall, diets composed of 2,800 kcal of ME/kg of diet and 3.75:0.45% Ca:Avai P were utilized more efficiently by laying hens in the late phase of production.

Key words: Metabolizable energy, calcium : available phosphorus ratio, laying hens, late phase of production

Introduction

The effect of diet on egg production and egg quality of laying hens has been investigated quite extensively Soisuwan and Chauychuworg [1]. For example, Keshavarz and Nakajima [2] has evaluated the possibility of increasing egg weight through manipulation of nutrients in the diet such as protein, metabolizable energy and fat content. An increase in dietary energy significantly improved egg production, egg weight and egg mass, whereas increasing matabolizable energy in experimental diets of laying hens decreased feed intake and improved feed conversion ratio per dozen eggs and per kilogram of egg Grobas et al [3]. However, research conducted to determine the nutrition requirement, particularly of the interaction between metabolizable energy and calcium per available phosphorus ratio on productive performance and egg quality of laying hens during late phase of production has been limited it is known that laying hens produced large egg size, however has low egg production and less eggshell

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thickness when reared in late phase production periods Khajali et al [4]. The objective of this study was to evaluate the effect of varying concentration of dietary metabolizable energy (ME) and calcium-available phosphorus ratio (Ca:Avai P) on productive performance and egg quality of laying hens in the late phase of production

Materials and Methods

Three hundred and sixty Dekalb Brown hens in six replications per treatment (15 birds/replication) were used. Four experimental diets which contained of 2 levels of dietary energy levels (2,800 and 3,000 kcal of ME/kg feed) and 2 levels of Ca:Avia P ratio (3.75:0.45% and 4.00:0.48%) while another nutrient contents of the recommendation were met by of NRC [5]. Ingredients and nutrient composition of experimental diets were shown in Table 1. Birds were raised in laying cage and received 16-h constant lighting regime throughout the experimentation period from 60-76 weeks of age and received feed in mash form with feed and water were provided for *ad libitum* consumption. During the experimental period, birds were observed for hen-day egg production (HD), egg weight (EW), average day feed intake (FI), feed conversion ratio per dozen eggs (FCR per dozen eggs), egg mass (EM), morality rate (MR) while egg quality was recorded for internal egg quality (eggyolk color) and shell thickness (ST). Data were objected to ANOVA using GLM procedures as suggested by Khunthum [6] as 2x2 factorial arrangement of dietary treatments with dietary metabolizable energy (ME) and Ca:Avia P as main effects. Two-way interaction between ME and Ca:Avai P and time periods were not significant ($P>0.05$), thus data were pooled across periods and analyzed for main effects. Least significant difference comparison were made between treatment means for main effects when there was a significant F-value. Significant implied ($P<0.05$) unless stated otherwise.

Results and Discussion

There were no interaction between main treatments and between experimental periods, therefore, only main treatments are presented (Table 2.). The results has found that percentage HDEP, EW, EM and FCR were significantly improved ($P<0.05$) in birds that received diets containing 2,800 kcal of ME/kg of diet than those fed diets containing 3,000 kcal of ME/kg diet. This study has supported by the report of Nahashon et al [7] who reported that the 2,800 kcal of ME/kg of diet may have provided energy to protein ratio that provide better utilization of dietary and protein by the laying hens. The authors also confirmed that the energy to protein ratio of the diet composed of 14% CP and 2,800 or 2,900 kcal of ME/kg was 200 and 207, respectively. Golian and Maurice [8] reported that birds would consume feed to primarily meet their energy requirement and protein utilization, which is essential in egg production, would therefore be highly dependent on this notion. Nahashon et al [7] described that bird consuming diets with energy to protein ration of 207 would consume less protein than those fed diets with energy to

protein ration 200. Rosenboim et al [9] also reported that excessive caloric consumption may lead to increased BW gain associated with fatness and as a result reduce egg production of laying hens.

The higher EM in birds fed the 2,800 than those fed the 3,000 kcal of ME/kg of diet may be due to higher HDEP and EW, which were associated with these diets. Feed conversion ratio of birds fed diets containing 2,800 kcal ME/kg was better ($P<0.05$) than those fed diets containing 3,000 kcal ME/kg of diet may be due to higher EM but had not significantly differ ($P>0.05$) in FI. The result was also found that mean ST of birds containing 3.75:0.45% Ca:Avai P ratio was significantly better than those fed diets containing 4.00:0.48%. This result has supported by the report of Lichovnikova [10] who recommended that brown-egg laying hens in the late phase of production required not more than 4.08 g of Ca/hen/day (3.5% Ca of diet) for egg shell quality.

Table 1. Ingredient composition and calculated chemical analyses of the experimental diets (% as-fed basic, unless stated otherwise)

Item	2,800 kcal of ME/kg feed		3,000 kcal of ME/kg feed	
	3.75:0.45% Cal : Avai P	4.00:0.48% Cal : Avai P	3.75:0.45% Cal : Avai P	4.00:0.48% Cal : Avai P
Ingredient				
Yellow corn	59.20	57.87	55.84	54.50
Rice bran	15.00	15.00	15.00	15.00
Soybean meal, 44% CP	10.63	10.62	10.33	10.38
Fish meal, 55% CP	5.00	5.00	5.00	5.00
Palm oil	0.10	0.62	3.74	4.24
Dicalcium phosphate (21% P)	0.56	0.70	0.54	0.70
calcium carbonate	8.40	9.10	8.42	9.04
Sodium chloride	0.35	0.35	0.35	0.35
Vitamin and mineral premix[1/]	0.50	0.50	0.50	0.50
L-Lys-HCL (78%)[2/]	0.10	0.10	0.11	0.12
Met-hydrory analog (88%)[3/]	0.16	0.16	0.17	0.17
Total	**100**	**100**	**100**	**100**
Calculated analysis (%)				
AME_n, kcal/kg of diet	2,800	2,800	3,000	3,000
Crude Protein	13.96	13.85	13.56	13.47
Ca	3.75	4.00	3.75	4.00
Available P	0.45	0.48	0.45	0.48
Digestible Lys	0.81	0.81	0.81	0.81
Digestible Met	0.44	0.44	0.44	0.44

Digestible Tryp	0.15	0.16	0.15	0.15
Digestible Thre	0.53	0.52	0.51	0.51
Cost (Baht/kg)[4/]	14.12	14.20	15.03	15.14

[1/] Provided per kilogram of diet: retinyl acetate 3,500 IU; cholecalciferol, 1,000 ICU, DL-α-tocopherol acetate 4.5 IU; menadione sodium bisulfate complex, 2.8 mg; vitamin B12, 5.0 mg; riboflavin, 2.5 mg; pantothenic acid, 4.0 mg; niacin, 15.0 mg; choline, 172 mg; folic acid, 230 mg; ethoxyquin, 56.7 mg; manganese, 65 mg; iodine, 1 mg; iron, 54.8 mg; copper, 6 mg; zinc, 55 mg; selenium, 0.3mg

[2/] Ajinomoto (Thailand) Co.Ltd.

[3/] Degussa (Thailand) Co.Ltd.

[4/] Price on 10/17/2013 in Thailand (Baht/kg)

Table 2. Influence of differing dietary metabolizable energy (ME) and calcium : available phosphorus (Ca:Avai P) ratio on productive performance and egg quality of laying hens in the late phase of production[2/]

Factors	HDEP[1/] (%)	EW[1/] (g)	FI (g)	EM (g/b/d)	FCR[1/]	MR (%)	ST[1/] (mm)	Eggyolk color
Metabolizable								
energy (kcal/kg)								
2,800	76.17[a]	67.14[a]	111.30	51.14[a]	2.35[b]	1.18	0.351	6.04
3,000	74.21[b]	64.47[b]	113.40	47.84[b]	2.96[a]	1.49	0.349	6.19
Ca : Avai P ratio (%)								
3.75:0.45	74.62	64.83	112.60	48.38	2.51	1.36	0.381[a]	6.13
4.00:0.48	75.01	64.91	112.10	48.69	2.42	1.41	0.352[b]	6.27
Pooled SEM	3.07	0.271	3.017	0.061	0.073	1.64	0.015	0.17
Main effect and								
interaction								
ME	0.032	0.041	0.254	0.039	0.042	0.612	0.104	0.412
Ca : Avai P ratio (%)	0.101	0.137	0.134	0.187	0.137	0.414	0.038	0.138
ME x Ca:Avai P ratio (%)	0.129	0.129	0.127	0.216	0.126	0.428	0.131	0.197

[1/a–b] Mean within a column and under each main effect with no common superscripts differ significant ($P<0.05$)

[2/] Data represent means of 6 replicated of 15 hens.

Conclusion

The present study has shown that it can be used the diets composed of 2,800 kcal of ME/kg feed and 3.75:0.45% Ca:Avai P ratio to optimize productive performance and egg quality of laying hens in the late phase of production

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Effect of Rice Leaf Cutting Length on Rice Yield

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Abstract

Length of rice leaf cutting was reported to have positive effecting on broadcasting Thai jasmine rice yield in Ponsai district ,Roi Et province but not clarify in other variety .Therefore ,the study aimed to search for the optimal length cutting of PathumThani1 rice leaf. The experimental design was randomized complete block design(RCBD).Treatment was 7 cutting lengths (0,5,10,15,20,25 and 30 cm from the leaf tip was performed by sickle after 60 days after planting and 6 replications. It was conducted in a research greenhouse and field of Agricultural Technology and Agro-industry, Rajamangala University of Technology Suvarnabhumi, Phra Nakhon Si Ayutthaya during November 2012to February 2013. The results showed that no effect on plant height , tiller number per plant panicle length and yield but significantly higher number of grains per panicle and 1,000 grains weight. The optimal length of rice leaf cutting was15-30 cm

Keywords : rice leaf cutting , rice yield

Introduction

Rice is Thailand's major agricultural products and main revenue comes from rice exports (Thai Rice Exporters Association,2014) In 2013 ,the volume of rice exports to 6.6 million tons with a value of 133,842 million baht. Pathum Thani rice was the least volume exports with a value of 51,684.15 tons (Office of Agricultural Economics,2013) However, there are many serious problems negative affecting rice yield resulted in yield losses such as pest insects, rice diseases, weeds and another pests.

Rice leaf cutting is a farmer wisdom for several reasons such as preventing wind destroy due to too heavy leaves, removal of weeds , easy for pest management ,reducing cost of rice pests and weeding, uniform plant height and stimulating all plant to bloom in the same time and easy for harvesting. Rice leaf cutting length have been recommended for 30 cm. at 30-60 day after planting and before flowering. It can cut multiple times but should not cut flag leaf(Provincial Agricultural Extension Office Phra Nakhon Si Ayutthaya,2011) because flag leaf is particular provides photosynthetic for grain filling. (Evans and Rawson ,1970) The lowest yield was produces from flag leaf cutting.(Khatun *et al*. ,2011) Sharma and De (1993) study on effect of foliage cutting on growth and yield of different rice cultivars under semi-deep water conditions(0-80) by foliage cutting at the collar of the uppermost leaf. The results showed that decrease in grain yield with two cuts of foliage was due to a reduction in the weight and number of grains/panicle as panicles/m2 and 1000 -grain weight remained unaffected.

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Rice leaf cutting at the vegetative stage was also practiced in India (Copeland,1972) and now it was frequently done in Thailand . (Kunpkanchanakul *et al*. ,1991) Rice leaf cutting is the one method for improving rice productivity. The farmers in Ponsai district, Roi Et province has initiated leaf cutting method for improving productivity of dry-seed broadcasting rice, In 2004/2005 cropping season, an average rice grain yield of approximately 6.25 ton/ha was obtained. (Konboon *et al*. ,2007).Cutting for forage at 40, 70, 100, or 40+100 days after emergence gave herbage yields of 0.7, 0.7, 1.0 and 1.4 ton/ha respectively, and grain yields of 2.13, 2.20, 2.24 and 1.94 ton/ha compared with 2.02 ton/ha without cutting. (Kupkanchanakul *et. al*, 1990)

Therefore ,this study aimed to search for the optimal length cutting of PathumThani1 rice leaf.

Materiais and Method

Experiment 1 Effect of rice leaf cutting length on rice yield in pot.

A pot experiment was conducted in a research greenhouse of Agricultural Technology and Agro-industry, Rajamangala University of Technology Suvarnabhumi, Phra Nakhon Si Ayutthaya during November 2012 to February 2013.

The experimental design was randomized complete block design(RCBD) .Treatment was 7 cutting lengths (0, 5, 10, 15, 20, 25 and 30 cm from the leaf tip was performed by sickle) at 60 days after planting and 6 replications. Analysis of variance was done and treatment different mean was compared with Duncan's New Multiple Range Test (Steel and Torrie,1980)

Experiment 2 Effect of rice leaf cutting length on rice yield in field

The experimental design was randomized complete block design(RCBD) .Treatment was 7 cutting lengths (0, 5, 10, 15, 20, 25 and 30 cm from the leaf tip was performed by sickle) at 60 days after planting and 6 replications. It was conducted in a research field of Agricultural Technology and Agro-industry, Rajamangala University of Technology Suvarnabhumi, Phra Nakhon Si Ayutthaya during November 2012 to February 2013. Analysis of variance was done and treatment different mean was compared with Duncan's New Multiple Range Test (Steel and Torrie,1980)

Results and Discusstons

The results in pot showed that no effect on plant height , tiller number per plant panicle length and grain yield /pot(Table 1,3,4,5) but highly significant differences of increased height rate per day, number of grains per panicle and 1,000 grains weight.(Table 2,4,5)

The results in the field showed that no effect on tiller number ,panicle number, yield/rai and plant height (Table 6)but the height of the rice consistently high in all treatments.

The plant height of rice before and after leaf cutting was not statistically significant differences. The plant height after leaf cutting in pots was 92.33 - 101.67 cm (Table 1) , coincided with the appearance of the variety of rice, Pathum Thani 1 reported was 104-133 cm.(Rice Department of Thailand,2554) but the height after leaf cutting increase in a week was significant differences. The highest plant height increase 7 days after leaf cutting was leaf cutting at 30 cm value of 4.26 cm/day (Table 2) This result coincided with the effect of foliage cutting on growth and yield of different rice cultivars under semi-deep water conditions(0-80)that the tall, elongating and floating deep water(Sharma and De,1993) Rice leaf cutting was provide to have little effect only on 1000-grain weight ($p<0.05$) when cut at 15-30 cm form leaf tip. Even though it increase rice yield but not significantly different because of the rice have flag leaf at 28 days after leaf cutting coincided with) Evans and Rawson (1970) report that flag leaf in particular provides photosynthetic for grain filling and the lowest yield was produces from flag leaf cutting.(Khatun *et al*. ,2011) In field experiment, rice leaf cutting at 60 days after planting only one time was no effect on weed growth but effect on uniform plant height and uniform flowering that coincided with Phra Nakhon Si Ayutthaya Provincial Agricultural Extension Office (2011) Another benefits of rice leaf cutting such as reduce the amount of leaves, trim the leaves to the left makes the crop useless strength not fall easily, eliminate weeds (grass) , flowering, ripening simultaneously and increase good quality productivity(grains free from contamination.) (Chai Nat province department of agriculture extension office,2556) The cost of rice leaf cutting about 130-150 bath/rai.

Table 1 Effect of rice leaf cutting on plant height.

Treatment	Plant height (cm)			
	Day after leaf cutting			
	7	14	21	28
No cutting	66.67	67.67	71.33	98.67
Leaf cutting at 5 cm	63.17	71.67	73.50	98.33
Leaf cutting at 10 cm	61.50	71.83	73.83	98.33
Leaf cutting at 15 cm	64.67	68.00	71.17	101.67
Leaf cutting at 20 cm	63.83	70.67	73.67	99.67
Leaf cutting at 25 cm	66.67	73.83	77.67	99.17
Leaf cutting at 30 cm	64.67	73.00	75.83	92.33
F-Test	ns	ns	ns	ns
% CV	7.29	10.76	10.13	4.83

Table 2 Effect of rice leaf cutting on increased height rate per day

Treatment	Increased height rate/day (cm)			
	Day after cutting			
	7	14	21	28
	0.74d	0.44f	0.47e	1.33d
Leaf cutting at 5 cm	0.43d	0.82ef	0.63de	1.37cd
Leaf cutting at 10 cm	1.04d	1.19de	0.88cd	1.54c
Leaf cutting at 15 cm	2.33c	1.39cd	1.08bc	1.87b
Leaf cutting at 20 cm	3.21b	1.88bc	1.39b	2.01ab
Leaf cutting at 25 cm	3.59ab	2.34ab	1.74a	2.11a
Leaf cutting at 30 cm	4.26a	2.69a	1.92a	2.01ab
F-Test	**	**	**	**
% CV	28.19	28.43	24.83	9.05

Note : Treatment difference mean was adjusted with Duncan's New multiple range Test

Table 3 Effect of leaf cutting on numbers of tiller per plant

Treatment	number of tiller per plant				
	Before leaf cutting	7 days after leaf cutting	14 days after leaf cutting	21 days after leaf cutting	28 days after leaf cutting
No cutting	40.67	44.33	44.33	44.33	44.33
Leaf cutting at 5 cm	49.67	49.50	47.33	46.67	46.67
Leaf cutting at 10 cm	43.17	43.83	44.83	44.50	44.50
Leaf cutting at 15 cm	41.67	42.00	43.17	42.67	42.67
Leaf cutting at 20 cm	39.00	39.00	40.17	39.50	39.50
Leaf cutting at 25 cm	46.67	47.00	47.00	46.33	46.33
Leaf cutting at 30 cm	42.17	42.67	43.50	43.33	43.33
F-Test	ns	ns	ns	ns	ns
% CV	16.78	17.93	15.15	15.15	15.15

Table 4 Effect of rice leaf cutting on number of grain per panicle and panicle length.

Treatment	number of grain / panicle (grains)	Panicle length (cm)
No cutting	88.20 c	24.46
Leaf cutting at 5 cm	89.90 c	25.03
Leaf cutting at 10 cm	92.90 c	25.88
Leaf cutting at 15 cm	98.30 bc	25.33
Leaf cutting at 20 cm	106.70 ab	24.30
Leaf cutting at 25 cm	109.70 a	25.21
Leaf cutting at 30 cm	110.20 a	24.37
F-Test	**	ns

% CV	8.15	6.9

Note: Treatment difference mean was adjusted with Duncan's New multiple range Test

Table 5 Effect of rice leaf cutting on grain size , 1,000 grains weight and grain yield .

Treatment	Yield component			
	Seed length (mm)	Seed thickness (mm)	1,000 grains weight(g)	Yield/pot (g)
No cutting	10.15	2.06	16.17 de	62.12
Leaf cutting at 5 cm	10.28	2.03	17.07 d	90.51
Leaf cutting at 10 cm	10.18	1.92	15.54 e	77.12
Leaf cutting at 15 cm	10.36	2.1	20.87 ab	86.19
Leaf cutting at 20 cm	10.19	2.03	19.64 bc	72.54
Leaf cutting at 25 cm	10.28	2.07	18.47 c	80.63
Leaf cutting at 30 cm	10.17	2.06	22.00 a	92.29
F-Test	ns	ns	**	ns
% CV	2.4	3.05	3.97	23.99

Note: Treatment difference mean was adjusted with Duncan's New multiple range Test

Table 6 Effect of rice leaf cutting on number of tiller, number of panicle ,yield and plant height in the field.

Treatment	number of tiller / rai	number of panicle /rai	yield/rai (kg)	plant height (cm)
No cutting	600,000	586,240	896	97.83
Leaf cutting at 5 cm	592,200	525,440	864	95.17
Leaf cutting at 10 cm	627,200	615,040	784	100.00

Leaf cutting at 15 cm	490,880	463,680	736	101.50
Leaf cutting at 20 cm	521,280	522,880	624	98.33
Leaf cutting at 25 cm	635,200	619,200	848	97.67
Leaf cutting at 30 cm	552,000	541,760	808	97.50
F-Test	ns	ns	ns	ns
% CV	16.86	17.39	20.05	4.20

Conclusion

Plant height and tiller numbers were not significantly increased after cutting, but grain yield and yield components were significantly different . The optimal length of rice leaf cutting at 15-30 cm tended to obtain the highest grain yield and 1,000 - grains weight.

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Use of Soap pod; *Acacia concinna* (Willd.) DC. crude extracted as natural adjuvant for wood vinegar in insect pest control

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Abstract

Wood vinegar was commonly use among Thai farmers to control plant pests. In particular, Bamboo and Eucalyptus Distilled Wood vinegar (BDWV and EDWV) are advanced product from wood vinegar. However, the adjuvant was needed to increase their effectiveness. The crude extracted of soap pod; *Acacia concinna* (Willd.) DC. was tested for adjuvant properties; acidity, viscosity feeding inhibit and mortality. Two solvents were used; water and ethyl alcohol. The acidity of soap pod extracted by ethyl alcohol (SPA) and water extracted (SPW) as 2.22 and 2.54 respectively. The acidity of solution were tested by mixed soap pod extracted with BDWV and EDWV. The acidity of BDWV+SPW and EDWV+SPW were 2.49 and 2.61 respectively. Meanwhile, BDWV+SPA and EDWV+SPA acidity was 2.71. These acidities were meet The Standard of Thai Local product (2010). The viscosity was test for SPA and SPW by Brookfield viscometer. The results were 9.11 and 6.62 cP (centipoise) respectively. The mortality of the solutions was test on Pink mealy bug; *Phenacoccusmanihoti*Matile-Ferrerocompared with commercial adjuvant (ABSA-80®). The results showed no statistically different of mortality between EDWV+ABSA-80® and EDWV+SPA that 78.50 and 78.14 percent respectively ($p<0.01$) Whereas EDWV+SPW solution obtain 64.90 percent of mortality. Additionally, the bioassay was done with coffee white stem borer (*Xylotrechusquadripes*) for feeding inhibit and percent of mortality. BDWV+SPA could statistically ($p<0.05$) inhibited feeding of larva. An average of 3.12 larva of 20 tested larva were feed on test diet. Whereas, average 3.91 and 4.77 larva feed on diet treated with BDWV+SPW. However, mortality was no statistically different. BDWV+SPA obtained average 21.42 dead larva while BDWV solely and solution of BDWV+SPA obtained average 15.21 and 15.17 dead larva respectively. This showing that, the crude extracted of soap pod obtains adjuvant property for distilled wood vinegar either acidity or viscosity. It maintains lethal effect of distilled wood vinegar compared to ABSA-80®. Thus, crude extracted of soap pod could be an alternative for commercial adjuvant in small scale agriculture in particular organic agricultural system.

Key words: *soap pod crude extracted, distilled wood vinegar, natural adjuvant*

Introduction

Wood vinegar is commonly used in pest control in Thai agriculture system. One of its products is distilled wood vinegar, which obtained high concentration of chemicals and pest control properties(Yanyong *et. al*. 2013). Phenol and acetic acid are major chemical that has pesticide effect (Pangnakorn, 2009, Tiilikkala, *et. al*. 2010). Wood vinegar showed potential biological activities as larvicidal, pupicidal, and adult deformities against *M. domestica*. The treated insect species showed deformities at larval, pupal and adult stages. After the treatment, development efficiency, metamorphosis, and growth were highly reduced depending on the concentrations (Ervina,*et al*., 2013). Rahmat, *et*

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al.(2014)also reported that mixing and fuming application of 5ml of wood vinegar as a pest insect repellent could increase the number of dead maize weevil and reduce the damage of maize kernel. In particular, bamboo and eucalyptus distilled wood vinegar (BDWV and EDWV) are local made substrates. Farmers used them to control some pests. However, adjuvant was needed for its effectiveness. Aqueous extracts of this soap pods (*Acacia concinna* (Willd.) DC fruit has been in use as detergent since a long time in India (Pai, 2013). Various properties of soap pods are due to the presence of saponins in it. Saponins have surfactant properties similar to dodecylbenzene sulfonates (Mote *et.al*., 2010). Pai (2013) had reviewed that,soap podsfruit contain the saponin of acaciac acid, a trihydroxymonocarboxylic acid belonging to the tetracyclic triterpene group. The aqueous extract of these pods of fruits shows acidic (pH 2.1) which is due to presence of acaciac acid with molecular formula $C_{30}H_{48}O_5$. Therefore, crude extracted of soap podwas tested for adjuvant properties.

Methodology

Extraction

Thousand grams of soap pods of were washed and oven-dried at temperature of 60°C for 24 hrs. They were subsequently grounded into fine powder in 1,000 ml of sterile distilled water and ethanol, maintained at 60°C for 24 hrs. The resulting suspensions were filtered and evaporated to dryness at 60°C for 24 hrs.It was labeled as SPW for water extract and SPA for ethanol extract

These crude extracts were subject to test for viscosity centipoise, cP) byBrookfield® and for acidity by PH meter.

Bioassay

Test insect were Pink mealy bug; *Phenacoccusmanihoti*Matile-Ferreroand coffee white stem borer; *Xylotrechusquadripes*.The mealy bugs were taken from Provincial Integrated Pest Management, Phitsanulok. Thesebugs were fed by newly sprout of cassava leaf. Thecrawlersof these bugs were subjected to bioassay. Whereas coffee white stem borer; *Xylotrechusquadripes*were directly collect from infested coffee trees and selected the same size of borer.

Mixture of EDWV and soap pods extracted was test for mortality of pink mealy bug; *Phenacoccusmanihoti*Matile-Ferrero by Leaf Dipping Method. Whereas, mixture of DWVsoap pods extracted were sprayed on test diet (4 inches long of coffee branches) to tested for feeding inhibition and mortalityoncoffee white stem borer; *Xylotrechusquadripes*.

Results and discussion

Chemicals properties

1. Acidity

The results showed average acidity of solely soap pod extracted by ethyl alcohol (SPA) and water extracted (SPW) as 2.22 and 2.54 respectively. The solution of BDWV+SPW and BDWV+SPA were average 2.49 and 2.71 respectively. Whereas, the solution of EDWV+SPW and EDWV+SPA were average 2.61 and 2.71 respectively. These acidity were meet The Standard of Thai Local product (2010). Hence, either SPW or SPA could be mix with any types of distilled wood vinegar. The mixtures are maintain acidity of both solution.

2. Viscosity(cP)

The crude extracts 1 ml were subject to test for viscosity (centipoise, cP) by Brookfield®. The results is showing in table 1.

Table 1 The viscosity (cP) of soap pod extracted by alcohol (SPA) and by water (SPW) and its solution in water

	SPA (mean±SD)	SPW (mean±SD)
100 %	6.62±0.06	9.11±0.31
+ 1 cc water	6.00±0.00	8.58±0.31
+ 5 cc water	6.00±0.00	8.01±0.14
+ 10 cc water	6.00±0.00	8.21±0.09
+ 20 cc water	5.79±0.28	7.68±0.00

Concerning to the viscosity (cP) of soap pod extracted by alcohol (SPA) and by water (SPW) and its solution in water. The average viscosity of soap pod extracted are 6.62+0.06 cPand 9.11+0.31 cP in solely soap pod extracted by alcohol and water respectively. Adding with water, these viscosity were declining according to amount of water solution. Remarkably, the viscosity are maintained till 10 cc of water were added and its viscosity was 8.21+0.09 and 6.00+0.00 cP in soap pod extracted by water and alcohol respectively.

Bioassay

Mortality of pink mealy bug (*Phenacoccusmanihoti*Matile-Ferrero)showed the solution of EDWV+SPA obtain average 75.93 percent of mortality whereas EDWV+ commercial adjuvant (ABSA-80) and EDWV+SPW obtain average 72.22 and 66.67 percent of mortality respectively (table 2). The result shows adding SPA encourage the mortality effect of distilled wood vinegar compare to adding Absa-80. These is probably saponins in soap pods have surfactant properties (Mote *et.al*., 2010 and Pai, 2013).

Table 2 The percentage mortality of pink mealy bug (*Phenacoccusmanihoti*Matile-Ferrero) treated by eucalyptus distilled wood vinegar (EDWV) mixed with soap pod extracted and Absa-80. (n=200)

Treatments	% mortality
water (control)	0.0 [c]
+SPW	66.67 [b]
+SPA	75.93 [a]
+Absa -80	72.22 [a]

Mean within the same column with different letter are significantly different ($p \leq 0.01$) by DMRT

Feeding inhibition and mortality were tested on20 larva of coffee stem borer, *Xylotrechusquadripes* in an experimental unit. The result showed BDWV+SPA could statistically ($p<0.05$) inhibited feeding of larva. An average of 3.12 larva of 20 tested larva were feed on test diet. Whereas, average 3.91 and 4.77 larva feed on diet treated with BDWV+SPW. However, mortality was no statistically different. BDWV+SPA obtained average 21.42 dead larva while BDWV solely and solution of BDWV+SPA obtained average 15.21 and 15.17 dead larva respectively.

The results shows adding soap pod extracted, distilled wood vinegar could obtain higher inhibition of feeding. That is probably surfactant and viscosity properties of soap pod extracted. These probably allows distilled wood vinegar long last absorbed to wood diet surface. Hence, inhibition effect of distilled wood vinegar could be extend and affective.Similar to mortality, adding soap pod extracted with distilled wood vinegar caused higher number of dead larva in particular soap pod extract with alcohol. These might be synergist between distilled wood vinegar and soap pod extracted.

Table 3 The Co-effects of distilled wood vinegarand soap pod extracted on inhibitory and mortality of coffee stem borer(*Xylotrechusquadripes*) (n=160)

treatments	feeding (no.)	mortality (no.)
Water	17.42 [c]	2.12 [ab]
+ water (1:200)	4.77 [b]	15.21 [a]
+ water (1:200)+ SPW	3.91 [a]	15.17 [a]
+ water (1:200)+ SPA	3.12 [a]	21.42 [a]

Mean within the same column with different letter are significantly different ($p \leq 0.01$) by DMRT

Conclussion

These experiments promisingly showed crude extracted from soap pod could be used as adjuvant in small scale agriculture in particular organic agricultural system. It has some adjuvant properties. In particular those extract with alcohol are enable to commercial adjuvant alternatives.

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Miso Produced from Different Thai Rice Cultivars: Physicochemical and Sensory Characteristics

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Abstract

Miso, a Japanese traditional fermented soybean product, exists in three forms, rice miso, barley miso and soybean miso. This work evaluated rice miso prepared from two Thai rice cultivars, Hommali and Homnil by examining physicochemical and sensory properties. After a 2-week fermentation the results showed that the rice cultivars themselves had a significant effect on miso color values of lightness (L*), redness (a*) and yellowness (b*). The miso products contained 20.81-32.70 mg/g of protein, 247-466 μmole/g of free alpha amino nitrogen and 164.57-281.55 mg/g of reducing sugars. When samples were tested for ABTS radical-scavenging activity, it was found that miso prepared by Homnil rice cultivar exhibited higher scavenging activity than miso prepared by Hommali rice cultivar. Sensory analysis of miso soups showed that appearance, color, umami and overall acceptance attributes in the miso soups were influenced by the rice cultivars used in miso fermentation. The present study implied that miso fermented using different Thai rice cultivars could provide different quality attributes for the consumers, and had the potential to be developed into high antioxidant products.

Keywords: miso, rice, fermentation

Introduction

Soybean is an excellent source for nutrition that include plant protein, oligosaccharides, vitamin B, vitamin E and mineral substances with some functional compounds which can reduce the risk of cardiovascular diseases and cancers [1]. Fermentation of soybean can improve the nutritional utilization of soybean because microbial enzyme degrades insoluble macromolecular substances; such as protein, fat and carbohydrate into polypeptides, fatty acids, oligopeptides and amino acids [1-4]. Amino acids, i.e. liberated glutamate and peptides during fermentation are taste enhancers in fermented products, e.g. miso, soy sauce. Miso is a Japanese traditional fermented soybean considered to serve both functions of health benefit and seasonings with consumption dating back to A.D. 700 [5-6]. Miso is a sort of two-stage fermentation process. The first stage involves the production of the koji from cooked grains inoculated with *Aspergillus oryzae* and a second fermentation (the moromi) is the koji mixed with salt, cooked soybeans, and appropriate inoculums [7]. Miso provides low cost protein with nutritional values of amino acids and short chain of peptides for consumers. Although, there are various types of miso, they can be classified into three major types on the basis of raw materials employed, e.g. rice (kome) miso, barley (mugi) miso and soybean (mame) miso [8-9].

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Thailand, a major rice production of the world and is the largest rice exporter in the world with the total volume of about 5-6 million tons per year. Many rice cultivars have been grown and available in the market. Regarding to the different quality of rice cultivars [10], it would be a useful information to study the effect of different rice cultivars on miso quality. In this research, the solid-state fermentation of whole soybean mixed with Thai rice was performed. Physicochemical and sensory characteristics were examined in miso products.

Materials and Methods

Microorganism and starter preparation

Aspergillus oryzae was obtained from the collection of Agricultural Technology Research Institue, Rajamangala University of Technology Lanna (RMUTL). The mold was grown at 35 ^{o}C in PDA medium (Merck, Darmstadt, Germany). The starter was prepared by inoculating the mold on rice which was sterilized at 15 lb/in^{2} for 15 min. The inoculated rice was then incubated at 35 ^{o}C for 5 days. The rice overgrown with mold was then used as a starter for koji production.

Koji fermentation

Soybean, Rajamangala 1 variety, was obtained from Agricultural Technology Research Institute, harvested in 2013. Soybean seeds were selected and cleaned prior to further use. Whole soybean was washed and then soaked in water that was five times of the soybeans weight at ambient temperature overnight. After water draining, soybean was washed, cooked in an autoclave (121 ^{o}C, 20 min) and cooled. Solid state fermentation was performed by addition of 1% starter into the cooked soybean substrate. After mixing thoroughly, the inoculated soybean substrate was placed on a bamboo tray and incubated for 30 h at ambient temperature.

Miso fermentation

Rice cultivar and ratio of soybean and rice were two factors in this study. Miso fermentation by two cultivars of rice, i.e. Hommali and Homnil and two ratios of soybean and rice, i.e. 1:1 and 2:1 was carried out. The treatments were Hommali with soybean and rice ration of 1:1 (HM/1:1), Hommali with soybean and rice ratio of 1:2 (HM/1:2), Homnil with soybean and rice ration of 1:1(HN/1:1) and Homnil with soybean and rice ratio of 1:2 (HN/1:2). Brewing process was performed as described in [11]. The ground koji was mixed with cooked and ground rice. The mixture was placed in glass jar and aged for two weeks at ambient temperature. Two replicate experiments were conducted.

Color measurement

L*, a* and b* color values were determined with a color meter (JS555, Juki, Japan).

Chemical analyses

Measurement of pH was carried out by a pH meter (Model C831, Consourt, Belgium) Absorbency at 450 nm (A_{450}) was employed for measurement of color change in water-soluble fraction of miso [12]. Total acidity was determined by diluting each 5 g of sample in 50 ml distilled water and then titrating to pH 8.2 using 0.1N NaOH. Titratable acidity was expressed as percent lactic acid. Moisture content was measured by the method of [13]. Ninhidrin colorimetric method was used to measure free alpha amino nitrogen (FAN) in the juice and the fermented juice [14]. Antioxidant activity assay was determined by using the ABTS methods as described by Wongputtisin et al. [15]. Reducing sugars were determined with dinitrosalicylic acid (DNS) method [16].

Sensory evaluation

All the panelists were experienced in fermented soybean products. A group of 30 panelists took part in this study. Miso products fermented for 2 weeks were evaluated for organoleptic quality. Ninety grams of boiling water was poured to 10 g of miso, mixed and directly served to panels. The panelists were asked to rate the products on the 9-point hedonic scale [17].

Statistics

The experimental designs of 2x2 factorial in CRD (completely randomized design) for physicochemical analysis and in RCBD (randomized complete block design) for sensory analysis were applied in this study. Analysis of variance (ANOVA) was used to compare mean differences of the samples. Mean separation was carried out using DMNRT (Duncan's new Multiple Range Test) for objectively measured data. Statistical significance was assigned as $p \leq 0.05$.

Results and Discussion

Table 1 showed the color values of 2-week fermented miso with different rice cultivars and ratios. The fermented misos showed L*, a* and b* values of 27.86 to 43.59, 8.20 to 11.44 and 13.84 to 24.54, respectively. Different soybean and rice ratios of 1:1 and 2:1 were not found to affect the lightness (L*) of the misos after fermentation for two weeks ($p>0.05$), while the use of Homnil rice cultivar in miso fermentation produced darker color than the use of Hommali rice cultivar ($p\leq0.05$). The a* and b* values indicated red-green and yellow-blue colors, respectively. The results showed that miso made from Hommali rice cultivar and higher soybean content had higher red color (a*) and blue color (b*) than miso made from Homnil rice cultivar and lower soybean content ($p\leq0.05$). This demonstrated that the rice the rice cultivars and their amounts in the misos influenced color components in the final products, however, components generated during fermentation might also have an impact on miso color quality [12, 18]. In addition, the rice property could also affect miso colors, e.g. amylose and amylopectin content, type of

rice. Homnil is colored glutinous rice while Hommali is white non-glutinous rice and glutinous rice generally contains lower content of amylose than non-glutinous rice [19].

Table 1 Color values of misos made by different rice cultivars and ratios after two-week fermentation.

Factor	L*	a*	b*
factor A (rice cultivar)			
A_1 : Hommali	39.76± 4.60^{a}	10.16±1.50^{a}	24.36±0.76^{a}
A_2: Homnil	28.71± 1.26^{b}	8.95± 0.86^{b}	16.02±2.59^{b}
factor B (soybean and rice ratio)			
B_1: 1:1	35.72±9.20^{ns}	8.54±0.41^{b}	19.19±6.22^{b}
B_2: 2:1	32.24±3.68^{ns}	10.57±1..12^{a}	21.19±3.49^{a}
Interaction			
$A_1 \times B_1$	43.59± 2.26^{a}	8.88±0.19^{ns}	24.54±0.95^{a}
$A_1 \times B_2$	35.93±0.12^{b}	11.44±0.85^{ns}	24.18±0.84^{a}
$A_2 \times B_1$	27.86±1.26^{c}	8.20±0.08^{ns}	13.84±0.98^{c}
$A_2 \times B_2$	29.57± 0.55^{c}	9.70±0.13^{ns}	18.20±0.43^{b}

Within a column different letters denote significant differences ($p \leq 0.05$)

ns denotes means are not significantly different ($p > 0.05$)

The color of the miso became browner during fermentation as indicated by A_{450} (Figure 1). The absorbance of the water-soluble fraction increased ca. 1-3 times after 2 weeks of fermentation. Darker color of the water-soluble fraction of miso was also observed in miso ripening for 20 months due to Maillard reaction [12]. However, rice cultivars affected the color of water-soluble fractions of miso. The use of Homnil rice cultivar resulted in higher values of A_{450} which led to the conclusion that the deep red color of the rice was associated with color quality of miso product. Furthermore, the results showed that fermented miso became browner with time.

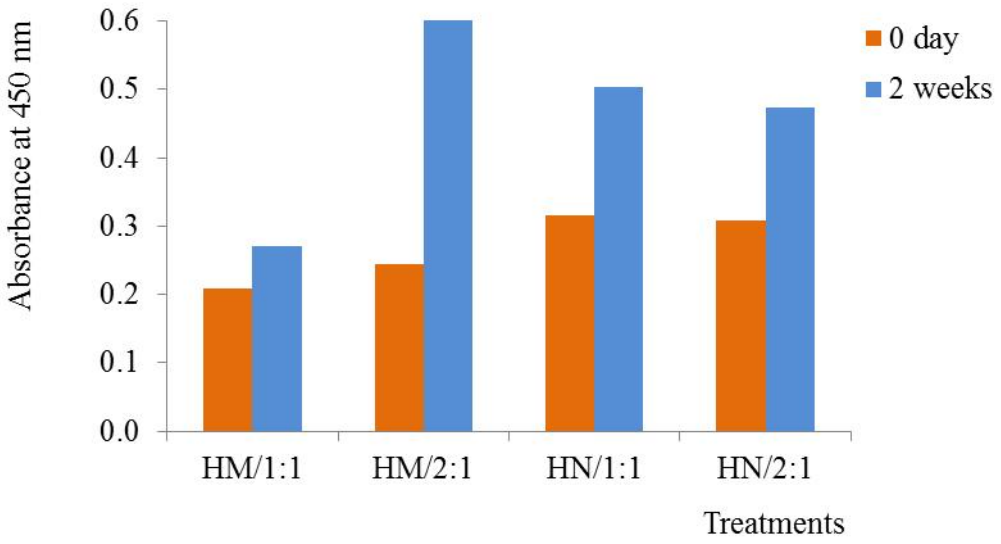

Figure 1 Absorbance at 450 nm of the water-soluble fraction increased after two-week fermentation

Considering total soluble protein and FAN, measurements in this study revealed approximately 22.19-27.15 mg/g and 246.94-466.76 μmol/g, respectively in two-week fermented misos. The total soluble protein contents in miso products were not significantly increased compared with the misos at the beginning of fermentation, while the FAN values of the miso products were increased of ca. 10-22 times after fermentation. Koji enzymes were responsible for the FAN increase as it depicted amino acid contents [2-3]. Enhancement of FAN was also reported in the solid-state fermentation of whole soybean [1].

Table 2 Protein and free alpha amino nitrogen (FAN) contents of misos made by different rice cultivars and ratios.

Factor	Protein content (mg/g)		FAN content (μmol/g)	
	0 D	2 weeks	0 D	2 weeks
factor A (rice cultivar)				
A_1 : Hommali	29.46±4.03^{ns}	26.23±2.33^{a}	23.21±2.24^{b}	356.58±128.54^{ns}
A_2: Homnil	35.97±4.13^{ns}	24.20±2.49^{b}	36.34±10.45^{a}	358.54±116.13^{ns}
factor B (soybean and rice ratio)				
B_1: 1:1	30.62±5.18^{ns}	26.69±51.20^{a}	33.49±13.78^{a}	351.07±124.69^{ns}
B_2: 2:1	34.80±4.80^{ns}	23.74±2.67^{b}	26.06±1.59^{b}	364.33±119.78^{ns}
Interaction				
A_1× B_1	27.54±5.81^{ns}	27.15±1.57^{ns}	21.62±1.90^{c}	246.94±18.24^{b}
A_1× B_2	31.38±0.62^{ns}	25.30±3.23^{ns}	24.80±1.15^{bc}	466.76±30.27^{a}

$A_2 \times B_1$	33.71±2.96^{ns}	26.22±0.99^{ns}	45.37±1.42^{a}	455.20±54.24.^{a}
$A_2 \times B_2$	38.23±4.69^{ns}	22.19±1.15^{ns}	27.31±0.16^{b}	261.89±12.41^{b}

Within a column different letters denote significant differences ($p \leq 0.05$)

ns denotes means are not significantly different ($p > 0.05$)

Determination of reducing sugars revealed that rice cultivars influenced the reducing sugar contents in miso products (Table 3). Miso fermented by addition of Homnil rice had higher reducing sugar content than Hommali rice. The structure of starch in the Homnil rice could be a reason because it might be easily digested by the mold amylase applied in this study [10]. The extract of miso after two-week fermentation was assayed for ABTS radical scavenging capacity. The results suggested that miso fermented by addition of Homnil rice produced higher scavenging activity of 76.45% than addition of Hommali (61.69%). With regard to the soybean and rice ratio, it was found that higher content of soybean significantly enhanced higher scavenging activity ($p \leq 0.05$).

Table 3 Antioxidant activity and reducing sugars content of misos made by different rice cultivars and ratios after two-week fermentation.

Factor	Reducing sugars content (mg/g)	Scavenging capacity (%)
factor A (rice cultivar)		
A_1 : Hommali	179.94±19.20^{b}	61.69±17.80^{b}
A_2: Homnil	261.38±28.19^{a}	76.45±2.18^{a}
factor B (soybean and rice ratio)		
B_1: 1:1	223.06±68.13^{ns}	61.46±17.64^{b}
B_2: 2:1	218.26±30.45^{ns}	76.68±1.07^{a}
Interaction		
$A_1 \times B_1$	164.57±12.30^{b}	46.30±0.90^{b}
$A_1 \times B_2$	195.32±3.05^{b}	77.09±1.35^{a}
$A_2 \times B_1$	281.55±9.48^{a}	76.63±3.63^{a}
$A_2 \times B_2$	241.21±25.82^{a}	76.28±0.98^{a}

Within a column different letters denote significant differences ($p \leq 0.05$)

ns denotes means are not significantly different ($p > 0.05$)

Sensory scores of 2-week fermented miso products were shown in Table 4. Rice cultivars had an impact on sensory quality of miso products. The results indicated that using Hommali rice cultivar for miso fermentation yielded the products with significantly higher sensory scores of appearance, color,

umami taste and overall preference attributes ($p \leq 0.05$). The effect of soybean and rice ratio on sensory quality of the miso products was not observed. The four misos recieved scores at the level of "like slightly" to "like very much" for the quality attributes of appearance, color, odor, umami taste and overall preference ($p > 0.05$).

Table 4 Mean scores for sensory attributes of miso soups prepared from two-week fermented misos with different rice cultivars and ratios after two-week fermentation.

Factor	appearance	color	odor	umami	overall
factor A (rice cultivar)					
A_1 : Hommali	7.30±0.99^{a}	7.21±1.10^{a}	6.63±1.09^{ns}	6.81±1.21^{a}	6.97±1.15^{a}
A_2: Homnil	6.30±1.17^{b}	6.05±1.19^{b}	6.32±1.22^{ns}	6.21± 1.40^{b}	6.26±1.31^{b}
factor B (soybean and rice ratio)					
B_1: 1:1	6.76±1.09^{ns}	6.53±1.25^{ns}	6.46±1.08^{ns}	6.56±1.31^{ns}	6.61±1.35^{ns}
B_2: 2:1	6.83±1.29^{ns}	6.72±1.32^{ns}	6.50±1.26^{ns}	6.46±1.37^{ns}	6.62±1.22^{ns}
Interaction					
$A_1 \times B_1$	7.15±0.87^{ns}	6.97±1.03^{ns}	6.62±1.03^{ns}	6.87±1.12^{ns}	7.07±0.97^{ns}
$A_1 \times B_2$	7.45±1.09^{ns}	7.45±1.14^{ns}	6.65±1.18^{ns}	6.75±1.33^{ns}	6.87±1.33^{ns}
$A_2 \times B_1$	6.37±1.17^{ns}	6.10±1.33^{ns}	6.30±1.12^{ns}	6.25±1.44^{ns}	6.15±1.53^{ns}
$A_2 \times B_2$	6.22±1.19^{ns}	6.00±1.07^{ns}	6.35±1.34^{ns}	6.17±1.38^{ns}	6.37±1.08^{ns}

Within a column different letters denote significant differences ($p \leq 0.05$)

ns denotes means are not significantly different ($p > 0.05$)

There are many types of miso depending on ingredient utilization and fermentation condition. This study provided the results of different cultivars of rice and different ratios of soybean and rice had an impact on physicochemical and sensory quality of miso products. The obtained data can support miso production in Thailand as the Thai rice was used in this research. However, various aspects of

investigation such as other potential rice cultivars, different amounts of ingredients, microbial change during fermentation, shelf-life study and consumer test, are needed to be explored.

Conclusion

Recent growing consumer interest in health food is due to the human health associated to food. Miso, a source of nutrients and functional compounds, is considered beneficial to health. In this study, miso fermentation using different amounts and cultivars of rice as co-substrates affected the quality of miso products. Utilization of Homnil rice cultivar in miso production resulted in the product containing higher content of free alpha amino nitrogen and scavenging capacity than Hommali cultivar.

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Growth, Yield and Yield Components of 4 Dark Red Roselle Cultivars

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Abstract

The experiment on growth, yield and yield components in 4 cultivars of dark red roselle (Surin, Ubonratchatani, Klongpai and Kaengkrachan) was conducted at Faculty of Agricultural Technology; RMUTT, by RCB design 4 replications during August to November 2010. The results indicated that plant height, no.of main branches/plant, periods of flowering and maturity duration of the first fruit of all cultivars were not statistically different.The time of flowering (days to 50% flowering) of Ubonratchatani was earlier than the other cultivars. Nevertheless, Kaengkrachan and Surin gave superior yield components resulting in higher yield (890.7 and 821.4 kg/rai of fresh calyxes, 110.4 and 106.1kg/rai of dry calyxes respectively). Surin showed the highest seed yield (140.8 kg/rai), however, Kaengkrachan and Klongpai had greater harvest index than others (0.34). Regarding to the analysis of seed oil content, dry calyx acid and anthocyanin contents, all cultivars contained 15-18 % dry calyx acid and 20-21% seed oil while Surin was the richest in anthocyanin (318.35 mg/100g dry calyx).

Keywords: red roselle, cultivar, yield, yield component.

Introduction

Roselle (Hibiscus sabdariffa L.), a tetraploid (2n=72) species that belongs to the large family of Malvaceae, is an important crop in the tropical and sub-tropical regions [1]. Normally, the plant was grown as annual plant, 0.5-2 meters in height with dense bushy canopy of dark green leaves. The calyx color has played a major role to stipulate the quality of the crop. The crimson red (dark red) color is the most popular desirable of roselle, even the other shades and color exist, including the white or greenish white color [2]. Roselle has natural and considerably unique characteristics, in particular its rich contents of ascorbic acid , anthocyanin and phenolic compounds which presents the antimicrobial plus antioxidant activities [3]. Apart to its high contents of vitamin C and anthocyanins, Mohamad et al. [4] had reported the discovery of hydroxycitric acid (a potential antiobesity compound) from the extract of roselle calyxes which will add an invaluable characteristic for roselle. Thus, roselle becomes a multi-purpose plant used for a myriad of purposes, from home consumption to medicinal and industrial uses. It is commonly used to make jelly, jam, beverages, sauces and food preserves [5]. Many medical application of this plant have been developed around the world. It is used to treat hypertension, pyrexia and liver damage in China [6]. Moreover, due to the high content in protocatechuic acid, the calyx extract has

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been used as an effective treatment against leukemia [7]. Roselle seeds are also a source of vegetable oil , low cholesterol but rich in other phytosterols and tocopherols. These Characteristics represent an added value for the cultivation of this plant [8].

Thailand used to be the outstanding exporter of high quality dry roselle calyxes before the occurrence of economic crisis. Roselle is one of the twelve target medicinal herbs that Thai government aimed to promote their products to the world markets. According to the analytic report of the roselle production, market and processing by OAE [9], concluded that despite Thai roselle products have a good chance for world market demands but there are still some hindrances in development. The main limiting factors in part of crop production are: the small scale of plantation of each grower (only 5-6 rai, 1 rai = 1,600 m^2), lacking of good varieties and appropriated cultural practices, then led to the low productive efficiency. Unfortunately, until now there is very few of available research papers that could support to roselle production in commercial scale. Therefore, in order to improve the yield of roselle, it should be have a better understanding of the variability of growth, yield and yield components among the cultivated roselle cultivars which such information will be necessary to breeder for making a breeding program or to growers for selecting the right variety that meet to their production purposes. Thus, the present investigation aimed to find the responses on growth, yield and yield components among 4 culitivars of dark red roselle which were collected from different locations for planting in Pathumtani area.

Materials and Methods

This study was carried out at Agricultural Technology Faculty; Rajamangala University of Technology Thanyaburi; Pathumtani province during August to November 2010, on sandy clay loam soil texture, pH 6.5, organic matter 2.09 %, total N 0.11%, P_2O_5 70.2 ppm, K_2O 239.2 ppm and CEC 15.04 meq/100g. The experiment was laid out in RCB design with 4 replications and treatments which were consisted of 4 dark red roselle cultivars: Surin (RMUTI, Surin Campus), Ubonratchatani (Sufficiency Economy Study Center, Ubon Ratchatani University), Klongpai (Plant Genetic Conservation Project Office, Nakhon Ratchasima) and Kaengkrachan (Kaeng Krachan district, Phetchaburi). At the land preparation time or two weeks before planting, 2 tons/rai of organic fertilizer (farmyard manure mixed with compost) were uniform applied to all plots as basal application. Two-three seeds/hill were sown (two weeks later thinned to one plant/stand) at 75x50 cm (inter x intra row spacing), 5 rows in 21 m^2 of plot size. Two weeks later, the chemical fertilizer (formula 16-16-16) were applied with 50 kg/rai. Hand weeding and irrigation were carried out whenever it was necessary. All other agronomic practices were kept normally and uniformly. Ten sample plants in the middle rows of each plot were measured of some agronomic characteristics (plant height, number of main branches, days to 50 % flowering , flowering periods and 1st fruit maturation date). At the maturity period, dark red fresh fruit of ten sample plants in

each plot were harvested for collecting yield and yield components data (number of fresh fruits/plant, fresh calyx weight/plant, dry calyx weight/plant, seed weight/plant, 1000 seeds weight, fresh and dry calyxes yield, seed yield and harvest index. Afterward 200 g of dry calyxes and seeds of each treatment were taken to Agricultural and Agro-Industrial Product Improvement Institute at Kasetsart University for the analysis of seed oil content, dry calyx acid and anthocyanin contents.

Results and Discussions

1. Some agronomic characteristics (Table 1)

At harvest, no significantly differences were found in plant height and no. of main branches/plant among the cultivars. Base on the result, the mean of plant height of these dark red roselle varied from 203.5 cm (Klongpai) to 209.4 cm (Ubonratchatani) and the means of no. of main branches/plant in this trait ranged from 9.3 to 10.5. In case of 50 % of 1st flower blooming date, flowering periods and 1st fruit maturation date, the data had shown that Ubonratchatani reached days to 50 % flowering 2-4 days earlier than the other 3 cultivars. However, there was no significantly difference with regarding to the flowering periods (20.3-21.5 days) and 1st fruit maturation date (22.0-23.6 days).

2. Yield and yield components (Table 2 and Table3)

Analysis of variance on yield components (Table 2) had shown significantly difference among cultivars ($p<0.05$ and 0.01). Surin and Ubonratchatani had provided more no. of fresh fruits/plant (36.6 and 39.2) than Kaengkrachan and Klongpai (30.0 and 32.5). Nevertheless, Kaengkrachan with the lowest of fresh fruits/plant got greater fresh calyx weight/plant (890.7 g) but was not significantly different from Surin. Furthermore, these two cultivars were found to give higher dry calyx weight/plant (24.9-25.9 g) as well. When considering the seed weight/plant and 1000 seed weight, the heaviest of these two characters belonged to Ubonratchatani equal to 36.6 and 40.0 g, respectively. While Kaengkrachan was recorded in the least seed weight/plant as well as the smallest seed size of all cultivars.

Base on data analysis in Table 3, it indicated that the cultivars which could provided higher fresh and dry calyx weight/plant, absolutely could get larger fresh and dry calyx yields/rai as well. From this experiment, Kaengkrachan was the best performance in yielding calyx yields (890.7 kg in fresh and 110.4 kg in dry weight). Simultaneously, Ubonratchatani which gained more fruits/plant in smaller calyx size but bigger size of seeds, was the great cultivar in producing seed yield (150.0 kg/rai). Regarding to the harvest index (calyx plus seed yield), Kaengkrachan and Klongpai took the highest value (0.34).

Table 1 Some agronomic characteristics of 4 dark red roselle cultivars.

Cultivars	Plant height at harvest (cm)	No.of main branches/ plant	day to 50 % flowering (days)	Flowering periods (days)	1st fruit maturation date(days)
Surin	204.6	9.5	101.0 a	21.8	23.6
Ubonratchatani	209.4	10.1	97.8 b	20.3	22.0
Klongpai	203.5	9.3	102.0 a	21.9	22.0
Kaengkrachan	208.7	10.5	100.2 a	21.1	22.8
CV.(%)	2.83	5.91	1.10	4.32	3.48
F test	ns	ns	**	ns	ns
LSD.05	-	-	1.8	-	-
LSD.01	-	-	2.5	-	-

Means followed by the same letter at the same column were not significantly different by LSD

** significant at P< 0.01, and ns not significant

Table 2 Yield components of 4 dark red roselle cultivars.

Cultivars	No.of fresh fruits/plant	Fresh calyx Weight/plant(g)	Dry calyx Weight/plant(g)	Seed Weight/plant(g)	1000 seeds weight(g)
Surin	36.6a	192.5a	24.9a	33.0a	37.5ab
Ubonratchatani	39.2a	135.8c	19.5b	36.6a	40.0a
Klongpai	32.5b	162.9b	23.0ab	33.4ab	36.3b
Kaengkrachan	30.0b	208.8a	25.9a	28.0b	35.0b
CV.(%)	7.25	8.58	11.77	8.92	5.60
F test	**	**	*	*	*
LSD.05	4.0	24.1	4.4	4.6	3.3
LSD.01	5.8	34.6	-	-	-

Means followed by the same letter at the same column were not significantly different by LSD

*, ** significant at P<0.05 and 0.01, respectively.

Table 3 Yield of 4 dark red roselle cultivars.

Cultivars	Yield of fresh calyx (kg/rai)	Yield of dry calyx (kg/rai)	Seed yield (kg/rai)	Harvest Index
Surin	821.4a	106.1a	140.8a	0.32b
Ubonratchatani	579.6b	83.2b	152.0a	0.32b
Klongpai	754.2a	98.1ab	138.2ab	0.34a
Kaengkrachan	890.7a	110.4a	119.5b	0.34a
CV.(%)	12.15	11.76	8.93	3.47
F test	**	*	*	*
LSD.05	148.0	18.7	19.6	0.02
LSD.01	212.6	-	-	-

Means followed by the same letter at the same column were not significantly different by LSD

*, ** significant at P<0.05 and 0.01, respectively.

Data from Table 4 revealed that the pH value together with acid content (titratable acidity percentage) in dry calyxes and seed oil content of these 4 dark red roselle cultivars were not shown obviously different. The values ranged from 2.78-2.85, 15.26-17.51 and 20.37-22.17 %, respectively. On the contrary, in case of anthocyanin content in dry calyxes, Surin cultivar trended to have the biggest amount (318.35 mg/100g dry calyx)

Table 4 The pH, dry calyx acid content, Anthocyanin content and seed oil content of 4 dark red roselle cultivars.

Cultivars	pH	Dry calyx acid content (%)	Anthocyanin content (mg/100g dry calyx)	Seed oil content (%)
Surin	2.85 ± 0.02	15.26 ± 0.27	318.35 ± 5.73	21.60±0.44
Ubonratchatani	2.81 ± 0.02	16.41 ± 0.29	279.61± 4.19	22.17±0.41
Klongpai	2.79 ± 0.02	17.51 ± 1.14	307.72 ± 5.66	21.73±1.04
Kaengkrachan	2.78 ± 0.03	15.95 ± 0.13	303.81±14.15	20.37±0.50

From the result of this experiment, in respect to the responses of all cultivars on vegetative growth, there was slightly different that had been found. They tended to grow tall as high as 2 meters in Pathumthani growing conditions. From the report of Chang et al. [10], roselle plant with higher main stem are stronger and does not fall easily in production levels compared to the short one. Mohamad [1] had mentioned the

fact that it was uncertain in the variation on no. of main branches/plant among varieties or mutants, sometimes significant and sometimes non significant, in addition, it was varied upon the growing seasons [11]. For the characters of days to 50 % flowering , flowering periods and 1st fruit maturation date which were shown that roselle plants had switched from vegetative growth to reproductive growth. The variation between cultivars on these characters were not distinct. This might because roselle is a short day plant that is very sensitive to the photoperiod. In the first 4-5 month of its growth, it requires a daily light phase 11 hours but not more than 13 hours [12]. In case on yield and yield component responses of these cultivar, it indicated the various significant different levels in each character, these would be related to the adaptations of each cultivar in the new environment and cultivation methods. Ahmed et al. [13] had evaluated six genotypes of roselle under rain fed conditions in two locations of Sudan, it was found that at the genotypic level: calyx yield had highly significant negative correlation with days to 50 % flowering and 100 seed weight, on the other hand at the phenotypic level : calyx yield showed the highly significant positive correlation with no. of branches/plant and 100 seed weight. From the path coefficient analysis, the days of 50 % flowering had the highest positive direct effect on calyx yield. Therefore, selection for late maturing varieties and high no. of branches/plant will cause high calyx yield. Atta et al. [14] reported the study on yield character variability by using nine ecotypes of roselle that were planted during the raining season of 2004 in Niger, the ecotype which produced the highest seed yield also had high leaf yield but low in calyx yield, in contrary on the ecotype with higher yield had lower in 100 seed weight.

Conclusion

The results from this trial could be concluded that all cultivars had developed their vegetative parts and the switch time from vegetative to reproductive growth periods nearly the same. Kaengkrachan and Surin had superior yield components and produced higher calyx yield. Kaengkrachan gave the bigger and thicker calyxes and the highest harvest index while Surin had greater content in anthocyanin and Ubonratchatani gave the highest of seed yield.

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Effect of Germinated Brown Rice on the Characteristic of Steamed Chive Dumpling

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Abstract:

The objective of this study was to characterize the steamed chive dumpling made from germinated brown rice flour, which was substituted with rice flour. The various amounts of germinated brown rice flour (25, 50, 75 and 100% of flours weight, wet basis) were added into steamed chive dumpling. The textural characteristics (softness and stickiness values) and viscosity values (particularly peak viscosity, breakdown and setback values) of steamed chive dumpling with 100% germinated brown rice flour were the lowest values and they increased with a decreasing of germinated brown rice flour content, while an increasing of germinated brown rice flour led to an increasing of brown color in steamed chive dumpling. No differences significant of the chemical composition of all developed steamed chive dumpling were found, whereas crude fiber of the sample with 100% germinated brown rice flour showed the remarkable high value compared to that without germinated brown rice flour (4.80% compared to 1.81%). The microbiological properties of the developed products were also investigated and found that yeast and total bacteria count were less than 1.18×10^3 and 8.80×10^2 CFU/g, respectively, while coliform and *E. Coli* were not detected in all samples. The sensory evaluation of steamed chive dumpling was performed by 9 points hedonic scale and showed that the product with 100% germinated brown rice flour was the highest level.

Key words: Germinated Brown Rice Flour, Steamed Chive Dumpling, KanomKuichai, Characteristics

Introduction

Rice (*Oryza Sativa*. L.) is an important cereal crop in Thailand and one of an excellent source of carbohydrate. It consists of husk, bran and germ which contain vitamins and minerals as well as active enzymes concerning rice germination (Saif*et al*., 2004). Brown rice, known as hulled or un-milled rice, is whole grain rice and has many health benefits, particularly dietary fiber, protein, nutrients and phytochemicals. Recently, germinated brown rice is widely consumed due to its significant nutrient sourcesthat generated during germination. During rice germination, mostly nutrients of brown rice increase such as dietary fiber, gamma-aminobutyric acid (GABA), gamma-oryzanol, peptides and tocopherols contentsdue to their structural change (Kayahara and Tsukahara, 2000; Ito and Ishikawa, 2004). Germinated brown rice contains ten times of GABA, four times of dietary fiber and tocopherols, and three times of vitamin B1 and B6 compared to that of white rice. These components are reduce the risk of cancer, hearth attract and hypertension diseases, as well as promote blood sugar balance. GABA is a chemical messenger that is widely distributed in the human brainas inhibitory synapses(Kayahara

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and Tsukahara, 2000). In addition, GABA is recently used as a dietary supplement in health foods due to reducingblood pressure (Abe *et al*., 1995; Aoki *et al*., 2003; Inoue *et al*., 2003; Hayakawa *et al*., 2004) and alcoholism (Oh *et al*., 2003).Therefore, germinated brown rice flour is expected to apply in many flour-based products such as steamed chive dumpling (KanomKuichai) which is popular in Thailand.The developed product can be promoting health benefits.

The aims of the work were to study the suitable proportion of mixed flours (i.e., germinated brown rice flour and rice flour) in steamed chive dumpling, and to characterize the physical (textural and pasting properties), chemical and microbiological properties of the final product as well as their sensory evaluation.

Materials and Methods

Preparation of steamed chive dumpling

Germinated brown rice flour was purchased from SantiAsoke, Bangkok, Thailand. It was substituted with rice flour as 0, 25, 50, 75 and 100% compared to total flour weight, whilst other ingredients were fixed contents.Therefore, five different samples of steamed chive dumpling were prepared (by wet basis weight) according to the design formulas as show in **Table 1**. After preparing, the each premixed flour was determined of pasting properties.The other premixed flour was mixed with water and oil and filled with cooked Chinese chive and shaped before steaming for 7 minutes. The samples were used immediately to determine the textural properties and color parameter.

Table 1 Preparing of steamed chive dumpling

Germinated brown rice flour (%)	Ingredient (g, wet basis weight)					
	Rice flour	Germinated brown rice flour	Glutinous rice flour	Tapioca flour	Water	Palm oil
0	500	0	80	30	200	40
25	375	125	80	30	200	40
50	250	250	80	30	200	40
75	125	375	80	30	200	40
100	0	500	80	30	200	40

Determination of physical properties astextural and color parameters

The textural properties of 10-g steamed chive dumpling sample were determined by using Texture analyzer equipped with crisp fracture supportprobe. The measured values are expressed as softness and stickiness. Five times of measurement were repeated for each sample. The Hunter color parameters (L*, a* and b* values) of the steamed chive dumpling were measured by a Colorimeter (UltraScan VIS s/n: USVIS 1406, USA) in five replicates.

Determination of pasting properties

The pasting properties of mixed flours (non-steamed sample) were monitored by using Rapid visco analyzer (RVA4500,Perten Instruments, Australia).The slurry was pre-heated to 50 °C at a constant rate of 12 °C/min, heated up to 95 °C at a constant rate and then held at 95 °C for 3 min. It was subsequently cooled to 50 °C at a constant rate of 12 °C/min and then held at 55 °C for 2 min. During pasting measurement, viscosity values atpeak viscosity, trough, breakdown, final viscosity and set back of mixed flour samples were recorded. The data were reported as the average of triplicate measurements.

Determination of chemical properties

A whole set of proximate analysis, i.e. moisture content, protein, fat, fiber, ash and carbohydrate, of steamed chive dumpling was examined according to standard methods, as described by AOAC (2000). Each sample was repeated three times.

Determination of microbiological properties

The total plate, and yeast and mold counts were obtained using the pour plate technique on plate count agar and potato dextrose agar, respectively, which are standard methods(AOAC, 2000). The determination of Coliform and *E. coli* was count by Perifilm (3M™) method. Duplicate was done for each dilution. The number of microbial was expressed in colony forming unit per g sample (CFU/g).

Evaluation of sensory attributes

The steamed chive dumpling with filling was served with sweet and sour sauce to the untrained panelists.The sensory attributes were evaluated based on a 9-point hedonic scale for a set ofattributes: flavor, odor, taste, texture and overall liking, where 9 is like extremely and 1 is dislike extremely by 50 panelists.

Statistical analysis

In the study, the data were analyzed and shown as means ± standard deviation (SD). Analysis of variance (ANOVA) was conducted to differentiate between means of all samples at the 0.05 confidence level.

Results and Discussions

Physical properties of steamed chive dumpling made from germinated brown rice flour

The germinated brown rice flour had significant effect on textural properties of the product. An increasing of germinated brown rice flour content from 0 to 100% led to a decreasing of softness (473.13 to 40.10 g) and stickiness values (181.9 to 19.52 g) of the product (**Table 2**). It can be explained that active enzyme in rice works during germination and therefore, the chemical compositionsuch as

polysaccharides, non-polysaccharides and proteinof flour changes (Yang *et al*. 2001) resulting in textural changes of rice-based product.

Table 2 Effect of germinated brown rice flour on physical properties of steamed chivedumpling

Germinated brown rice flour (%)	Textural properties		Color parameters		
	Softness (g)	Stickiness (g)	L*	a*	b*
0	473.13± 1.00^{a}	181.9± 1.00^{a}	49.26±0.06^{a}	-1.36±0.03^{ab}	-7.11±0.15^{d}
25	221.54± 0.95^{b}	87.06± 0.21^{b}	48.63±0.55^{a}	-1.38±0.03^{ab}	-5.76±0.16^{c}
50	209.72± 0.95^{cd}	86.25± 0.21^{b}	46.30±0.52^{b}	-1.33±0.09^{ab}	-3.22±0.08^{b}
75	180.21± 0.95^{d}	76.29± 0.21^{b}	46.38±0.49^{b}	-1.51±0.08^{b}	-3.05±0.22^{b}
100	40.10± 1.00^{e}	19.52± 1.00^{c}	45.91±0.25^{b}	-1.29±0.17^{a}	-2.22±0.17^{a}

The superscripts with the different letters within the same column are significantly different ($p < 0.05$).

As illustrated in **Table 2**, the color of five steamed chivedumpling samples is different because of the germinated brown rice flour content. The L* value (lightness) of steamed chivedumpling with 0% germinated brown rice flour was the highest and it decreased with content of germinated brown rice flour. The a* values (redness) of all samples were negative and comparable values (-1.29 to -1.51), while the b* values (yellowness) increased with content of germinated brown rice flour.

Pasting properties of steamed chive dumpling made from germinated brown rice flour

The pasting properties of mixed flours with germinated brown rice flour were investigated by RVA analysis. It was found that germinated brown rice flourhad an important effect on gelatinization temperature. An increasing of germinated brown rice flour led to a high gelatinization temperature, as shown in **Table 3**.

Table 3 Pasting properties of mixed flours for makingsteamed chive dumpling

Parameters	Germinated brown rice flour (%)				
	0	25	50	75	100
Temperature (°C)	80.00±0.07^{c}	79.97±0.03^{c}	80.25±0.63^{c}	81.85±0.56^{b}	87.97±0.03^{a}
Peak (cp)	4337.50±12.02^{a}	3196.00±18.38^{b}	2450.50±30.40^{c}	1843.50±21.92^{d}	1537.00±19.79^{e}
Trough (cp)	3314.50±96.87^{a}	2737.50±41.71^{b}	2285.50±24.74^{c}	1731.50±20.50^{d}	1291.00±7.07^{e}
Breakdown(cp)	1023.00±108.89^{a}	458.50±23.33^{b}	165.00±5.65^{cd}	112.00±1.41^{d}	246.00±12.72^{c}
Final viscosity (cp)	5973.50±126.57^{a}	4923.00±63.63^{b}	4283.00±55.15^{c}	3436.00±42.42^{d}	2775.50±43.37^{e}
Setback (cp)	2659.00±29.69^{a}	2190.00±28.28^{b}	1997.50±30.40^{c}	1704.50±21.92^{d}	1484.50±40.30^{e}
Peak Time (min)	6.37±0.14^{b}	6.47±0.00^{b}	6.53±0.09^{b}	7.00±0.00^{a}	7.00±0.00^{a}

The superscripts with the different letters within the same row are significantly different ($p < 0.05$).

The mixed flours with 25% and 50% ofgerminated brown rice flour can be identified asmoderate-swelling starch that starch is not completely swelled and has limit to degradation during heating. On the other hand, the mixed flours with 75% and100% ofgerminated brown rice flour can be identified asrestricted-swelling starch. During germination, starch turns to be sugar and therefore, the structure and viscosity of starch changes such as decreasing of swelling and solubility values, and increasing of viscosity while heating (Schoch andMaywald,1968). Besides, the mixed flours also consisted of tapioca and glutinous flours making moderate-swelling starch property. The addition of germinated brown rice flour leads to reduce the viscosity due to active enzymes (i.e., amylase) during rice germination (Palmiano andJuliano, 1972).

Chemical properties of steamed chive dumpling made from germinated brown rice flour

The chemical properties ofsteamed chive dumpling with five different amounts of germinatedbrown rice flour were analyzed and showed in **Table 4**. The moisture, fat and ash contents of all samples were comparable contents (59.26 – 63.93 %, 1.49 – 2.67% and 0.01%, respectively).On the other hand,a higher protein and fiber content was found in the sample with higher germinatedbrown rice flour amount. Thegerminatedbrown rice contains both essential and non-essential amino acids including GABA which is health benefit.

Table 4 The chemical properties of steamed chive dumpling with different germinated brown rice flour contents

Properties (%)	Germinated brown rice flour (%)				
	0	25	50	75	100
Moisture	63.28±0.64^{ab}	60.55±0.65^{bc}	59.26±0.60^{c}	63.93±1.57^{a}	62.40±1.10^{ab}
Protein	2.490±0.09^{c}	2.54±0.03^{c}	2.59±0.01^{bc}	2.71±0.04$^{a\,b}$	2.81±0.02^{a}
Fat	1.49±0.08	1.84±0.29	2.67±0.22	1.52±0.17	1.12±1.13
Ash	0.0130±0.00007^{b}	0.0124±0.00021^{b}	0.0128±0.00021^{b}	0.0144±0.00035^{a}	0.0146±0.00014^{a}
Fiber	1.81	1.83	2.39	4.15	4.8
Carbohydrate	30.90±0.64^{ab}	33.22±0.90^{a}	33.06±0.39^{a}	27.66±1.35^{b}	27.96±2.26^{b}

The superscripts with the different letters within the same row are significantly different ($p < 0.05$).

Sensory evaluation of steamed chive dumpling made from germinated brown rice flour

The steamed chive dumpling made from germinated brown rice flour was subjected to sensory evaluation based on a 9-point hedonic scale for a set ofattributes: flavor, odor, taste, texture and overall liking, where 9=like extremely and 1=dislike extremely by fitty panelists. It was found that the sensory scores of these five steamed chive dumpling samples were no significantly different for all evaluated attributes (**Table 5**).

Table 5 The sensory evaluation of steamed chive dumpling with different germinated brown rice flour contents

Germinated brown rice flour (%)	Sensory attributes				
	Color	Odor	Taste	Texture	Overall liking
0	7.34±0.15^{a}	6.72±0.20	6.76±0.23	6.92±0.24	6.72±0.24
25	6.74±0.19^{b}	6.60±0.21	6.48±0.27	6.36±0.25	6.56±0.21
50	7.00±0.20^{ab}	6.82±0.17	7.16±0.18	6.82±0.27	7.10±0.18
75	6.92±0.19^{ab}	6.54±0.22	6.80±0.23	6.82±0.24	6.94±0.17
100	6.74±0.20^{b}	6.76±0.23	6.74±0.23	6.54±0.26	6.68±0.22

The superscripts with the different letters within the same column are significantly different ($p < 0.05$).

Microbiological properties of steamed chive dumpling made from germinated brown rice flour

The microbial counts(yeast, mold, total bacteria, Coliform and *E. coli*)of the developed samples were examined and found that mold, Coliform and *E. coli* were not observed in all samples, whereas yeast(6×10^{2} - 1.18×10^{3} CFU/g)and total bacteria(300 - 8.80×10^{2}CFU/g) can be counted, as shown in **Table 6**. It can be proofed that the products are safe to consume according toThai Community Product Standard no. 1041/2548 (total bacteria $<1\times10^{6}$ CFU/g and *E. coli* < 3 CFU/g).

Table 6 The microbial counts of steamed chive dumpling with different germinated brown rice flour contents

Germinated brown rice flour (%)	Microbiological properties (CFU/g)				
	Yeast	Mold	Total bacteria	Coliform	*E.coli*
0	9×10^{2}	ND	7.3×10^{2}	ND	ND
25	6×10^{2}	ND	3×10^{2}	ND	ND
50	1.2×10^{3}	ND	8.8×10^{2}	ND	ND
75	8.6×10^{2}	ND	4.7×10^{2}	ND	ND
100	6.2×10^{2}	ND	5.1×10^{2}	ND	ND

The superscripts with the different letters within the same column are significantly different ($p < 0.05$) and ND is meant not detected.

Conclusion

According to the major finding of the work, it can be recommended that the steamed chive dumpling with 100% germinatedbrown rice flour (based on rice flour weight) had high nutritional values (especially protein and fiber contents) as well as provided acceptable properties. The panelists gave comparable sensory scores for alldeveloped products. Also, the product was safe according to the results of microbial counts. However, itis suggested to monitor the self-life of the product under different storage conditions for further study.

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Effects of different kindand concentration of carbon sourceson secondary somatic embryo formation and germination of oil palm (*Elaeisguineensis*Jacq.)

Sakulrat Sanputawong,[1*] Sompong Te-chato[2] and Sorapong Benchasri[3]

Abstract

Somatic embryos (SEs) at the final stages, calledhaustorium embryos (HEs) were obtained from immature zygotic embryo of cross number 7 and 16 of oil palm. HEs were cultured on MS medium supplemented with different kindand concentration of carbon sources. The result reveal that MS medium supplemented with 0.2 M of sorbitol and 200 mg/l ascorbic acid (As) gave the highest secondary somatic embryos (SSEs) at 80% that was obtained from cross number 7. However, cross number 16 gave thebetter average of SSE formation (40%) than cross number 7 (34%). Moreover, cross number 16 gave the higher sets of SSE formation at 16.8SSE/HE with the germination at 63.33% and 18.6 SSE/HE.

Keywords: carbon source, secondary somatic embryo, germination, oil palm

Introduction

Oil palm (*Elaeisguineensis*Jacq.) is important in terms of economy, industry and biofuel. In its productive life time of more than twenty years in plantation, a palm produces about 150 kg (10 bunches x 15 kg) of fresh fruit bunches (FFB) per year and 3 tonnes of FFB over a twenty year period. The oil palm is also a crop species producing high quality oil, which can be obtained from the mesocarp of the fruit (palm oil) and the kernel of the nut (palm kernel oil). The use of palm oil as a biofuel could eventually cause constraints on worldwide supply of edible oil and increase the pressure for higher yield and/or cultivated (Biofuel, 2007). Accordingly, a high yield plant is needed for fuel oil/biodiesel production. Indeed, the large amount of oil produced in the oil palm fruit is the unique biological characteristic of this palm species. The oil palm has only a single growing point, and does not produce suckers like some other palm species, so clones cannot be produced by the common techniques such as cutting, grafting or layering (Corley and Tinker, 2003). Thus it is possible to enhance efficiency for propagation through somatic embryogenesis, especially in vitro culture through zygotic embryo (ZE) culture. The embryo explants are convenient a handle because fruits are readily available, have a high degree of physiological uniformity, and can be shipped for a long distances. To ensure that the parents used for commercial hybrid seed production are not related, oil palm breeders rely on pedigrees of the palms(Te-chato, 1998b)

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There are two types of embryogenesis in plants; zygotic and somatic. Zygoticembryogenesis is one of the most important steps in the life cycle of plants. The processbegins with double fertilization, followed by determination of the three axes of embryos(longitudinal, lateral, and radial) and morphological changes of the embryos (globular, heartshaped,and torpedo-shaped). Subsequently, seed storage proteins accumulate inthe embryos, and finally, the embryos become desiccated and dormant. These processes areregulated by numerous factors, including phytohormones, enzymes, and other substancesrelated to embryogenesis(Laura *et al*., 2012).Somatic embryogenesis is the process whereby either a single somatic cell or clusters of cells develop into differentiated plants through characteristic embryological stages without fusion of gametes. Somatic embryos (SEs) can differentiate either indirectly from callus or directly from cells of an organized structure without an intervening callus phase (Williamsand and Maheswaran, 1986; Uzelac*et al*., 2007). Plant regeneration of oil palm through in vitro culture has been reported by several researchers (Te-chato, 1998a).Various stages of ZE and genotypes of embryos were reported to be successful by inducing somatic embryogenesis (Chehmalee and Te-chato, 2008). Regeneration of oil palm through secondary somatic embryos (SSEs) has also been reported using polyamines (Rajesh *et al*., 2003). However, percentage and number of new forming embryos were limited and germination of those embryos has not been reported.

The purpose of the work is to find different kind and concentration of carbon sources on formation and germination of SSEs. In order to increase the percentage of SSE formation,number SSE/HEandgermination of SSEs. The finding can help solving the problem onlimitationinformation and germination of SSE.

Materials and Methods

Effects of different kind and concentration of carbon sourceson formation and germination of SSE

Haustorium embryos (HEs) of cross number 7 and 16 were carefully isolated and inoculated onhormone-free MS medium supplemented with 200 mg/l ascorbic acid and different kinds of carbon sources such as sorbitol,mannitol, sucrose, glucose and fructose at 0.1 and 0.2 M of concentration. The cultures were placed under light conditions at 25μmolm^{-2}s^{-1}at 14 h photoperiod, and 27±1°C for 2 months. The experimental design was a completely randomized design (CRD) with 5 replicates each replicate consists of 10 embryos. The percentage of secondary somatic embryo (SSE) and number of SSE/HE were recorded and compared among those crosses.TheSSEs of both crosses from different kind and concentration of carbon sources were transferred to hormone-free MS medium supplemented with 3% sucrose and 200 mg/l ascorbic acid. The cultures were maintained underthe same conditions as described earlier. Again, a completely randomized design (CRD) with 5 replicates (each replicate

consists of 10 SSEs) was performed. The percentage of germination and plant regeneration were recorded and compared among the crosses.

Results and Discussions

Formation of secondary somatic embryo (SSE)

HEs cultured on all culture media promotes SSE induction and germination, except MS supplemented with 0.2 M sucrose which resulted indead HE (Fig 1A) andbrowning formed by old HE interrupted the new SSE (Fig 1B). In this experiment, SSEs were originated from the basal (Fig 2A,B) and the surface parts of HEs (Fig 2C,D). Those SSEs were clustered with white opaque characteristic consisted of torpedo-stage embryos (Fig 2).Promchan and Te-chato (2007) and Quiroz-Figueroa *et al*. (2006) reported that SSE arosedirectly from epidermal layer at the basal part of HEs. After 2 months of culture,cross number 16 gave higher result in percentage of SSE induction (80%) and number of SSE/HE (5.03) than cross number 7 (34% and 3.22 SSE/HE, respectively) (Table 1, 2). Sorbitol gave the highest response on SSE induction (40) and number of SSE/HE (9.25) (Table 1, 2). Cross number 16 gave the highest number of SSE formation at 16.8 SSE/HE.

This experiment reveals that different genotype and carbon source gave the different response on SSE induction and number of SSE/HE.Sorbitol was proved to be a better stress agent (waterstress) than polyamine in promoting SSE in both percentage and number.A full-strength MS medium supplemented with 0.2 M sorbitolproduced significantly higher percentage (80 and 73.33) and number of SSE/HE(13.8) which are similar to the results of Te-chato andHilae(2007).

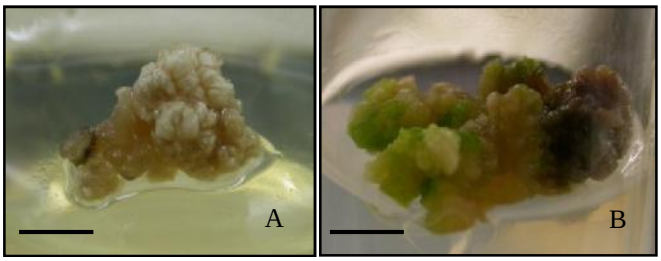

Figure 1 Characteristics of browning formed in old HE interrupted the new SSE after cultured on MS medium supplemented with 3% sucrose, 200 mg/l ascorbic acid and 200 mg/l ascorbic acid for 2 month (bar = 5 mm).

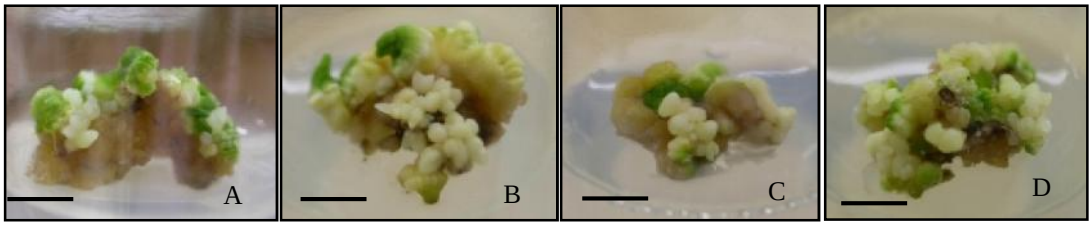

Figure 2 Development of SSE from basal (A,B) and surface (C,D) of HE after being cultured on MS medium supplemented with 0.2 M sorbitol for 2 months (bar = 5 mm).

Table 1 Effect of cross,kind and concentration of carbon sources on percentage of SSE induction from HEs on MS mediumsupplemented with 0.2 M sorbitol and 200 mg/l ascorbic acid for 2 months.

Cross No.	Kind of carbon source	Concentration (M)	SSE induction (%)	Average ofSSE (%)
7	Sorbitol	0.1	66.67	34.00
		0.2	80.00	
	Mannitol	0.1	33.33	
		0.2	53.33	
	Sucrose	0.1	33.33	
		0.2	0.00	
	Glucose	0.1	13.37	
		0.2	26.67	
	Fructose	0.1	13.33	
		0.2	20.00	
16	Sorbitol	0.1	46.67	40.00
		0.2	73.33	
	Mannitol	0.1	33.33	
		0.2	46.67	
	Sucrose	0.1	66.67	
		0.2	0.00	
	Glucose	0.1	26.67	
		0.2	40.00	
	Fructose	0.1	33.33	
		0.2	33.33	

Table2 Effects of crosses, different kind and concentration of carbon source on number of SSE/HE induction from HEs of hybrid tenera oil palm cultured on MS free medium supplemented with 200 mg/l ascorbic acid for 2months.

Cross No.	No. of SSE/HE										Average$^{3}_{Cross}$
	Sorbitol (M)		Mannitol (M)		Sucrose (M)		Glucose (M)		Fructose (M)		
	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2	
7	3.0c	10.8b	5.2c	4.8c	2.2d	0.0e	1.4de	1.2de	2.0d	1.6de	3.22B
16	6.4c	16.8a	3.0d	16a	1.8de	0.0e	1.2de	1.6de	1.8de	2.2d	5.03A
Average$^{1}_{concentration}$	4.7C	13.8A	4.1C	10.4B	2D	0E	1.3DE	1.4DE	1.9D	1.9D	**
Average$^{2}_{carbon\ source}$	9.25A		7.25B		1C		1.35C		1.9C		
											C.V.34.9 %

**: significant different atp≤0.01

[1, 2, 3] Means followed by the same letters in each column and row (capital letters) andcomparison between 3 factors (small letters) are not significantly different by DMRT

Germination of secondary somatic embryo (SSE)

SSEs of different carbon sources and concentration were cultured on an MS free medium supplemented with 3% sucrose and 200 mg/l AS for 3 months. The result revealed that cross number 16 gave the better germination of SSE (39.19%) and embryo/explant (7.84) than cross number 7 (37.42% and 5.26 embryo/explant, respectively) (Table 3, 4). SSE induction from 0.2 M sorbitol gave the highest germination of SSE of both crosses at 63.33% and 58.33% from cross number 16 and 7 (Table 3), respectively. For kind of carbon source, the result revealed that sorbitol gave the highest germination of SSE (13 embryo/explant) than another carbon source. Cross number 16 gave the highest germination of SSE at 63.63% and number of embryos/explantfrom HE cultured on 0.2 M sorbitol at 18.6.Maintenance of SSE on sorbitolcontaining medium was sufficient to stress those SSE ready forgermination. This process might be related to the hydrolysis of food reserves in theendosperm and the mobilization of nutrients required for embryo germinationwas reportedbySarasan (2005).Carbon source is an important factor for induction of SSE because it acts as a stress agent affecting germination and development of SSE (Mamiya and Sakamoto, 2000).Alam*et al*. (2013) reported thatthe combination of genotype and culture medium plays vital roles in somaticembryogenesis induction and plant regeneration. Plants from various genotypes possess different internal hormonalbalances showed different reactions to stimulants that induce somatic embryogenesis.

Table 3 Effect of cross, kind and concentration of carbon sources on percentage of SSE germination of hybrid tenera of oil palm cultured onMS free medium supplemented with 3% sucrose and 200 mg/l ascorbic acid for 3 months.

Cross No.	Kind of carbon source	Concentration (M)	Germination ofSSE (%)	Average ofSSE (%)
7	Sorbitol	0.1	50.00	37.42
		0.2	58.33	
	Mannitol	0.1	40.00	
		0.2	50.00	
	Sucrose	0.1	40.00	
		0.2	0.00	
	Glucose	0.1	50.00	
		0.2	25.00	
	Fructose	0.1	50.00	
		0.2	33.33	
16	Sorbitol	0.1	57.14	39.19
		0.2	63.63	
	Mannitol	0.1	40.00	
		0.2	42.86	
	Sucrose	0.1	50.00	
		0.2	0.00	
	Glucose	0.1	25.00	
		0.2	33.33	
	Fructose	0.1	40	
		0.2	40	

Table4 Effects of crosses, different kind and concentration of carbon sources on number of embryos/explant of tenera oil palm cultured onan MS free medium supplemented with 3% sucrose and 200 mg/l ascorbic acid for 3 months.

Cross No.	No. of embryo (embryo/explant)										Average$^{3}_{Cross}$
	Sorbitol (M)		Mannitol (M)		Sucrose (M)		Glucose (M)		Fructose (M)		
	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2	
7	6.6cde	16.8a	3.2fg	7.4bcd	4.6defg	0h	2gh	2.4gh	4.6defg	5cdefg	5.26B
16	10b	18.6a	8.2bc	16a	5.2cdefg	0h	4.6defg	3.4efg	6cdef	6.4cdef	7.84A
Average$^{1}_{concentration}$	8.30	17.7A	5.7CD	11.7B	4.9D	0E	3.3D	2.9DE	5.3CD	5.7CD	ns
Average$^{2}_{carbon\ source}$	13A		8.7B		2.45D		3.1D		5.5C		
											C.V. 39.64%

ns :Not-significant different

[1, 2, 3] Means followed by the same letters in each column and row (capital letters) and comparison between 3 factors (small letters) are not significantly different by DMRT

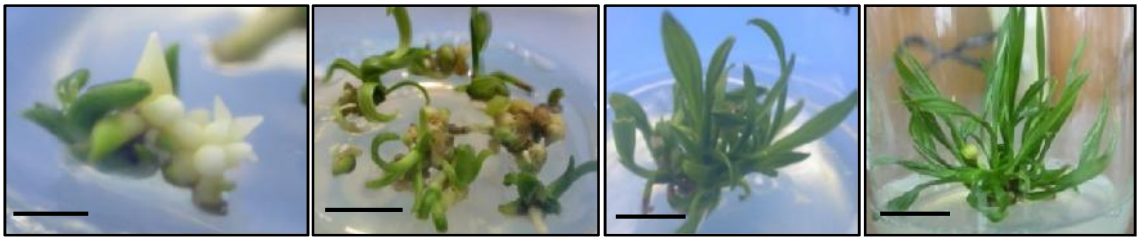

Figure 6 Development of SSE from HE (A) on 0.2 M sorbitol containing MS medium for 1month of culture (bar: 3.25 mm), subsequent germination of SSE (B) on hormone-free MSmedium (bar: 6 mm) for additional 3 months. (C) Multiple shoots. (D) Root without shoot. (E)Complete plantlet.

Conclusions

MS medium supplemented with 0.2 M sorbitol gave the highest induction and germination of SSE from both crosses. SSEs were obtained from 2 months maintenance of HE on sorbitol containing medium subsequently cultured onPGR-free MS medium. Different genotypes gave different response on the percentage of cultures producing SSE, SSE/HE and germination of SSE.

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Consumer Study of Mulberry Wine Fermented by *Saccharomyces* Yeast Co-Inoculation

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Abstract

The objective of this present study was to examine consumer preference and consumption behavior of mulberry wine fermented by two different inoculation protocols, namely *Saccharomyces* single strain inoculation and *Saccharomyces* yeast co-inoculation. Mulberry wines displayed pH values of 3.67 to 3.71, while titratable acidity values were 6.6 and 6.8 g/L in fermentations of single strain and co-inoculations, respectively. Single strain yeast culture produced alcohol content slightly less than the mixed culture of co-inoculation. Mulberry wines from the different yeast inocula were subjected to testing by 200 consumers in the Bangkok metropolitan region, Thailand. Slight differences in the overall liking factor were found. This study demonstrated that the yeast inocula used to conduct fermentation affected consumer acceptance. Consumers tended to prefer mulberry wine fermented by co-inoculation to single strain inoculation, revealing that 55% of consumers were interested in purchasing of mulberry wine fermented with the co-inoculation technique. These results are particularly useful for fruit wineries since they are able to produce the relevant taste of fruit wine with an enhancement of consumer acceptability.

Keywords: Mulberry Wine, Consumer Analysis, Fruit Wine

Introduction

Over the last decade, the fruit wine industry in Thailand has much improved in quality and many efforts have been made in the fruit wineries resulting in many high quality fruit wines launching into the market. As imported wines become more competitive, Thai marketers constantly strive to differentiate home-grown brands to consumers in ways that are crucial to their success.

Wine is a highly complex mixture of aroma and flavor compounds arising from three major sources, i.e. the grape berry, microbes and oak wood. To date, more than 800 volatile compounds have been indentified in wine [1]. The grape-derived compounds provide wine basic structure with varietal distinction while yeast and bacteria fermentation produce a wide range of metabolites, e.g. ethanol, ester, higher alcohols, carbonyls, volatile fatty acids and sulfur compounds which give wine specific aroma and flavor profile [2-4]. The oak wood is introduced to wine in the form of free-floating oak chips or as wood sticks added into wine in a fermentation vessel, fermentation in oak barrel and aging in oak barrel [5]. The use of oak plays a significant role in winemaking as a number of constituents are extracted from the wood, and become part of the wine in both its bouquet and taste [6]. To obtain desirable sensory profile, the winemakers utilize a variety of oenological technologies to produce wines, including yeast inoculation

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protocol. The use of different wine yeast strains and inoculation protocols for grape winemaking has been widely studied and thus winemakers in these countries can readily identify appropriate manner for their wines. However, there are many problems encountered by fruit winemakers that require solutions to improve fruit wine quality. Unfortunately, there is little research on fruit wines, particularly the influence of mixed cultures starter and inoculation protocols on fruit wine flavor.

Mulberry is a fruit berry possessing attractive color and flavor for fruit winemaking. Red fruit wine produced from mulberry is now available in modern trade in Thailand. Nonetheless, there are many aspects that have not yet been studied in order to meet consumer acceptability. Recently, some sensorial and chemical properties of mulberry wine fermented with mixed yeast cultures was studied [7]. The authors reported that different inoculation protocols influenced the mulberry wine sensory quality only on the overall impression of character using sensory analysis of 15 trained panelists. According to Faye et al. [8], nowadays, sensory research increasingly focuses on how to better understand consumer perception. For this purpose, understanding the importance of customer acceptance testing is essential to making the right decisions for wine and fruit wine products. Wine consumer research has mainly focused on assessing the impact of sensory quality differences on preferences of wine consumers for certain aspects, e.g. varieties [9-10], categories of commercial wines [11], wine selection [12], purchase decision [13], optimization of blended wine quality [14], brand and country of origin [15-16]. This study attempted to investigate the effect of the wine yeasts used to conduct fermentation on the response of consumer acceptance to mulberry wines.

Materials and Methods

Mulberry and winemaking

Mulberry obtained from CY Boss Winery was used for fermentation by two different inoculation protocols, namely *Saccharomyces* single strain inoculation and *Saccharomyces* yeast co-inoculation. Yeast strains were derived from the collection of the Section of Microbiology and Biochemistry, Hochschule Geisenheim University, Germany. The fruit winemaking was carried out according to Chomsri et al. [7]. The juice was inoculated with 24 h pre-culture to obtain an initial level of $1x10^6$ cells/ml. The fermentation trials were performed at 20 ± 2 ^{o}C.

Chemical analyses

Total soluble solid was determined byrefractometer (Atago Model N-1a, Japan). pH was measured by a pH meter (Model C831, Consourt, Belgium). Total acidity was determined by titrimetric method [17]. Ethanol concentration was measured by ebulliometer [17].

Consumer test

Consumer acceptance testing was carried out on two mulberry wines fermented with different yeast inoculation protocols. Consumers were approached in retail liquor stores and modern trade stores across the Bangkok metropolitan region, Thailand. Selection and exclusion criteria were as follows: age between 20 and 60+ years; used to drink wine or fruit wine. Testing occurred in the retail liquor stores and modern trade stores immediately following recruitment [18]. In total, 200 consumers participated in the testing. Mulberry wines (50 mL) were served at approximately 22-25 ^{o}C, in tasting. Consumers were required to rate their liking for each wine on a hedonic five-point category scale from 'dislike very much' to 'like very much'. Paper score-sheet was used for data collection in this study.

Statistical analysis

Chi-square and Student's t-tests were a statistical test used to compare observed data. Statistical significance was assigned as $p \leq 0.05$.

Results and Discussion

Mulberry winemaking

All wine fermentations were completed successfully regarding to initial and terminal concentrations of reducing sugars and alcohol content obtained in the mulberry product (data not shown). Target concentration of reducing sugars is typically less than 2 g/L [19]. The rate of sugar consumption of single strain inoculation (6.73 g/l/d) was faster than co-inoculation (4.37 g/l/d). The results of this study differed from previous study, which reported that the mixed culture in co-inoculations completed fermentation faster than the single-strain culture [11]. This may be due to the fact that substrate, yeast strains, and fermentation condition used in the study could affect fermentation behavior. Furthermore, other factors such as yeast interaction and proportion of inoculated yeast could also affect the fermentation profile [20-21]. Standard chemical analyses of the mulberry wines showed the pH values of 3.67 to 3.71, while titratable acidity values were 6.6 and 6.8 g/L in the products obtained from single strain and co-inoculations, respectively. There was a slight difference in alcohol concentrations of the mulberry with fermented by single strain (13.6 v/v) and co-inoculations (14.0 v/v). Mulberry juice (mulberry must) fermented with single strain and co-inoculations produced dark-colored red fruit wine (Figure 1).

Figure 1 Mulberry wine produced by single strain (V1) inoculation and co-inoculation (V1/GH)

Socio-demographics

Table 1 shows the demographic information of participants. Two hundred (47.5% male and 52.5 female) participants were recruited. Age of consumers ranged from 20 to 60+ years, while the ages were relatively well distributed from 20 to the 45 years with an average value of 33 years. The majority of consumer age was between 31-35 years. Regarding education, the highest number was holders of a bachelor's degree followed by high vocational/diploma, high school not completed and high school graduate/vocational, respectively. Consumers were predominantly employees in relation to profession. Consumer income based on Thai Baht, the majority of consumers earned an income below THB 10,000 and there was a relatively even spread of consumers across income categories from the below THB 10,000 category to the THB 10,000- THB 20,000 category. These demographic characteristics of the consumers serve as one of the bases for further data analysis.

Table 1 Socio-demographic characteristics of the sampled population (N=200)

Characteristic	Number of respondents	Percent
Gender		
Male	95	47.5
female	105	52.5
Age		
20 - 25	39	19.4
26 - 30	43	21.4
31 - 35	59	30.0
36 - 40	18	9.2
41 - 45	24	12.0
46 - 50	4	2.0
51 - 55	6	3.0
56 - 60	2	1.0
60+	4	2.0

Education		
High school not completed	42	21.1
High school graduate/vocational	29	14.7
High vocational/diploma	53	26.3
Bachelor's degree	66	32.6
Bachelor's degree+	8	4.2
Others	2	1.1
Profession		
Students	8	3.8
Business	4	1.9
Employees	156	78.0
Househusbands/Housewives	10	5.0
Government officers/State employees	15	7.5
Others	8	3.8
Monthly Income		
Under THB 10,000	88	44.2
THB 10,001- THB 20,000	74	36.8
THB 20,001- THB 30,000	4	1.8
THB 30,001- THB 40,000	7	3.7
THB 40,001- THB 50,000	15	7.4
Over THB 50,000	12	6.1

Frequency of wine consumption

According to Bruwer et al. [22], wine consumers can be split into two main groups, namely regular and in frequent drinkers. There is no universal standard for denoting wine consumption frequency and this means that wine consumption is therefore very much country-specific. In this study, consumers mostly drank wine or fruit wine at least once a week (61%), while 1.2 % did so at least over 7 times a week (Table 2). In most instances, the 'at least once a week' consumer was regarded as a regular wine drinker, e.g. in the UK, USA, and Australia[22]. On analyzing this finding on wine consumption frequency, it emerged that Thai wine and fruit wine consumers fell into this category. In contrast, many of respondents in other studies indicated that they consumed wine a few times a week [11-12, 22-25].

Table 2 Normal wine/fruit wine consumption frequency of the wine/fruit wine consumer

Consumption frequency	Percent	Cumulative Percent
Once a week	61.4	61.4
2-3 times a week	33.7	95.2
4-5 times a week	1.2	96.4
6-7 times a week	2.4	98.8
Over 7 times a week	1.2	100.0

Attitudes towards mulberry wine

Consumers were asked to rate their liking for each mulberry wine on a 5- point hedonic scale ranging from 'dislike very much' to 'like very much'. The mulberry wines were rated in a preference by consumers had average scores in all sensory attributes of 3.40-3.62 indicating they relatively liked the fruit wine moderately (Figure 2). Mean hedonic scores of the fruit wine fermented with single strain inoculation ranged from 3.40 to 3.56 scores and with co-inoculation from 3.57 to 3.62 scores. However, standard deviations of mean scores were relatively high about 1 scale unit for both samples, indicating there was a broad range of consumer opinions. The results of the consumer acceptance testing revealed that wine and fruit wine-drinking consumers differed in their liking for the mulberry wines, resulting from the effect of the yeast inocula used to conduct fermentation on the sensory properties of the mulberry wines. Student's *t*-tests reveal that the mulberry wine fermented with co-inoculation was on average significantly more appreciated than the mulberry wine fermented with single strain inoculation.

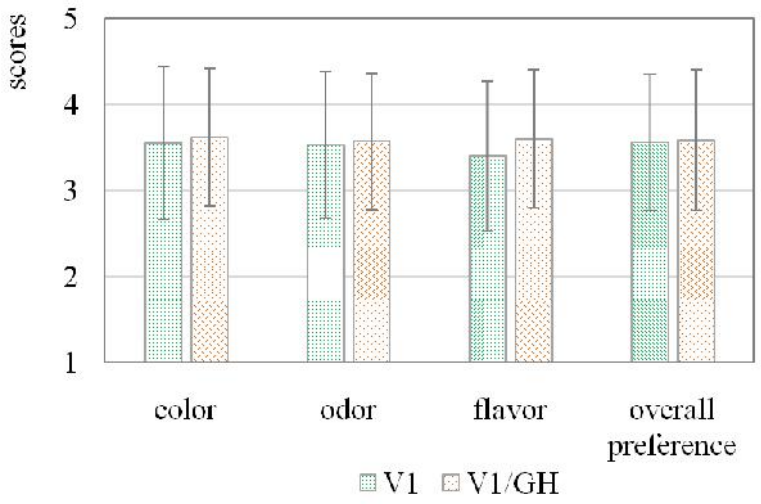

Figure 2 Mean hedonic scores for mulberry wine fermented with single strain inoculation (V1) and with co-inoculation (V1/GH)

The research explored whether any relationships exist between purchase decision of mulberry wine produced by co-inoculation technique and the sensory attributes. The statistics show significant differences ($p \leq 0.05$) in purchase decision for odor and overall acceptance (Table 3). An impact of metabolites generated during fermentation and maturation of wine fermented by co-inoculation yeast on wine quality and consumer preference was reported [11, 26-27]. For example, wine produced by mixed yeast fermentation generated different contents of metabolites, e.g. acetates, ethyl esters of fatty acids and higher alcohols, exhibiting more complex chemical profile of fruity notes, fatty notes and sweet notes. This may also be the reason for the buying decision of mulberry wine fermented with co-inoculation in this study.

Table 3 X^2-test for sensory attributes of mulberry wine fermented with co-inoculation and buying decision.

Sensory attributes	X^2	df	sig
Color	15.78	9	0.072
Odor	37.28	12	0.000*
Flavor	12.90	9	0.166
Overall acceptance	29.36	12	0.003*

* significant level at $p \leq 0.05$

Wine purchasing

Participants were also asked to select one of five possible consumer's purchase choice. The majority of Thai wine and fruit wine consumers in this study proposed the product brand for buying decision, followed by the product image, while label and production region were less considered (Table 4). In comparison to Korean and Australian wine consumers, price and production region were more important than brand [25].

Table 4 Factors involved in choosing wine/fruit wine of consumer

Consumer's purchase choice	Percent	Cumulative Percent
Image	23	23
Brand	37	60
Label	3	63
Price	15	78
Production region	4	82
Others	18	100

These findings reveal that respondents were more likely to buy mulberry wine fermented with co-inoculation (55%) than mulberry wine fermented with single strain inoculation (49%) as shown in Figure 3. Taking into account, purchase intention of respondents related to many factors, e.g. consumption behavior, purchasing behavior, social desirability, hence, it is important to point out that these factors play an important role on participant responses [28-29].

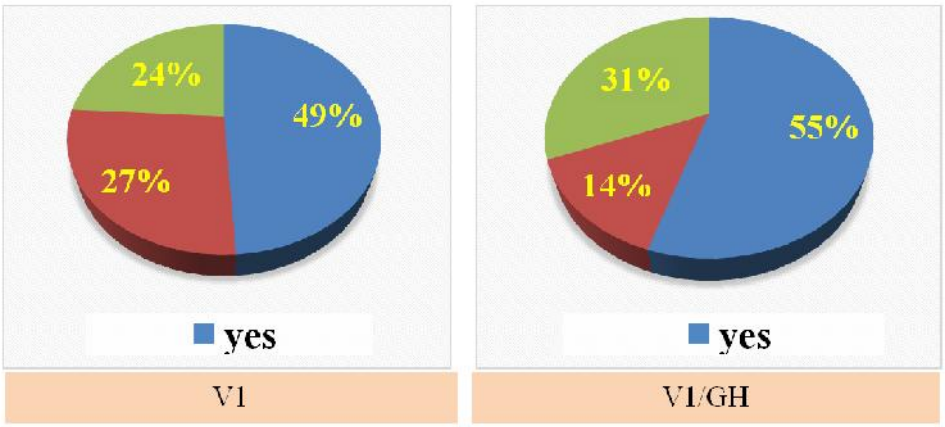

Figure 3 Purchase decision of mulberry wine fermented with single strain inoculation (V1) and with co-inoculation (V1/GH)

These results are particularly useful for fruit wineries since they are able to produce the relevant taste of fruit wine with an enhancement of consumer acceptability. The results are also beneficial to marketers and entrepreneurs as there are few studies that compare different aspects of mulberry wine. This work raises the importance of the consumer test as a helpful piece of information for Thai fruit wineries to maximize their marketing appeals to the beverage population segment.

Conclusion

As an exploratory study on mulberry wines with Thai consumers, this work reveals interesting results. Utilization of single strain and co-inoculation fermentation in mulberry wine making seems to influence on sensory attributes of consumer's responses. The characteristics of preference or liking of the fruit wines enable fruit winemakers to modulate fruit wine styles based on the optimal choice of yeast inoculation protocols. The study highlights the importance of consumer research in evaluation of the impact of winemaking treatments on fruit wine quality. To confirm the hypothesis, chemical analyses to identify key compounds in mulberry wine potentially responsible for driving consumer preference should be the further case study.

Acknowledgements

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Stability Analysis of Six Super Sweet Corn Cultivars under Chemical and Organic Fertilizer Growing Systems

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Abstract

The research aimed to evaluate the stability of six super sweet corn cultivars viz. Hibrix#3, Topsweet#801, Sugar#75, Sugarstar, Aurora, and Insee#2. They were planted at Faculty of Agriculture and Natural Resources, Rajamangala University of Technology Tawan- ok, Chonburi province in 5 environments: organic, chemical, chemical + organic fertilizer grown in the first season (December 2010 – March 2011), and organic and chemical fertilizer grown in the second season (April – June 2011). In each environment, randomized complete block design (RCBD) with 4 replications was used. After having homogeneity test for error variances, combined analysis of variance was performed and showed that the two important characters (ear length and kernel sweetness) were significant ($P < 0.01$) for the effect of genotype x environment interaction. Stability parameters were analyzed for these characters using Eberhart and Russell model, which defined cultivars with positive phenotypic index ($P_i > 0$), regression coefficient around unity ($b_i = 1$), and deviation from regression value around zero ($S^2_{di} = 0$) were considered highly stable. The results revealed that Topsweet#801 showed high stability in ear length. For kernel sweetness, Sugarstar possessed high stability, whereas Topsweet#801 had positive phenotypic index ($P_i > 0$) but its regression coefficient was more than 1 ($b_i > 1$), thus it would be classified as suitable for rich environments.

Keywords: *Zea mays saccharata*, stability, genotype-environment interaction

Introduction

Super sweet corn (*Zea mays* L. *saccharata* (Sturtev.) L.H. Bailey) (Porcher, 2005) is one of the most important vegetable grown in Thailand. Planting areas of super sweet corn in Thailand in 2013 are approximately 33,218 ha (Department of Agricultural Extension, 2014). Super sweet corn is generally named for shrunken-2 types that have more sugar content than sugary types, which are commonly called as normal sweet corn or sweet corn (Lerner and Dana, 2001). Yellow variety super sweet corn has significant levels of phenolic flavonoid pigment antioxidants such as β-carotenes, lutein, xanthins and cryptoxanthin pigments along with vitamin A. 100 g fresh kernels provide 208 IU of vitamin A, 0.20 mg Thiamine, 0.06 mg Riboflavin, 1.70 mg Niacin,6.8 mg Ascorbic Acid and 0.06 mg Vitamin B_6 (Maynard and Hochmuth, 2007).

Crop cultivars with different genotypes generally have high yield performance or other characters if they were planted in suitable or rich environments, but they may give high or low yield in

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diverse environments since each cultivar may have different response to each environment. Genotype-environment interaction is definitely significant in the development and evaluation of plant cultivars, because it affects yield performance of plant cultivars grown under various environments (Hebert *et al*., 1995; Detios *et al*., 2006). It also provides information about the effects of different environments on cultivar performance and plays a key role for assessment of performance stability of the breeding materials (Moldovan *et al*., 2000). The concept of stability has been evaluated in several aspects and through several biometrical methods (Lin *et al*., 1986; Crossa, 1990). Eberhart and Russell (1966) proposed the model that has been widely used to study stability parameters. They defined a stable cultivar as having unit regression over the environments and minimum deviation from regression. Therefore, a cultivar with high mean yield over the environments, unit regression coefficient (b=1) and deviation from regression as small as possible (S^2_{di}= 0), will be considered as a stable cultivar. To study stability of genotypes the multilocational trials over a number of years are conducted. Sometimes the unilocational trials can also serve the purpose provided different environments are created by planting experimental material at different dates of sowing, using various spacings and doses of fertilizers and irrigation levels etc. (Tehlan, 1973; Luthra *et al*., 1974; Ottai *et al*., 2006). Because of the important roles of genotype-environment interaction on crop production and plant breeding program, thus stability parameters have been widely studied in various crops (Babic *et al*., 2006; Karadavut *et al*., 2010; Biswas *et al*., 2012) including super sweet corn (Cordea *et al*., 2011; Ardelean *et al*., 2012).

Since the trend of organic and low input farms in growing plants has widely interested recently. Thus, apart from the natural environmental variables (seasons and places), this study purposes to determine stability of six super sweet corn hybrid cultivars under chemical and organic fertilizer growing systems.

Materials and Methods

Materials: Six super sweet corn hybrid cultivars namely Hibrix#3, Topsweet#801, Sugar#75, Sugarstar and Aurora were obtained from seed companies (markets), and Insee#2 from National Corn and Sorghum Research Center.

Experimental application: The seeds of six sweet corn cultivars were sown at the experimental field of Department of Plant Production Technology, Faculty of Agriculture and Natural Resources, Rajamangala University of Technology Tawan- ok, Chonburi province during December 2010 – March 2011 and April – June 2011 in the first and the second season, respectively. They were conducted in randomized complete block design (RCBD) with 4 replications. Each experimental unit (plot size) was 1 × 3 m^2, 2 rows per plot, with 25 × 75-cm spacing (plant × row), 24 plants per plot (1 plant/hill). The experiment was repeated for five modified environments divided into two successive seasons as the following.

Environment 1: organic fertilizer (cow dung 43.75 ton/ha) in the first season.

Environment 2: chemical fertilizer (500 kg/ha of 15N-15P-15K and 187.5 kg/ha of 46N-0P-0K) in the first season.

Environment 3: organic fertilizer (cow dung 21.87 ton/ha) + chemical fertilizer (500 kg/ha of 15N-15P-15K and 187.5 kg/ha of 46N-0P-0K) in the first season.

Environment 4: organic fertilizer (cow dung 43.75 ton/ha) in the second season.

Environment 5: chemical fertilizer (500 kg/ha of 15N-15P-15K and 187.5 kg/ha of 46N-0P-0K) in the second season.

Data were recorded for plant and ear characters (averaged from10 plants and 10 ears per plot, respectively), un-husked and husked ear yield/hectare (calculated from un-husked and husked ear weight per plot, respectively). Homogeneity tests of error variance of all environments were determined using Bartlett' test (Little and Hills, 1978). Combined analyses were performed only for characters with having homogeneity of error variance (stem diameter, un-husked and husked ear weight, ear length (husked), un-husked and husked ear yield/hectare and kernel sweetness) to investigate genotype-environment interactions (McIntosh, 1983). Stability parameters were calculated for characters possessing significance of genotype-environment interaction according to the model of Eberhart and Russell (1966) as illustrated by Sharma (2008) and Singh and Chaudhary (2012).

Note: The present study was intended to determine the stability of each super sweet corn cultivar only. The study on cultivars and environments comparisons was separated to another report.

Results and discussion

Combined analysis of variance:

Homogeneity of variance for all five environments was detected in un-husked ear weight, husked ear weight, ear length and stem diameter, whereas un-husked and husked ear yield per ha and kernel sweetness were discovered the homogeneity of variance under four environments. Thus, combine analyses were performed according to these characters under five and four environments, respectively. Cultivar-environment interactions were significant for ear length ($P < 0.05$) and kernel sweetness ($P < 0.01$). The combined analyses of variance for these characters were shown in Table 1 and 2.

Table 1: Analysis of variance for six super sweet corn hybrid cultivars under five environments having homogeneity of variance.

Source of variance	df	Mean Square			
		Un-husked ear weight (g)	Husked ear weight (g)	Ear length (cm)	Stem diameter (cm)

Cultivars (C)	5	47,491.98**	26,008.92**	17.49**	0.14*
Environments (E)	4	46,758.11**	20,696.75**	2.36	7.13**
Rep. in Environments	15	1,903.72	1,044.71	0.55	0.02
C x E	20	1,375.10	732.70	1.04*	0.07
Error	75	1,207.66	679.88	0.52	0.04

*Significant at $P < 0.05$, **significant at $P < 0.01$.

Table 2: Analysis of variance for six super sweet corn hybrid cultivars under four environments having homogeneity of variance.

Source of variance	df	Mean Square		
		Un-husked ear yield (kg/ha)	Husked ear yield (kg/ha)	Kernel sweetness (°Brix)
Cultivars (C)	5	52,592.28**	27,978.40**	1.22
Environments (E)	3	130,358.72**	62,377.76**	59.71**
Rep. in Environments	12	3,060.11	1,237.85	0.19
C x E	15	3,024.90	2,374.39	0.66**
Error	60	3,353.86	2,352.39	0.16

**Significant at $P < 0.01$.

Stability analysis:

The pooled analysis of variance elucidated by Eberhart and Russell (1966) was conducted for ear length and kernel sweetness as shown in Table 3. The results indicated that cultivars x environments were significantly different ($P < 0.05$) for both characters, implied that these cultivars had different genetic background and environments used (organic and chemical fertilizers) had different effects on plant cultivars, which resulted the expression of the characters. The significance of e (linear) for both characters indicated that variation among environments was linear. A linear environmental variance would signify unit changes in environmental index for each unit change in the environmental conditions (Sharma, 2008). Cultivar-environment (linear) interaction was significant ($P < 0.01$) for kernel sweetness, which revealed that there were genetic differences among genotypes for their regression on the environmental index. Pooled deviation from regression was detected for ear length ($P < 0.05$), suggested that performance of different cultivars fluctuated significantly from their respective linear path of response

to environments. However, on the analyzing of the individual cultivar fluctuation from linearity, only the two cultivars Sugar#75 and Sugarstar fluctuated significantly ($P < 0.05$). Insignificant pooled deviation for kernel sweetness signified that all cultivars were close to linear response (Table 3).

Table 3: Pooled analysis of variance for six super sweet corn hybrid cultivars under five and four environments, according Eberhart and Russell's model.

Ear length (5 environments)			Kernel sweetness (4 environments)		
Source of variance	df	MS	Source of variance	df	MS
Cultivars (C)	5	4.372**	Cultivars (C)	5	0.304**
Environments (E)	4	0.589	Environments (E)	3	14.927**
C x E	20	0.261*	C x E	15	0.165*
E + (V x E)	24	0.316	E + (V x E)	18	2.626**
E (linear)	1	2.356**	E (linear)	1	44.782**
C x E (linear)	5	0.219	C x E (linear)	5	0.366**
Pooled deviation	18	0.231*	Pooled deviation	12	0.054
Hibrix#3	3	0.121	Hibrix#3	2	0.111
Topsweet#801	3	0.328	Topsweet#801	2	0.001
Sugar#75	3	0.399*	Sugar#75	2	0.050
Sugarstar	3	0.457*	Sugarstar	2	0.041
Aurora	3	0.037	Aurora	2	0.002
Insee#2	3	0.043	Insee#2	2	0.115
Pooled error	90	0.131	Pooled error	72	0.041

*Significant at $P < 0.05$, **significant at $P < 0.01$.

Stability parameters:

Ear length: Topsweet#801 had the highest positive phenotypic index (P_i) for ear length, regression coefficient around 1.0 ($b_i = 0.81$), and small deviation from regression (not different from zero), thus it was consider as a stable cultivar (Table 4). Phenotypic index is greatly useful to facilitate identification of poor (negative P_i) and highly potential (positive P_i) genotypes without referring every time to genotypic mean (Sharma, 2008). Regression coefficient for ear length (b_i), which was the linear regression of the performance of each cultivar under different environments on the environmental means over all the genotypes (Singh and Chaudhary, 2012), ranged from 0.04 to 1.95. The great variation in regression coefficient indicates the different responses of cultivars to environmental changes (Akcura *et al*., 2005). Sugarstar also had highly positive phenotypic index and regression coefficient around 1 ($b_i = 0.72$), but

its deviation from regression was significantly different from zero (S^2_{di} = 0.457). The higher value of S^2_{di} signified that there was high sensitivity to environmental changes, thus this cultivar quite gave high performance when environmental conditions were conductive (Arshad *et al*., 2003). Zubair et al. (2002) also suggested that if regression coefficients of the genotypes are not significantly different from 1, the stability of these genotypes should be judged upon other two parameters i.e. genotypic mean (as used by phenotypic index; P_i in this study) and the value of deviation from regression (S^2_{di}).

Kernel sweetness: Sugarstar was considered as a high stable cultivar for kernel sweetness because it had high phenotypic index (P_i = 0.46), regression coefficient equal to the unity (b_i = 1.18) and small deviation from regression (S^2_{di} = 0.041) (Table 5). Topsweet#801 also had positive phenotypic index for kernel sweetness but its regression coefficient was significantly more than 1.0, thus it would be classified suitable for rich environments. Whereas Aurora was considered suitable for poor environments since its regression coefficient was significantly less than 1.0.

Table 4: Stability parameters estimated for ear length of six super sweet corn hybrid cultivars under five environments.

Cultivars	Mean ear length (cm)	Phenotypic index (P_i)	Regression coefficient (b_i)	Deviation from regression (S^2_{di})
Hibrix#3	20.53	0.46	0.04	0.121
Topsweet#801	21.03	0.97	0.81	0.328
Sugar#75	19.71	-0.35	0.79	0.399*
Sugarstar	20.69	0.63	0.72	0.457*
Aurora	20.00	-0.07	1.78	0.037
Insee#2	18.42	-1.64	1.95	0.043
Mean	20.06			

*Significantly different from 0 at $P < 0.05$.

Table 5: Stability parameters estimated for kernel sweetness of six super sweet corn hybrid cultivars under four environments.

Cultivars	Mean kernel sweetness (°Brix)	Phenotypic index (P_i)	Regression coefficient (b_i)	Deviation from regression (S^2_{di})
Hibrix#3	13.08	-0.22	0.92	0.111
Topsweet#801	13.52	0.22	1.14**	0.001
Sugar#75	13.11	-0.20	0.75	0.050

Sugarstar	13.76	0.46	1.18	0.041
Aurora	13.13	-0.17	0.76**	0.002
Insee#2	13.22	-0.09	1.25	0.115
Mean	13.30			

**Significantly different from 1.0 at $P < 0.01$.

Eberhart and Russell (1966) emphasized that both linear (b_i) and non-linear (S^2_{di}) components of genotype-environment interaction are necessary for judging the stability of a genotype. A regression coefficient approximately 1.0, along with deviation from regression equal to zero and positive phenotypic index, indicated average stability (Sharma, 2008). Genotypes with regression values above 1.0 were classified as high sensitivity to environment change (below average stability) and great specificity of adaptability to rich environments. A regression coefficient below 1.0 provides a measurement of greater resistance to environmental change (above average stability). Cultivars with this value were considered having high adaptability to poor environments (Wachira *et al*., 2002).

Environmental index (I_j):

Environmental index directly reflects the poor or rich environment in terms of negative and positive I_j, respectively. For ear length, environment 3 (organic + chemical fertilizer, 1st season) had the highest and positive environmental index of 0.33 (Table 6), thus it was the favorable environment. Whereas, environment 4 (organic fertilizer, 2nd season) was the most favorable for kernel sweetness (Table 7).

Table 6: Environmental mean ($\bar{e}$) and Environmental index (I_j) for ear length of six super sweet corn cultivars.

	Ear length (cm)					
	Env.1	Env.2	Env.3	Env.4	Env.5	Mean
Environmental mean ($\bar{e}$)	19.99	20.23	20.39	19.56	20.14	20.06
Environmental index (I_j)	-0.07	0.17	0.33	-0.50	0.08	0.00

Table 7: Environmental mean ($\bar{e}$) and Environmental index (I_j) for kernel sweetness of six super sweet corn cultivars.

	Kernel sweetness (°Brix)				
	Env.1	Env.2	Env.4	Env.5	Mean
Environmental mean ($\bar{e}$)	12.87	11.40	14.53	14.49	13.32

Environmental index (I_j)	-0.45	-1.93	1.21	1.17	0.00

Conclusions:

Among the studied characters of the six cultivars grown in five environments under chemical and organic fertilizer growing systems, only ear length and kernel sweetness were found significance of cultivar-environment interaction. The results from stability parameters for ear length revealed that Topsweet#801 was the most stable cultivar, and Sugarstar was considered as a sensitive cultivar suitable for favorable environmental conditions. For kernel sweetness, Sugarstar was a stable cultivar recommended for a wide range of environments, whereas Topsweet#801 was classified suitable for rich environments.

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Process development of KanomJak

Orawan Oupathumpanont[1*]

Abstract

The research aim to develop KanomJak process by using prototype machine that has two parts. The oven part included mold and heating coil and the smoke generator part. In the oven part, temperature and time were studied for cooking at each 2 level 150, 180 degree Celsius and 10, 15 min respectively. In the smoke generator part, smoked time was studied at 3 level 10, 20 and 30 min. Experimental Design was factorial in CRD. The result indicated the optimum temperature and time that consistently cooked was 180 degree Celsius 15 min and smoked 30 min had highest liking score in appearance, tobacco aroma, tobacco flavor and overall liking ($p \leq 0.05$). Acceptance testing of KanomJak form develop process showed that the liking score in appearance, tobacco aroma, tobacco flavor, softness and overall liking and manufacturer acceptedthe developed process.. The shelf life of KanomJak that packed in vaccum bag was 8 days.

Keywords : Development, Process, KanomJak

Introduction

KanomJak istraditional Thai snack that very popular. The ingredient were sticky rice flour, coconut sugar, grated coconut, coconut milk and salt. Some formula were added vegetative oil for improving softness and oiliness. In the traditional process, all ingredients were mixed together then after that wrapped by tobacco leave and grilled on stove until cooked. Tobacco leave made a specific flavor in KanomJak.The problems of traditional process were (1)Carry problem because after grilled process, the tobacco leave were crisped and broken. (2) Short shelf life because when the tobacco leave were crisped and broken, it could be contaminated easily.The shelf life was refer to quality and safety of product and packaging can often help control or extend shelf life.(3) Cancer risk because KanomJak had vegetative oil in formula, when fat drips onto hot coals, creating smoke that contains polycyclic aromatic hydrocarbons, toxic chemicals that have been associated with increased of cancer.(4) Destructive nature, because a lot of tobacco leave were cutfor packing. In addition, packaging was a one marketing strategy but the packaging of KanomJak could not used for this duty. From those problems, there were concept in process development of KanomJak. This research focused on study the optimum process by using prototype machine and prolong the shelf life by using vacuum packing technique.

This research was designed the prototype machine(show in Fig. 1) for develop KanomJak process because the quality of these processed food products are significantly affected by the processing equipment (Chung*et al*., 2013). The prototype machine had two parts, the first was oven that included

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mold and heating coil for forming and cooking. Another was smoke generator part. In this part had heating coil and blower were used to burn tobacco leave for smokeKanomJak.Accordingly, this research focused on studying the optimum temperature and time for operation of the oven and studying the optimum smoked time of smoke generator part. Then the quality of KanomJak from the prototype machine were analyzed. Finally consumer acceptance and process acceptance of manufacturer were evaluated.

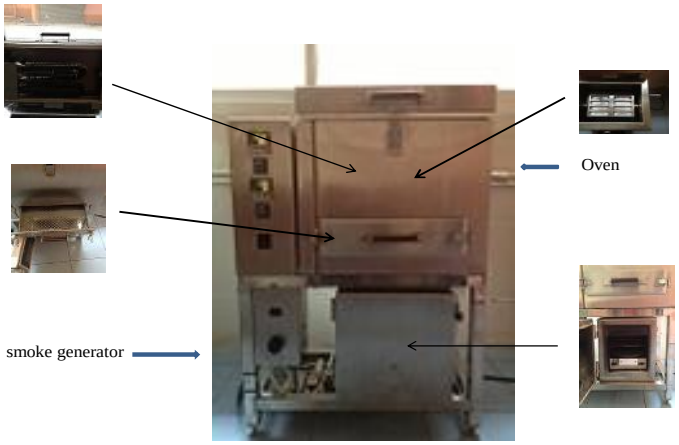

Figure 1 The prototype machine for KanomJak

Materials and Methods

1.Process Development by using Prototype machine

In the oven part, studiedthe optimum temperature and time for operation the oven.In smoke generator, smoking time was selected to study. For experimental, temperature, time for cooking and smoking time was varied at 150 and 180 degree Celsius, 10 and 15 min and 10, 20 and 30 min, reapectively. The 2x2x3 factorial design was employed to investigate the influence of temperature, time and smoking time on the qualities of KanomJak. There were 12 treatment (shown in Table 1). Two replications of each condition were performed. The data were subjected to analysis of variance (ANOVA) using general linear model procedure. SPSS for Window Version 17.00. Means comparison was performed using Duncan's Multiple Range Test (DMRT). The process flow by the prototype machine for this research is shown in Fig 2.

Table 1 A number of treatment

treatment	Temperature (°C)	time for cooking (min)	smoking time (min)
1	150	10	10
2	150	10	20
3	150	10	30
4	150	15	10
5	150	15	20
6	150	15	30
7	180	10	10
8	180	10	20
9	180	10	30
10	180	15	10
11	180	15	20
12	180	15	30

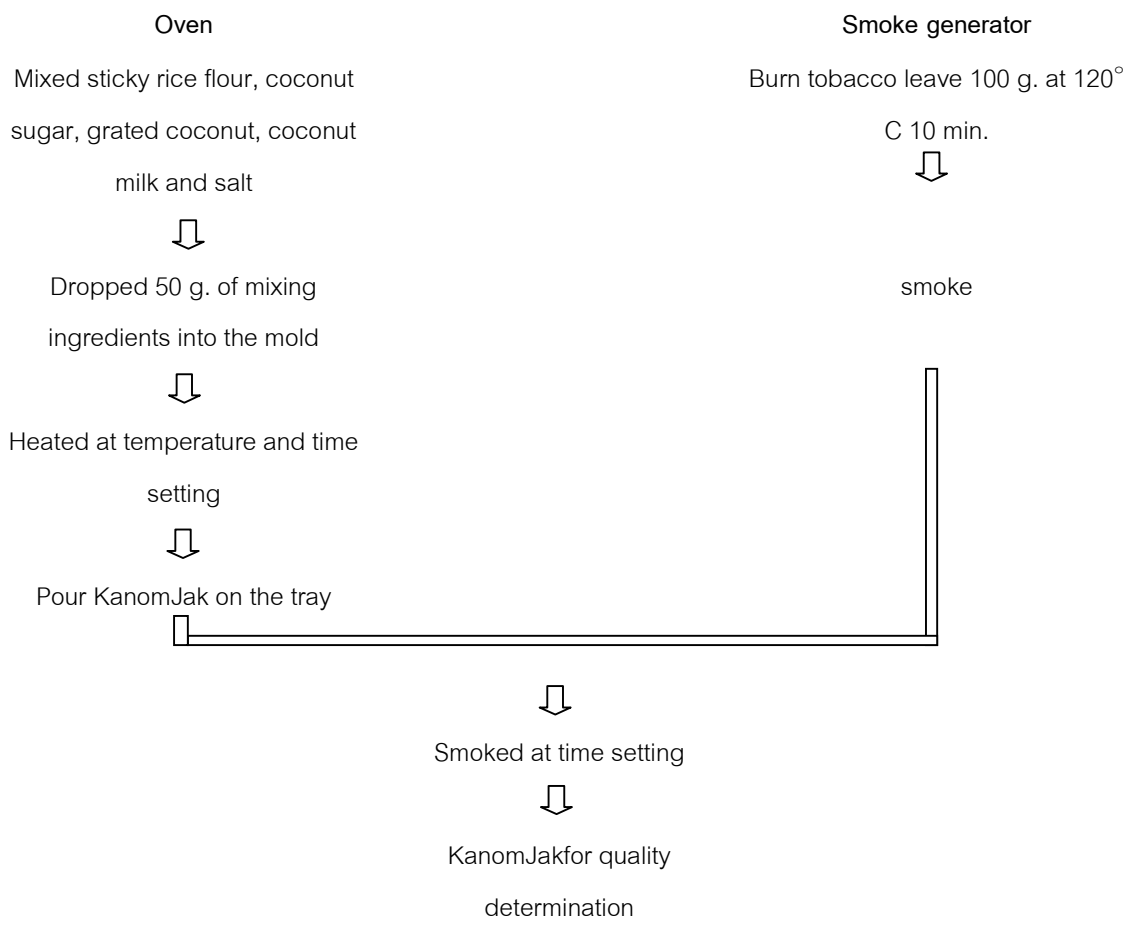

Figure 2 The process flow by the prototype machine

1.1 Screening by a_W value

Samples of each treatment were evaluated a_W using Nobasina MLK60 . Selected treatment that had a_W value less than 0.6 (a_W value less than 0.6 can control microbial growth, extend shelf life and allows some products to be safely stored without refrigeration.)(Karel*et al.*,1975)for determinate consumer acceptance.

1.2 Consumer acceptance

Samples from1.1 were acceptance test by 60 consumers (age 15 to 50 years old) of both sex.The hedonic scalewas structured in nine points, which theminimum grade corresponded to the term"extremely disliked" and the highest gradecorresponded to the term "extremely liked". Thefollowing characteristics were evaluated by thetester: appearance, tobacco aroma, tobacco flavor and overall liking. Selected treatment that had high score of acceptance test for next experimental.

2. Quality analysis compare with commercial product

2.1 Physical analysis

a_W value of samples and 3 replications were measured with Nobasina MLK 60, The color was measured withLovilond SP 60

2.2 Sensory analysis

2.2.1 Consumer Test

Consumer testby 100 consumers (age 15 to 50 years old) of both sex.The sample and questionnaire were gave to consumer.The hedonic scale was structured in nine points, which the minimum grade corresponded to the term "extremely disliked" and the highest grade corresponded to the term "extremely liked". The following characteristics were evaluated by the tester: appearance, tobacco aroma, tobacco flavor, softness and overall liking

2.2.2 Manufacture acceptance

10 of KanonJak manufacture were used to acceptance testing of develop process (usingthe prototype machine)by indepth interviews and questionnaire. After demonstration the develop process by using flow chart, manufacture answered the aboutacceptance in thedifficultiesin producing, cost, environment,health and overall acceptance.

3.Storage Test

KanomJak produce by the prototype machine were keep in polypopyrinebag andpackedinavacuum (Fig.3). The sample were keep in room temperature (30°C) and sampling every 2 days for analyze appearance characteristic and microbiology quality : Total plate count, Yeast and Mold compare with commercial product.

Figure 3 Packaging for storage test

Results and Discussions

1.Process Development by using Prototype machine

1.1 Screening bya_w value

After measured a_w value (shown in Fig 4), the result indicated treatment 10 (oven temperature180 degree Celsius, cooking time 15 min smoking time 10 min, 180/15/10),11(oven temperature 180 degree Celsius, cooking time 15 min smoking time 20 min, 180/15/20) and 12 (oven temperature 180 degree Celsius, cooking time 15 min smoking time 30 min, 180/15/30) had a_w value less than 0.6.The water activity scale extends from 0 (bone dry) to 1.0 (pure water) but most foods have a water activity level in the range of 0.2 for very dry foods to 0.99 for moist fresh foods. Water activity is in practice usually measured as equilibrium relative humidity. Water activity had effect on shelf life. Water activity less than 0.6 could limit for microbial growth (Karel*et al.*, 1975)

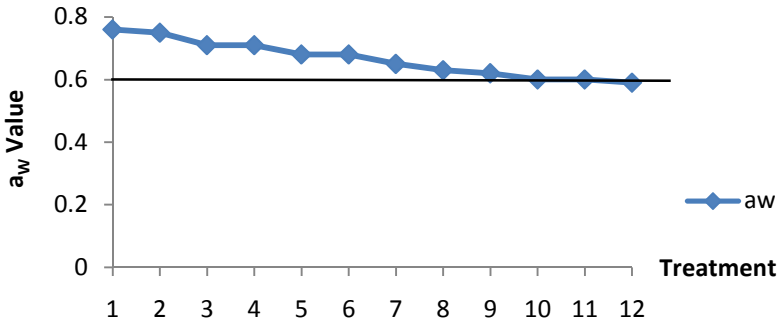

Figure 4a_w value of KanomJak 12 treatments

1.2 Consumer acceptance

All 3 samples were scored by 60 consumers (age 15 to 50 years old) of both sex. The hedonic scale was structured in nine points. The result shown in Table 2

Table 2 Average score of KanomJak

Sensory Characteristics	Score of Treatment		
	10(180/15/10)	11(180/15/20)	12(180/15/30)
appearance	6.4±1.24[c]	7.2±1.56[b]	8.1±1.46[a]
tobacco aroma	5.3±1.78[c]	6.7±1.67[b]	7.4±1.81[a]
tobacco flavor	6.1±2.08[b]	6.9±1.87[b]	7.8±1.77[a]
overall liking	6.8±1.20[b]	7.1±1.23[b]	8.0±1.24[a]

[a-c] Means within the same row by the different letters are significantly different ($P \leq 0.05$)

Table 2, the result showed that KanomJakproduced by using oven temperature 180 degree Celsius, cooking time 15 min smoking time 20 min (treatment 12) had highest score of consumer acceptance in all sensory characteristics ($p \leq 0.05$). These indicated smoking time was effected on liking score. Specification characteristic of KanomJak was tobacco aroma, so KanomJak that used long smoking time had more tobacco aroma than each another.

2.Quality analysis compare with commercial product

Both KanomJakproduce from that same formula byprototype machinewith condition : baked in oven temperature 180 degree Celsius, at 15 min and smoked in smoke generator at 20 min and commercial production that cooked by grilled were determinatedand shown in Table 3

Table 3 Quality analysis of KanomJak produce by prototype machine and commercial product

Quality	Type of KanomJak	
	Commercial Product	Using Prototype Machine
Physical		
- a_w*	0.56±0.25	0.59±0.23
- color		
L*	29.33±2.03	32.00±0.03
a*	4.87±1.14	3.16±0.06
b*	5.79±1.06	3.79±0.02
Sensory		
- Consumer test		
Appearance*	7.21±2.87	8.60±1.87
tobacco aroma*	7.56±1.96	8.77±2.00
tobacco flavor*	7.12±2.47	8.71±2.15
softness *	6.89±2.85	8.70±2.03
overall liking*	7.33±2.50	8.79±1.93
- Manufacture acceptance(%)		100

*Means within the same row are significantly different (P≤ 0.05)

From table 3, the result showed thatThe physical quality indicated water activity (a_w) of commercial product was lower than KanomJak byprototype machine ($p \leq 0.05$). Water activity affects the shelf life, safety, texture, flavor, and smell of foods (Phanitcharoen*et al*., 2010). It has also been reported that decreasing $a_w$snack to became harder (Maneerote*et al*., 2009). Color analysis, L^* of commercial product was lower than KanomJak byprototype machine ($p \leq 0.05$). Commercial product that used grilled for cooking. It was direct heat, the product may be burned and grilled at high temperature conditions found darker than the lower temperature (Pandey*et al*., 2014)

The sensory quality indicated the consumer test, the result of quality analysis KanomJak byprototype machineand commercial production showed liking score of KanomJak byprototype machine was higher than commercial production ($p \leq 0.05$) in all attribute.These indicated that cooking process of KanomJak was causedby grilled made the commercial product burned and had burned aroma on product. The sensory characteristic had the effect on consumer acceptance (Gormley, 1992). Pawar*et al*. (2000) also found that different quality parameters changes with different method of cooking. The manufacture acceptance showed 100 % of manufacture accept the development process because the development process could reduce cost, could control the quality, follow by GMP and was a clean technology.

3.Storage Test

The quality of KanomJak produce by prototype machine and commercial product during storage shown in Table 4.An increase of storage time ,both of 2 the samples gives a result increasing of a_W, total plate count, yeast and mold. Increasing a_W content caused an increase in microbiology quality because the water activity has an important effect on the microbiology growth. But a_W of commercial product was increased quickly than KanomJak produce by prototype machine because after grilled the tobacco leave were crisped and broken so it could not protect the product.KanomJak produced using prototype machine was kept in polypopyrine bag andpackedinavacuum. Vacuum packing hasbecome popular as a protection techniqueduring storage. Shelf life quality ofaquatic food products can be improved byvacuum packing technique. Moreover, themicrobial ecology of food basically dependson the environment, used equipment, foodtype, handling practices, processing,packaging and storage temperature (Krizek*et al*., 2004; Ozogul*et al*. 2004;Sachindra*et al*., 2005).

For commercial product, the shelf life was 4th day because in this day it had a_W value more than 0.6 and had a little moist and some bad smell. Moreover the microbiology quality was out of standard of processed food (TISI, 2552). But the shelf life of KanomJak produce by prototype machine was 8th day because it change the appearance and microbiology quality too.

Table 4 The quality of KanomJak produce by prototype machine and commercial product during storage

Time for storage (days)	a_W		Apperance		Microbiology Quality			
					Total Plate Count		Yeast and Mold	
	Commercial Product	Using Prototype Machine	Commercial Product	Using Prototype Machine	Commercial Product	Using Prototype Machine	Commercial Product	Using Prototype Machine
0	0.57	0.59	unremarkable	unremarkable	7.2×10^3	1.2×10^3	5.2×10^2	1.0×10^2
2	0.60	0.59	unremarkable	unremarkable	1.2×10^4	1.5×10^3	1.1×10^3	3.1×10^2
4	0.63	0.60	A little moist and bad smell	unremarkable	3.4×10^5	1.6×10^3	1.2×10^4	5.2×10^2
6	0.70	0.62	had mucilage and bad smell	unremarkable	9.2×10^6	8.2×10^3	5.4×10^4	6.4×10^2
8	0.74	0.69	had more mucilage and more bad smell	had a little mucilage and bad smell	8.4×10^7	9.8×10^3	2.2×10^5	4.8×10^3

Conclusion

The experimental results showed that the optimum condition to produce KanomJak by using prototype machine was oven temperature 180 degree Celsius, cooking time 15 min smoking time 20 min.The properties of KanomJak by using prototype machine : a_W value was 0.59, L*,a*,b* were 32.00, 3.16, 3.79 respectively, liking score of appearance, tobacco aroma, tobacco flour, softness and overall liking were 8.60, 8.77, 8.71, 8.70 and 8.79respectively. Manufacture accepted the develop process 100 %. The shelf life of KanomJak by using prototype and packed in vacuumpolypopyrine bag could prolong the to 8 days

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Effect of gamma irradiation on growth of pineapple (*Ananas comosus* L.) in vitro

Rungnapa changjeraja[1*]

Abstract

Effect of gamma irradiation on growth of pineapple (*Ananas comosus* L.) in vitro was studied at Agricultural Technology Research Institute, Rajamangala University of Technology Lanna, during June - September 2013. Plantlets of pineapple cultured on MS medium were irradiated with gamma rays for acute at 0, 10, 20 and 30 Krads and 10 replications (5 plants per replication). The results revealed that fifty percent of lethal dose at 60 days after application of the irradiation (LD50(60)) was 25 Krads. the number of plants, height, leaf length and root length in non treated plants were higher than those of the other treatments (i.e. 1.16 plants, 1.70 cm., 5.00 and 4.88 cm., respectively. The 20 Krads treated plants gave the least number of leaves (i.e. 4.83 leaves per plant). The 10 Krads treated plants gave the greatest stoma width and length (i.e. 21.68 and 25.02 micrometres, respectively). Furthermore, The 20 treated plants gave the highest of number of stoma (i.e. 164.47 stoma per mm2). However, Radiation 300 Gray made the in vitro pineapple explants all died.

Keywords: pineapple (*Ananas comosus* L.), gamma irradiation

Introduction

The Pineapple or *Ananas comosus* is an important fruit crop that belongs to the Bromeliaceae and is important fruit crop that cultivated in Thailand, Indonesia, Brazil, Peru, Mexico, USA, India and other regions of the tropical world. The interest for its production is due to the high cost that reaches in the fresh fruit and industrialized markets (Carlier et al., 2006). Fruit contains a variety of compounds of which bromelain and a proteolytic enzyme that it aids digestion. The use of bromelain for dental, general surgery and as an antibody (Murachi 1972). Pineapple can be divided into 5 groups according to morphological characteristics, such as spination, length and shape of the leaves, and weight, shape, texture and taste of the fruits. These 5 groups are Abacaxi, Cayenne, Maipure or Perolera, Queen, and Spanish (Leal and Soule, 1977). Thai pineapple cultivars according to their morphologies. Bartholomew and Malezieux, (1994) reported that 'Tradsithong', 'Phuket' and 'Sawee' were in the Queen group, 'Pattavia', 'Nanglae' and 'Petburi' in the Cayenne, and 'Intrachitdang' in the Spanish. The pineapples in the Queen group have small and very spiny leaves. The fruits are small and oblong with full yellow shells, small prominent eyes, the fruit is a sweet and crispy golden-yellow flesh. The Cayenne has leaves with the spines confined to the tips. The fruits are ovoid and medium-sized. They ripen progressively, turning. yellow from the base to the top of the fruits. The flesh is pale-yellow, soft and juicy. The cultivars in the Spanish group have small, oval to cylindrical-shaped, and dark purple fruits that will turn copper-orange

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when ripening. The flesh is golden-yellow, low sugar and acidity, and poor in taste. The leaf spines are varied from clone to clone.

The ionizing radiation, such as X-rays, gamma rays and neutrons for inducing genetic variation is well established. The radicals can damage or modify important components of plant cells and have been reported to affect differentially the morphology, anatomy, biochemistry and physiology of plants depending on the irradiation level. These effects include changes in the plant cellular structure and metabolism, e.g., dilation of thylakoid membranes, alteration in photosynthesis, modulation of the antioxidative system and accumulation of phenolic compounds (Kim *et al*., 2004; Wi *et al*., 2005). And some plant, increase crop yields, confer resistance to diseases or pests, or enhance fitness in stressful environmental conditions, such as drought, frost, or poor soils (with depleted nutrients, extremes in salinity, acidity, or alkalinity, etc). Induced mutations have been used to improve many crops such as the floricultural plants (chrysanthemum, Alstroemeria, dahlia, bougainvillea, rose, Achimenes, begonia, carnation, and azalea) and a few in fruit trees. Irradiation of micropropagated plants, axillary and adventitious buds, apical meristems, regenerative callus, pollen and microspores. (Ahloowalia and Maluszynski, 2001). Pongchawee *et al.* (2007) found that different doses of radiation caused changes in the leaves and size of Anubias nana, such as variegated leaves and dwarf plants. Letchamo *et al*., (1994); Letchamo and Gosselin, (1995, 1996) has also been observed that plant grown under higher radiation intensity were shorter, had shoots with more tillers, and thicker branches on the shoot, while plants cultivated under less intense radiation, had a prostrate growth with thinner, broader leaves and a slightly pale green color. The aim of this study to effect of gamma irradiation on growth of pineapple (*Ananas comosus* L.) in vitro.

Materials and Methods

The experimental design was a completely randomized design with 4 treatments gamma radiation dose (i.e. 0, 10, 20, and 30 Krads) and 10 replications (5 plants per replication). The acute gamma irradiation was used to induce mutation on variegated pineapple which propagated by in vitro (the age of plant at 30 days and 1 cm of height). The treatments were application of the radiation doses at 0, 10, 20 and 30 Krads. The growth of in vitro pineapple explants and number of stoma, width and length of stoma were measured at 60 days after treated.

Results and discussion

The fifty percent of lethal dose at 60 days after application of the irradiation (LD50(60)) was 25 Krads, When the plantlets of pineapple were exposed to acute gamma radiation at the rates of 0, 10, 20, and 30 Krads, it was found that 60 days after the treatment, the percentage of survival plants was negatively correlated with the amount of radiation received and none of the plantlets exposed to 30

Krads. The number of plants, height and leaf length in non treated plants were higher than those of the other treatments (i.e. 1.16 plants, 1.70 cm., and 5.00 cm., respectively. According to Fardous, (2013) reported in Moluccella laevis L. The tallest plants were observed on the low doses of gamma rays On contrast, by increasing radiation dose decreased the plant height. The 20 Krads treated plants gave the least number of leaves (i.e. 4.83 leaves per plant). (Table 1) According to Zaka *et al.*, (2004) reported that The effects of short-term gamma radiation on pea plants were investigated by exposing 5-day-old seedlings with doses ranging from 0 to 60 Gys, Doses higher than 6 Gys significantly inhibited the plant growth, and no seedling survived irradiation with 40 Gys and above. Likewise, the tissue cultured lotus were induced by treating plantlets with either acute radiations that the most plants treated with 35 krad of either gamma- or X-rays exhibited abnormal characteristics including vitrification, chlorosis, deformed petioles and in addition had inhibited growth of lateral buds, secondary roots and rhizomes. All plants treated with 6 krad of gamma-rays died within 4 weeks (Arunyanart and Soontronyatara, 2002)

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Table 1 Growth of shoot and leave of pineapple after application of the irradiation at 60 days

Gamma rays dose	Shoot number (shoot)	Height (cm)	Leave number (leave)	Leaf length (cm)
0	1.16a	1.70a	9.33a	5.00a
10 Krads	1.00ab	1.45ab	9.50a	3.50ab
20 Krads	0.67b	0.97b	4.83b	2.16b
30 Krads	0.00c	0.00c	0.00c	0.00c
LSD	0.39	0.52	3.32	1.51

Values within columns followed by different letters were significantly different at P<0.05

*= significant at P<0.05

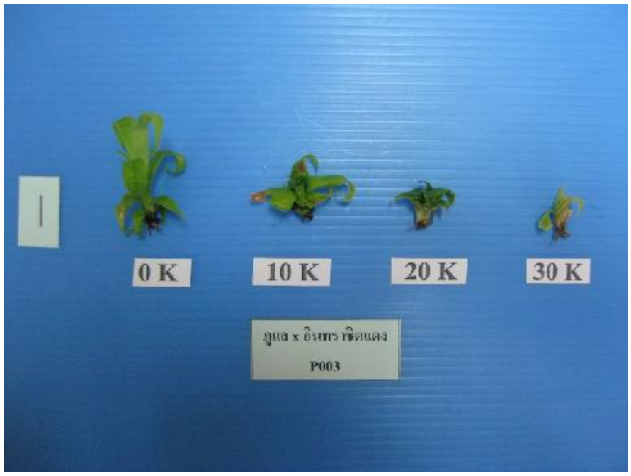
The root length in non treated plants were higher than those of the other treatments (i.e. 4.88 cm.). The 10 Krads treated plants gave the greatest stoma width and length (i.e. 21.68 and 25.02 micrometres, respectively). Furthermore, The 20 Krads treated plants gave the highest of number of stoma (i.e. 164.47 stoma per mm2). However, gamma ray did not affect on number of root of the in vitro pineapple explants.

Table 2 Growth of pineapple after application of the irradiation at 60 days

Gamma rays dose	Root number (roots)	Root length (cm)	Stoma width (μm)	Stoma length (μm)	Number of stoma (stoma)
0	5.50a	4.88a	20.37b	23.96b	135.13b
10 Krads	3.25a	2.83b	21.68a	25.02a	136.33b
20 Krads	3.16a	2.18b	19.58b	23.49b	164.47a
30 Krads	0.00b	0.00c	-	-	-
LSD	2.48	1.93	1.00	0.79	30.21

Values within columns followed by different letters were significantly different at P<0.05

*= significant at P<0.05



Fiq. 1 Pineapple explant after application of the irradiation at 8 weeks

Conclusion

It was shown that plantlet of pineapple responds positively to increases in irradiation with reduction in number of leaves, increase in the stoma width and length and number of stoma.

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Application of expanded clay as a substrate culture for water cress (*Nasturtium officinale*) production

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Abstract

Qualification of expanded clay and its use as a substrate culture was studied at Agricultural Technology Research Institute, Rajamangala University of Technology Lanna. The experimental design was completely randomized design (CRD) with 8 treatments of expanded clay formulations (clay + rice husk formula 1, clay + rice bran formula 2, clay + resin beads formula 3, clay + rice husk + rice bran formula 4 clay + rice husk + resin beads formula 5, clay + rice bran+ resin beads formula 6, clay + rice husk + rice bran + resin beads formula 7 and clay formula 8). The aggregates were burned at 600 ^{o}C for 8 hours. The canopy of water cress grown in different substrate cultures from 8 formulas of expanded clays was also evaluated. It was found that water cress planted in formula 4 (clay + rice husk + rice bran) for 30, 60 and 90 days gave the highest growth of canopy (i.e. 19.66, 27.00 and 33.33 cm, respectively). In terms of branch growth, water cress planted in formula 4 (clay + rice husk + rice bran) for 30 and 60 days gave the highest branches number (i.e. 17.33 and 25.33 branches, respectively). The substrate cultures did not significantly affect height of water cress at 30, 60 and 90 days after planting.

Keywords: Expanded Clay, Substrate Culture, *Nasturtium officinale*

Introduction

Nasturtium officinale produces leafy shoots in the spring and begins to flower in late spring. It is usually found in clumps in cold, gently flowing, shallow freshwater. It will be emergent through the winter in waters that do not freeze. The older leaves are compound with many wavy-edged, oval or lance-shaped leaflets growing from a central stalk. The leaves taste strong of pepper, leading to its commercial use in salads. The leaves are between 4 and 12 cm long, with the end leaflet typically being the largest. *N. officinale* has a 10 to 60 cm stem with thin and fibrous roots at the bottom. At the top of stems and short stalks, its flowers are 3-5 mm long and have 4 white petals. They are found above the water between March and October. Its fruits is 10 to 25 mm long and 2 mm wide and found on stalks that are 8 to 12 mm long. They are thin, slightly curved cylinders and containing 4 rows of small, round seeds (Howard and Lyon, 1952). Watercress contains significant amounts of iron, calcium, iodine, manganese, and folic acid, in addition to vitamins A, B_6, C, and K (Conaway et al., 2005). Because it is relatively rich in vitamin C, watercress has been suggested (among other plants) by English military surgeon John

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Woodall(1570–1643) as a remedy for scurvy. Watercress is also a significant source of omega-3 fatty acids primarily in the form of 16:3n-3 (Hexadecatrienoic acid) at 45 mg/100g (Gill et al., 2007).

Several substrates are used for soilless crop production such as Sawdust, Vermiculite, Sand and expanded clay. Important factor in choosing a substrate for soilless crop production that substrate needs to enough oxygen for respiration ; provides adequate moisture; the concentrations of ions should not be so high as to restrict the absorption of water and not be too low as to cause nutritional deficiencies; and has the appropriate pH. (Sedibe, 2012). The aim of this research was to investigate application of expanded clay as a substrate culture for water cress production. Lightweight expanded clay aggregate (LECA) or expanded clay (exclay) has been utilized mainly in agriculture and landscapes, it is used as a growing medium in hydroponics systems, and blended with other growing media, such as soil and peat, to improve drainage, retain water during periods of drought, insulate roots during frost and provide roots with increased oxygen levels, that promoting very vigorous growth (Hammer et al., 2005). Expanded clay pellet is rather expensive but it is one of the few kinds of growing medium that is easily reusable, which makes it a good choice for the long term usage. After harvest a crop, the used expanded clay can be washed to remove the old root debris and then sterilize with a 10% bleach in water (http://www.simplyhydro.com/ growing2.htm., 2015). The aim of this research was to investigate application of expanded clay as a substrate culture for water cress production.

Materials and Methods

The experimental design employed was a completely randomized design (CRD) consisted of 8 treatments of expanded clay formulas (clay + rice husk ;formula 1, clay + rice bran;formula 2, clay + resin beads ;formula 3, clay + rice husk + rice bran ;formula 4 clay + rice husk + resin beads ;formula 5, clay + rice bran+ resin beads ;formula 6, clay + rice husk + rice bran + resin beads ;formula 7 and clay ; formula 8) The expanded clay was obtained by burning at 600° C for 8 hours which had the diameter in the range of 3-5 mm. Dry clay soil was used as the main material and the practical process of producing expanded clay was attained form the knowledge of the earthenware group community Ban-Mon-Kaokaew, Lampang province. The expanded clay from all treatments were tested for water cress and plant growth in from of height, canopy size and number of branch at 30, 60 and 90 days were followed.

Results

Growth of water cress, in terms of plant height, grown in substrate culture containing 8 different formulas of expanded clay at 30, 60 and 90 days was in the ranges of 10-15, 18-24 and 24-32 cm.,

respectively (Table 1). The results indicated that growth of water cress were not influenced by different substrate cultures used in this study.

Water cress planted in substrate cultures containing expanded clay formula 4 for 30, 60 and 90 days resulted in the greatest growth of canopy of 19.67, 27.00 and 33.33 cm. respectively. The expanded clay formula 6 gave the least canopy size of water cress growth in all times, which was 10.67, 17.33 and 23.00 cm. respectively (Table 2). And that, water cress planted in substrate cultures containing expanded clay formula 4 for all times resulted in the highest number of branches/plant of 17.33, 25.33 and 31.00 respectively. The expanded clay formula 5 had the number branches/plant in 30 and 60 days the least which were 9.33 and 16.00 respectively (Table 3). This suggested that water cress growth, in terms of canopy size and number of branches/plant, was influenced by different substrate cultures used in this study.

Table 1. Plant height of Water cress at 30, 60 and 90 day after planting in substrate cultures containing 8 different formulas of expanded clay.

Expanded clay	Pant height (cm.)		
	30 days	60 days	90 days
formula 1	10.00	18.00	24.33
formula 2	12.33	20.66	28.33
formula 3	10.33	18.00	25.67
formula 4	15.33	24.33	32.00
formula 5	13.67	21.33	29.33
formula 6	12.33	19.67	26.00
formula 7	13.67	22.00	31.00
formula 8	12.67	21.00	28.66
F-test	ns	ns	ns
cv (%)	17.90	13.86	11.06

ns = not significantly different

Table 2. Pant canopy size of Water cress at 30, 60 and 90 day after planting in substrate cultures containing 8 different formulas of expanded clay.

Expanded clay	Plant canopy (cm.)		
	30 days	60 days	90 days
formula 1	11.33e	18.00d	23.33c
formula 2	14.67bcd	23.33abc	30.00ab
formula 3	13.00de	21.00cd	28.00b
formula 4	19.67a	27.00a	33.33a
formula 5	17.00ab	25.33ab	30.67ab
formula 6	10.67e	17.33d	23.00c
formula 7	16.67abc	25.33ab	31.67ab
formula 8	13.67cde	22.00bc	31.00ab
F-test	3.29	3.93	4.29
cv (%)	13.06	10.14	8.60

Values within a column followed by common letter were not significantly different by Duncan's New Multiple Rang Test at 95%,

* = significantly different

Table 3. Number of branches per plant of Water cress at 30 60 and 90 day after planting in substrate cultures containing 8 different formulas of expanded clay.

Expaned clay	Number of branches		
	30 days	60 days	90 days
formula 1	14.66ab	26.00a	27.67abc
formula 2	14.33abc	22.67ab	29.33ab
formula 3	9.67bc	18.00bc	23.00bc
formula 4	17.33a	25.33a	31.00a
formula 5	9.33c	16.00c	23.00bc
formula 6	10.33bc	17.00bc	22.00c
formula 7	11.00bc	14.67c	28.00abc
formula 8	12.00bc	20.33abc	28.33abc
F-test	5.05	6.51	7.00
cv (%)	23.64	18.82	15.25

Values within a column followed by common letter were not significantly different by Duncan's New Multiple Rang Test at 95%,

* = significantly different

Discussion

The natures of materials employed for mixing clay to product expanded clay product affects the physical structure of the product (e.g. weight, water holding capacity and pH) and in turn, may consequently influence growth and development of crop grown in such substraty. The rice bran and rice husk for soil mix structure has features on light weight, and water content of the expanded clay product. Baked clay pellets, are suitable for hydroponic systems in which all nutrients are carefully controlled in water solution. The expanded clay are inert, pH neutral and do not contain any nutrient value. (wikipedia, 2013) This experiment was conducted to study the properties of expanded clay incorporated with mixtures of various materials. Furture study is needed to be tested on the growth and development of different plants grown in the soilless culture.

Conclusion

Different materials used for mixing in expanded clay exerted an effect on the product properties, which in turn, had the impact on growth and development of water cress. Water cress grown in the formula 4 expanded clay (clay + rice husk + rice bran) yielded the greatest growth, in terms of canopy size and branch number, while that of plant height was similar to the others.

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Effects of Hydrothermal Treatment on Rheological Properties and Texture of High-Amylose Rice Flour.

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Abstract

Hydrothermal treatment namely heat-moisture treatment (HMT) and annealing (ANN) were commonly applied in order to High-amylose rice flour (Takandtong variety; TK). The objective was to understand the impact of modifying process on physicochemical and rheological properties of hydrothermal rice flour and to develop novel starches for food application. Response surface methodology, using central composite design (CCD) was applied to investigate the effects of moisture content (18, 22.5, 27 %), heating temperature (90, 105, 120 °C) and heating time (1, 2,3 hr.) in HMT and heating temperature (60, 65, 70 °C), heating time (12, 24, 36 hr.) in ANN. These response variables were fitted to predictive models applying multiple linear regressions. Contour plot showed the increase in moisture content and heating temperature of HMT caused lowering in pasting properties (peak viscosity, trough, final viscosity, and setback) in both varieties. However, rheological properties (storage modulus, storage modulus at 95 °C) and gel hardness were increased when moisture content and heating temperature increased. Heating time showed non-significant effect of heating time on response variables. ANN of TK variety showed negative response with heating temperature in all pasting, rheological properties. Understanding HMT and ANN on these treatment conditions should be crucial for tailoring their properties that match product quality.

Introduction

Thailand is major exporter of rice flour. 15,759 tones of nonwaxy rice flour and waxy rice flour was exported during January-July 2006 and earned 27.9 million US$. Rice flour paste viscosity change drastically during gelatinization. Measure it is difficult to control its rheological properties. Modified starch and cereal flours have become important in processed foods because of its functional properties. The main functional properties of native starches are their thickening and gelling properties, which makes them excellent ingredients for the food manufacture such as custards, porridges, puddings, cookies and sausages (Pouranee and Jindal, 2002). In this work, hydrothermal modifications (action of heat and moisture) of starch granules, which do not destroy the granule structure, are reviewed. The impact of hydrothermal treatments on starch physicochemical properties will be discussed. Hydrothermal treatment is known as a process which increases starch crystallinity and its perfection (Jacobasch et al., 2006; Tester and Morrison,1990), granule rigidity (Jacobs et al., 1995), polymer chain realignment, partial crystallite melting (Stute, 1992), and starch chain associations (amylose amylopectin and or amylopectin–

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amylo-pectin) (Ozcan and Jackson, 2003). These hydrothermal treatments could suppress granule swelling, retard gelatinization and increase starch paste stability. Starch gel structure is altered and gel hardness increased (Chung et al., 2000; Jacobasch et al., 2006; Lii et al.,1996; Lim et al., 2001; Liu et al., 2000). The objective was to understand the impact of modifying process on physicochemical and rheological properties of hydrothermal rice flour and to develop novel starches for food application.

Materials and methods

1. Sample selection and preparation

We selected two rice varieties including: Takandtong variety (TK) were all samples were obtained as polished rice grain from the Rice Research Institute, Department of Agriculture, Pathumtani, Thailand. Rice was then milled by wet milling by wet milling method. Rice flour cake was separated from slurry by centrifugation, after that it was dried in tray dryer at 45±5 °C for 12 hr to reduce the moisture content to approximately 12 %. Rice Flour was then milled using an ultra centrifugal mill (type ZM1 ,Retsch,Germany) until particle a size of 100 micron and passed through 100 mesh sieve, Pack in polyethylene bag and stored at -18 °C.

2. Modifications of rice flour:

Heat-moisture treatment: HMT was carried out using the method of Franco et al. (1995). The moisture levels of the rice flour samples were increased to 18 to 27% by adding the appropriate amount of distilled water. The mixture was stirred and incubated over night; the sealed samples in aluminum foil bags were heated in an air oven at 90 to120 °C for 1 to 3 hr. After cooling, the bags were opened and the flour samples were dried to a moisture content of 10 -12 %.

Annealing: The method of Knutson (1990) suspended was adopted in preparation of annealing rice flour. The flour was annealing by 100 g of flour in excess water at a temperature of 55 to 70 °C slightly above gelatinization temperature for 12 to36 hr sample was centrifuged to remove excess water and dried in tray dryer at 45±5°C and the flour samples were dried to a moisture content of 10 -12 %.

3. Pasting properties

Pasting properties of starch samples were determined by a Rapid Visco Analyzer (Model 3D, Newport Scientific, Australia) using approved Method of AACC 61-02 (AACC,2000) as described in Appendix. Rice flour samples were run in duplicate. First 25 ml of distilled water was added directly to a metal RVA canister. Then 3.00 ± 0.01 g of rice flour was weighed, added to water, and immediately measure by the RVA. These measurements were made with the standard Newport Scientific rice profile involved and initial 10 s high-speed [960 rotations min^{-1}] stir that dispersed the sample prior to the

beginning of the measuring phase at 160 rotations min^{-1}. Temperature was held at 50 °C for 1 min and then raised to 95 °C in 3.75 min, held for 2.5 min, cooled to 50 °C in 3.75 min, and held for 5 min. The RVA instrument provided the following parameters: peak viscosity (PV)-highest viscosity during heating; trough (T)-lowest viscosity following PV; breakdown (BD)-PV minus T; final viscosity (FV)-the viscosity at the completion of the cycle; setback (SB)-FV minus PV. Values are reported in centri point [cp.]

4. Textural Properties

Rice gel of flour was measured using texture analyzer (model TA-XT2, Stable Micro System, England). The gel was made from a 20% (w/v) flour suspension in distilled water and gelatinized in boiling water bath for 30 min. It was then placed in cylinder tube (10-15 ml.), cooled to room temperature (25°C to 30 °C), and equilibrated at room temperature for 4 h. The gel obtained had a dimension of 20.0 mm diameter and 20 mm height. A texture profile analysis was done to distance of 10 mm at a pretest speed 1.0 mm/s using a stainless steel punch probe (P/6, 6.0 mm diameter). Hardness and gel elasticity were recorded.

5. Rheological properties

Rice suspension of flour was measured using dynamic rheometer (Physica MCR Series300, Switzerland). The rice suspension of 20% (w/w) concentration was loaded on the upper plate of the rheometer and covered with a thin layer of low-density silicon oil (to minimize evaporation losses). Rheological properties of flour pastes were measured using a dynamic rheometer equipped with parallel plate system (50 mm diameter). The gap size was set at 1000 μm. The strain and frequency were set at 0.5% and 1 Hz, respectively. The flour samples were heated from 45 to 95 °C and cooled from 95 to 25 °C at rate 2 °C/min. Data related to dynamic viscoelastic characteristics of samples during gelatinization which were peak storage modulus (G'p) and storage modulus at 95 °C (G'95) were obtained.

6. Experimental design

Heat-moisture treatment: The CCD was selected three levels of temperature, eating time and moisture content. Three variable central composite design (CCD) was applied to estimate the relationship between variable on physicochemical and rheological roperties of hydrothermal rice flour. The CCD consisted of eight factorial point, six axial points and six center points, leading to 20 sets of experiments. The variables and their levels with code values apply for this study were represented in table 1.

Table 1 Variable and their levels employed in a central composite design.

Experiment	Temperature (X_1)		Heating time (X_2)		Moisture content(X_3)	
	Code value	Real value	Code value	Real value	Code value	Real value
1	-1	90	-1	1	-1	18
2	1	120	-1	1	-1	18
3	-1	90	1	3	-1	18
4	1	120	1	3	-1	18
5	-1	90	-1	1	1	27
6	1	120	-1	1	1	27
7	-1	90	1	3	1	27
8	1	120	1	3	1	27
9	-1	90	0	2	0	22.5
10	1	120	0	2	0	22.5
11	0	105	-1	1	0	22.5
12	0	105	1	3	0	22.5
13	0	105	0	2	-1	18
14	0	105	0	2	1	27
15-20	0	105	0	2	0	22.5

Annealing: A central composite design was selected involved three levels for temperature and heating time. The CCD consisted of six factorial point, two axial points and five center points, leading to 13 sets of experiments. The variables and their levels with code values apply for this study were represented in table 2.

Table 2 Variable and their levels employed in a central composite design.

Experiment	Temperature (X_1)		Tempering time (X_2)	
	Code value	Real value	Code value	Real value
1	-1	60	-1	12
2	1	70	-1	12
3	-1	60	1	36
4	1	70	1	36
5	-1	60	0	24
6	1	70	0	24
7	0	65	-1	12
8	0	65	1	36
9-13	0	65	0	24

Data Analyses

Regression analysis was performed based on the experimental data and was fitted into an empiric second order polynomial model as shown in the following equation:

$$Y = \beta_0 + \sum_{i=1}^{3} \beta_i X_i + \sum_{i=1}^{3} \beta_{ii} X_i^2 + \sum_{i=1}^{2} \sum_{j=i+1}^{3} \beta_{ij} X_i X_j + e \quad \text{..... (1)}$$

where Y was the response variable,B_0, B_i, B_{ii}, B_{ij} were the regression coefficients of variables for intercept, linear, quadratic and interaction terms, respectively. x_i and x_j were independent variables. The data reported in the table were average of triplicate observations. The data were subjected to correlation analysis and Person correlation coefficients were calculated using Minitab statistical Software version 14 (Minitab Inc., State College, PA). The relationships between the responses (pasting and rheological properties) were judged by correlation coefficients (R^2); the significance of p-values was decided at a probability level of 0.05.

Results and Discussions

Effects of HMT and ANN on pasting properties of rice flour by means of RSM method

RVA profile reflects pasting properties of rice flour as influenced by HMT and ANN. RVA measure of the viscosity of starch during the heating cycle reflecting the molecular events occurring in starch granules. The regression equation used to generate the contour plots are shown in table 3.

Table 3 Regression equations describing the response of pasting parameter as a function of the significant effects retained in the models

Response parameter	Equation	R^2
HMT of TK		
Peak viscosity	$19512.3 -136.2X_1+197.9X_2-656.7X_3+0.7X_1^2-47.0X_2^2+12.8X_3^2+0.6X_1X_2-0.5X_1X_3-8.2X_2X_3$	0.981
Trough	$16694.8 -63.5X_1+360.2X_2-905X_3+0.2X_1^2-65.5X_2^2+17X_3^2-1.5X_1X_2+0.5X_1X_3-0.4X_2X_3$	0.952
Final viscosity	$23572.4 -185.8X_1+782.9X_2-772.8X_3+0.9X_1^2-103.3X_2^2+15.3X_3^2-X_1X_2-0.5X_1X_3-14.7X_2X_3$	0.959
Set back	$1084.9 -116.9X_1+479.2X_2-236.2X_3+0.7X_1^2-47.4X_2^2+5.2X_3^2-X_1X_2-0.7X_1X_3-9.9X_2X_3$	0.958

High R^2 values and model significance were obtained for all quality factors tested. Table 3 showed the coefficients of all terms in the regression models. According to the analysis of each factor in the models. Result showed that heating temperature and moisture content had the highest effects on the response variables. Regressions models provide the excellent explanation of the relationship between 2 independent variables, heating temperature , moisture content and 4 responses; peak viscosity , trough , final viscosity and setback. The selected contour plots are presented in Fig. 1, including four representative parameters of pasting properties. The linear and quadratic effects of the moisture content level are very pronounced for peak viscosity, trough viscosity, final viscosity and setback. There responses decreased when the moisture content increased from 18 to 27 % and heating temperature increased from 90 to 120 ^{o}C. Hoover and Manuel (1996) reported the decreased of paste viscosities in HMT of maize starch. These were explained as a result of the increased in inter- and intra molecular hydrogen bonding due to association of starch chains, mainly amylose. It can be concluded that the effects of HMT on paste viscosities varied and were depended on different in starch source, instrument used and conditions of HMT.

Table 4 Regression equations describing the response of pasting parameter as a function of the significant effects retained in the models

Response parameter	Equation	R^2
ANN of TK		
Peak viscosity	$-9465.18 +519.51X_1-81.07X_2+-5.48X_1^2 +0.97X_2^2 +0.60X_1X_2$	0.962
Set back	$-309.525 +62.704X_1+0.455X_2 -0.761X_1^2 + 0.380X_2^2 -0.302X_1X_2$	0.852

Table 4 showed the coefficients of all terms in the regression models and the coefficients of determination of ANN condition on pasting properties of TK flour; which is a measure of how well a model can be fitted to the raw data. From this table give the coefficients for all term in the regression model. Coefficients of determination show that; peak storage modulus, Storage Modulus 95^{o}C and gel hardness have high R^2. The contour plots were generated by each of the fitted models as the function of temperature and moisture content with time was held constant factor. A contour plot shows how a response variable relates to two factors based on a model equation. For Figure 1a and 1b illustrate the 2 dimensional contour plots of the linear and quadratic. As shown in the figure both peak viscosity and setback decreased enhanced with increased heating temperature. Takahashi *et al*. (2005) reported that

RVA measurement of annealing and heat moisture treatment could delayed gelatinization and decreased peak viscosity, final viscosity and setback.

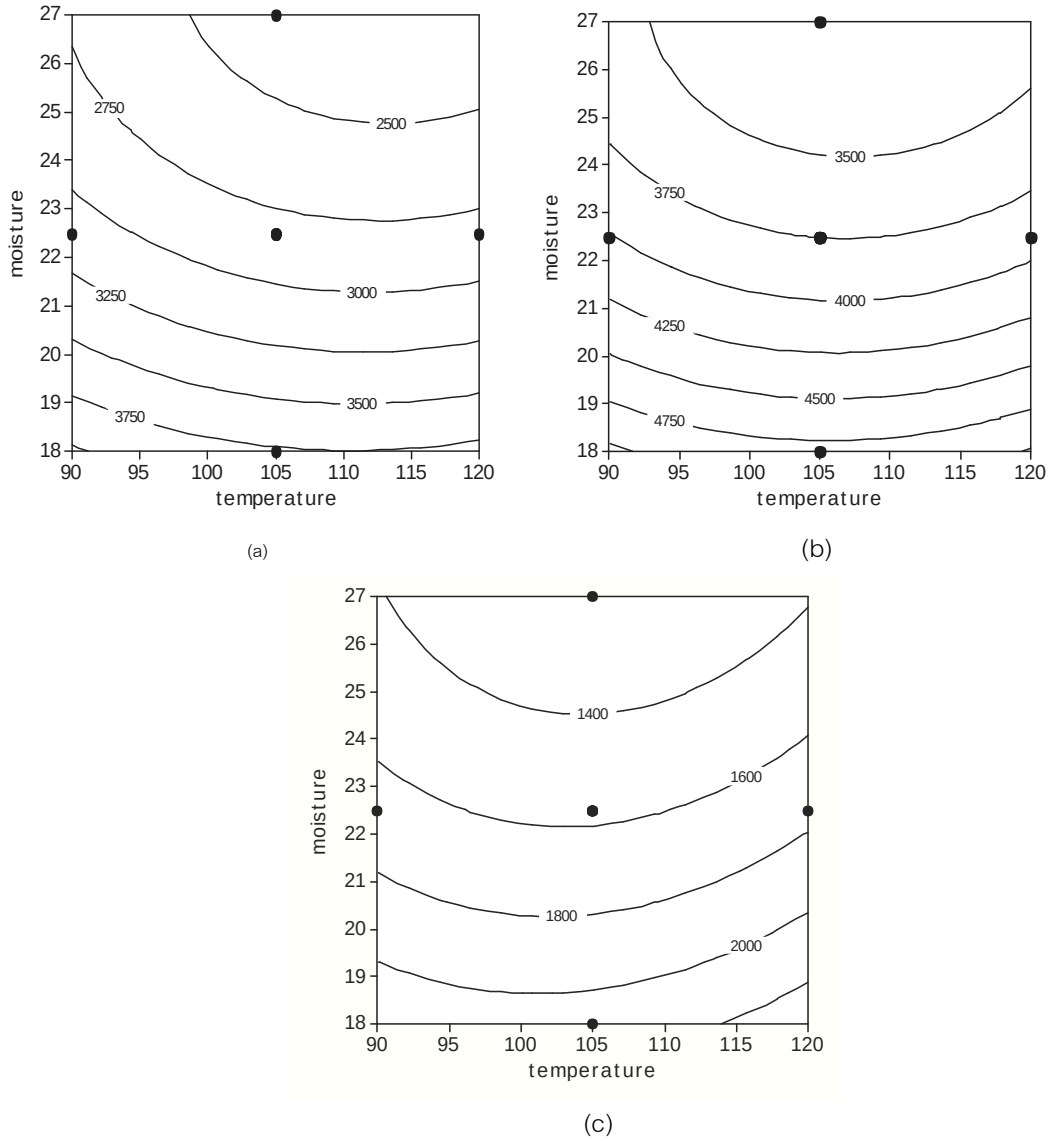
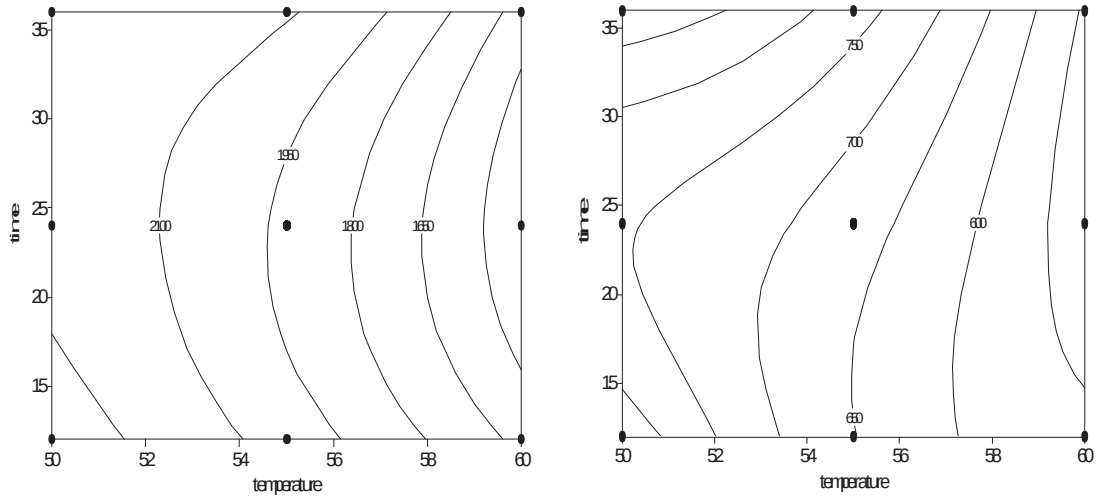


Figure 1 Contour plots for TK flour : the effect of temperature and moisture content of HMT on (a) peak viscosity (b) final viscosity (c) set back, other variable are held at zero level.



(a) (b)

Figure 2 Contour plots for TK flour : the effect of heating temperature and time of ANN on (a) peak viscosity (b) set back, other variable are held at zero level.

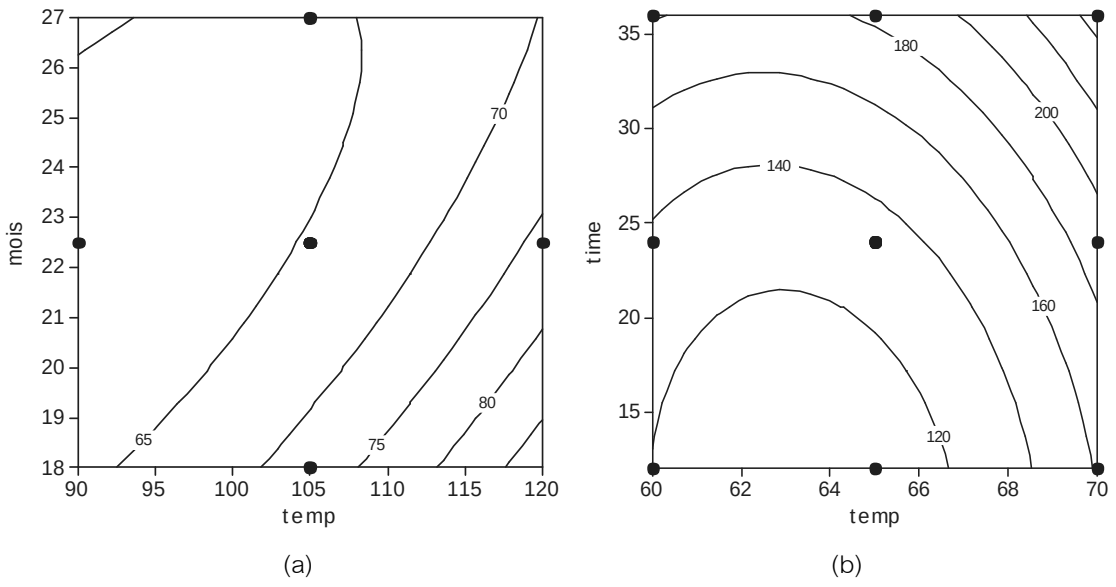
Effects of HMT and ANN on rheological properties and gel hardness of rice flour by means of RSM method

Peak storage modulus (G'peak) and Storage modulus at 95 °C(G'95°C) obtained by the dynamic rheometer of rice flour suspension on HMT and ANN. Takahashi *et al.*(2005) reported that heat treatment suppressed granule swelling and retarded gelatinization. Rheological properties were affected by heat treatment at a higher temperature. Table 5 showed Regression coefficients of the polynomial function and the coefficients of determination of HMT and ANN condition on rheological properties of TK flour. These measured how well a model can be fitted to the raw data. Coefficients of determination showed that peak storage modulus, storage modulus at 95°C and gel hardness have high R^2. The contour plots were generated by each of the fitted models as the function of heating temperature and moisture content with time was held constant. Figure 3 illustrated the two-dimensional contour plots of linear and quadratic effect of heating temperature and moisture content level for storage modulus and gel hardness. Increased in heating temperature and moisture content increased rheological properties and gel hardness. It was reported by Eliasson (1996) that large increase of G' for the annealed and heat-moisture treated starch suspension on heating is caused by increase of the amount of leached out amylose and the swelling ratio of the starch suspension. Hormdok and Noomhorm (2007) found positive correlation for instrument hardness and tensile strength n HMT processed rice flour. Starch gel structure was altered and gel hardness increased following heating temperature of HMT (Chung, Moon, & Chun, 2000). During HMT, increase in gel hardness was attributed to the increased cross-linking between starch chains in the particular amylose portion. These allowed the formation of more junction zone in the continuous phase of the gel,resulting in the increased gel hardness (Liu et al., 2000).The high moisture content and the

elevated temperature of treatment could allow polymer chain motion and consequently the greater effects (Hormdok & Noomhorm , 2007).

Table 5 Regression equations describing the response of rheological properties and gel texture as a function of the significant effects retained in the models

Response parameter	Equation	R^2
HMT of TK		
Gel hardness	$-3507.57 + 71.67X_1+78.69X_2 -17.58X_3 -0.32X_1^2$ $-18.34X_2^2+0.61X_3^2 +0.40X_1X_2 -0.09X_1X_3 -0.88X_2X_3$	0.923
ANN of TK		
Gel hardness	$2510.02 -84.19X_1 -10.79X_2 +0.71X_1^2 +0.02X_2^2 +0.18X_1X_2$	0.967



(a) (b)

Figure 3 Contour plots of rice flour: the effect of heating temperature and moisture content of (a) HMT (b) and ANN on gel hardness of TK flour, other variable are held at zero level.

Conclusion

Heat-moisture treatment condition on rice flours; heating temperature and moisture content have mainly influenced on rheological properties and texture which are peak viscosity, trough, final viscosity, setback, storage modulus, storage modulus at 95°C and gel hardness.

Annealing condition on rice flour; namely heating temperature had influences on rheological properties and texture that were measured as peak viscosity, setback, storage modulus, storage modulus at 95oC and gel hardness

HMT caused lowering in pasting properties (peak viscosity, trough, final viscosity, and setback) in both varieties. However, rheological properties (storage modulus, storage modulus at 95°C) and gel hardness were increased when moisture content and heating temperature increased. No-significant effect of heating time on response variables. ANN of TK variety had negative response with heating temperature in all pasting and rheological properties.

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Optimization of 5-Aminolevulinic Acid, Red Rice Mold and Biomass of Photosynthetic Bacteria Supplements on Egg Quality in Laying Hens

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Abstract

The effects of dietary 5-aminolevulinic acid (ALA) from photosynthetic bacteria (PSB) (0, 0.15 and 0.30g/kg diet), red rice mold from *Monascus* spp. (0, 5 and10 g/kg diet) and biomass of PSB (0, 1.5 and 0.30g/kg diet) supplements on egg quality in laying hen were studied. A total of 360 (23-wk age) Isa Brown hens were use in trial by Box-Behnken design with 15 treatments (3 replicates) and 8 hens per replication. Food and water were provided *ad libitum* for 10 weeks. From the static analysis revealed that ALA significantly inhibited yolk weight ($P<0.05$), red rice mold significantly inhibited feed intake at last 5 weeks ($P<0.05$), while biomass of PSB was significantly increased of yolk weight ($P<0.05$). In addition, the interaction of ALA and red rice mold showed the significantly inhibition of egg weight and shell weight ($P<0.05$), and the interaction of ALA and biomass of PSB indicated a significantly promotion of yolk weight and shell weight ($P<0.05$). The response surface methodology results from design expert program predicted the effect of ALA (0.20 g/kg), red rice mold (4.53 g/kg) and biomass of PSB (0.30 g/kg) as well as their interactive effects on the maximum yield of egg weight, yolk weight, shell weight and minimum feed intake of 61.30 g, 16.05 g, 9.65g and 114.06 g/h/d, respectively.

Keywords: Laying hen, Egg quality, 5-Aminolevulinic acid, Red rice mold, and Photosynthetic bacteria

Introduction

A new business emerging toward of the use of microbial feeds produced through biotechnological process free from antimicrobial drugs, synthetic colors and other chemicals have been actively investigated as alternative [1]. Among them, 5-aminolevulinic acid (ALA) is a compound which is important role as an intermediate of tetrapyrrole compound biosynthesis pathway for vitamin B_{12}, heme and chlorophyll [2]. Previous studied have also suggested that dietary supplementation of ALA for pigs can affect the synthesis of heme and subsequently improve immune response and the hemoglobin concentration or other blood components such as iron concentration. It is possible that dietary ALA may affect inflammatory response in chickens and modulate the immune system, resulting in mild oxidative stress but decline in growth performance [3]. Those probable effects may provide better general health and resistance to disease [4]. Min et al. [5] conducted a feeding trial in weanling pigs and found that 0.02% ALA could improve growth performance, nutrient digest ability and blood profiles. ALA may have the potential to act as antibiotic alternative. Moreover, Chen et al. [6] reported that supplementation of

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ALA 0, 5, 10 and 15 mg/kg in commercial broiler diets could partially improve hemoglobin concentration and immune organ weight linearity, without influencing the growth performance and other blood characteristics.

Red rice mold is made by fermenting rice shared kitchen (*Oryza sativa*) by *Monascus purpureus*. Product fermented high carotenoids based on by-product could be used as alternative poultry diet, another advantage using fermented product were significantly affected feed consumption, hen day production, egg weight, egg mass and feed conversion on laying hens performance [7]. Substrate for fermented product rich carotenoids can use solid substrate such as sago, cassava and tofu [8]. This product contains stopping cholesterol production (monacolins) and many other synergistic nutrients with lipid-lowering properties such as β-sitosterol and campesterol (interfere with cholesterol absorption in the intestine) [9][10]. Red rice mold also contains fiber, trace elements such as magnesium, unsaturated fatty acids such as oleic, linoleic and linolenic acids [11] and B-complex vitamins such as niacin which have benefit in lipid decreasing [12]. These fungi can produce an intense red pigment such as carotenoids. Carotenoids are lipid soluble pigment has potent antioxidant properties occurring in a wide variety of living organisms and biosynthesized by plant, certain bacteria and fungi and may be absorbed and metabolized by animal. There is evidence of dietary carotenoid supplementation, such as positive effect on immunological and stress response [13]. The ingested carotenoids are deposited in muscle, liver and skin along with their metabolites [14][15]. It has been used extensively in the feed industry for pigmentation, growth and survival. In poultry, carotenoids has been reported to improve egg production, general health of laying hens, improve hatching percentage and the shelflife of eggs, improvements in chick growth and feed utilization during the first 3 weeks of life, and resistance to Salmonella infection. Furthermore, chick mortality associated with yolk sac inflammation has been reduced and changes in egg yolk color and poultry muscle color that could improve consumer acceptance [16].

Photosynthetic bacteria (PSB) are widely distributed in nature, the biomass of these bacteria, especially Rhodospirillaceae, is rich in proteins, vitamins, carotenoids, biological cofactors, amino acid and highly digestible cell wall [17][18][19]. Few studied have been carried out on the potential of PSB, *Rhodopseudomonas palustris* and *Rhodobacter sphaeroides* as probiotic [20]. Probiotics have to firstly survive during the transit through the upper gastrointestinal tract, and then persist in the gut to provide beneficial effects for the host [21]. The in vitro antioxidative activity and acute toxicity of the probiotic *R. palustris* 2C were performed in Wistar rat. This strain was tolerance to acid, high concentration of bile salt and did not damage tissue [22]. The optimum could be either maximum or a minimum of a function of the design parameters. One of methodologies for obtaining the optimum is response surface technique [23]. Therefore, our objective was to evaluate the effect of feeding ALA, red rice mold and biomass of PSB for 10 weeks and evaluate of egg quality using Box-Behnken design. A Box-Behnken experiment is an example of response surface modeling (RSM). It features the economics of experimentation since it

allows reduce a classical 3^3 set up, requiring 27 replications to 15 replications. Generally, the first step is to identify the independent variables or factors that affect the product or process, and then study their effects on a dependent variable or response which a certain process attains the optimal results to determine the levels of the design parameters at which the response reaches its optimum.

Materials and Methods

1. Raw materials and animals

1.1 Experimental animals and diet

Isa Brown hens (Layer chickens) with age of 23 weeks were used in this work.They were housed in a windowless laying house under a 16 h light, and 8 h dark photo period. They were fed with the basal diet for 14-day prior to start of the experiment (Table 1). All cages were equipped with nipple drinkers and a common trough feed. Feed and water were provided *ad libitum* throughout the experimental period. All layers were randomly assigned to 15 treatments with 3 replicates per treatment by Box-Behnken design. Each replicate consisted of 3 adjacent cages with 2 hens per cage.The replicates were equally distributed into the upper and lower cage to minimize the effect of cage level. The diets were supplemented with 3 levels of ALA, red rice mold and biomass of PSB (Table 2) and the experimental design was showed in table 3.

2. Biological substances preparation

2.1 Preparation of ALA and biomass of *R. palustris* JP255

ALA and biomass of *R. palustris* JP255 were prepared by cultured the bacterium in flat bottles containing 350 ml of GMY medium [24] and incubated under a static condition with a light intensity of 5000 lux at 35±1°C for 72 h after that the cell culture were centrifugation at 7000×*g* for 15 min at 4°C. The clear supernatant and the cell pellets are separately lyophilized (EYELA, FDU2100) by dehydration process at low pressure. A fine powder obtained from the clear supernatant portion was determined ALA concentration by the colorimetric method of Mauzerall and Granick [25].

Table 1 Formula and composition of basal diets for the experiments

Ingredients	Quantity (kg)
Corn	65.55
Soy bean mill	19.1
Fish meal	6
Di-calcium	0.15
DL-methionine	0.07
Sodium chloride	0.3
Oil	0.33
Shell	8
Premix	0.5
Total	100

2.2 Red rice mold preparation

Monascus strains were cultured at room temperature for 7 days on C medium and suspended the conidia in sterile 0.1% (v/v) tween 80. Two milliliters of 10^6 spores/ml were inoculated on a local cultivar of non-sticky rice (Kao-Hom Mali) and incubated on moistened rice in Erlenmeyer flasks for one or five weeks in an incubator (64% humidity) with different temperature conditions as described by Chayawut et al. [26]. The rice medium was prepared for a solid culture by soaked the dehulled rice in tap water (2 h) and the soaked rice was drained (10 min) and then a 500-ml flask containing 100 g rice was sterile and cooled to room temperature. The fermented rice was dried in a hot air oven overnight at 105ºC and stored in refrigerator [27]. (The red rice mold was assisted form Prof. Dr. BussabaYongsmith)

3. Samples collection

Daily feed intake (g) was recorded, andfeed conversion efficiency (feed intake: mass production during the 5-wk feeding period was calculated from:

$$\text{Feed intake (g/hen/day)} = \frac{\text{Feed consumption (g)}}{\text{Amount of laying hen (hen) x Time (day)}}$$

Eggs from each group of laying hens were collected at the end of 10-wk of the feeding period for measuring egg quality (egg weight, yolk weight and shell weight) (Khan *et al.*, 2007).

Results and Discussion

Using the Box-Behnken design for determination of the effects of ALA, red rice mold and biomass of PSB

The experiment was performed by adding of ALA, biomass of PSB and red rice mold into feed daily toward the eggs internal quality (yolk weight, egg weight, shell weight and feed intake), the Box-Behnken design was set up. Three variables of ALA (X_1), red rice mold (X_2), and biomass of PSB (X_3) at three levels (low, medium, and high) of each parameter and coded (-1, 0, and +1) shown in Table 2. The results were subjected to statistical analysis and the predicted condition obtained by RSM was selected to confirm the results. The eggs internal quality was determined at 10 week.

The Box-Behnken experiments were 15 replications (Table 3). The linear, quadratic effects and first order interactions can be elegantly estimated, which is in most case satisfactory. The quadratic second-order polynomial equation was as follows:

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_{12}X_{12} + b_{13}X_{13} + b_{23}X_{23} + b_{11}X_1^2 + b_{22}X_2^2 + b_{33}X_3^2$$

The coefficient, b_0 is the free or off-set term called the intercept. The terms b_1, and b_3 are linear coefficients and b_{11}, and b_{33} are the quadratic coefficients. The difference between means was evaluated by Duncan's Multiple Range Test, and *P*-value < 0.05 was considered as significant.

Table 2 ALA, red rice mold and biomass of PSB and their levels chosen for a Box- Behnken design

Variables (g/kg)	Coded	Levels of supplements (g/kg)		
		-1 (low)	0 (medium)	1 (high)
ALA powder	X_1	0	0.15	0.30
Red rice mold	X_2	0	5	10
Biomass of PSB	X_3	0	0.15	0.30

1. Influence on egg weight

Table 3 indicates that there was not a wide variation of egg weight (54.08-63.17 g) obtained from experimental runs. The lowest egg weight (54.08 g) was obtained from run No. 2, in which the supplemented 5g/kg red rice mold and 0.30 g/kg biomass of PSB into feed dairy. In contrast, the maximum egg weight (63.17 g) was obtained from run No. 14, in which the supplemented 5g/kg ALA into feed dairy. Runs Nos. 8, 10, 11, 12, 13 and 15 were operated at 0.15 g/kg ALA and runs Nos. 3, 4, 6 and

7 at 0.30 g/kg ALA. It should be noted that the egg weight obtained from runs no. 1 and 5 were drastically different, although they were operated under the same ALA. The results of 15 runs were investigated to find the best model to represent the maximum egg weight by entering the results of the experimental data obtained from the Box-Behnken design into the Design-Expert software. The quadratic regression Eq. [1] for egg weight was therefore given as follow:

$$Y_1 \text{ (g)} = +57.39542 + (51.65278 * X_1) + (0.19958 * X_2) - (13.52222 * X_3) - (1.07667 * X_1X_2) + (31.77778 * X_1X_3) + (0.68 * X_2X_3) - (102.3148 * X_1^2) - (6.68333 * 10^{-3} * X_2^2) + (10.42593 * X_3^2) \quad \text{.....[1]}$$

Where Y_1 is the egg weight (g) and X_1, X_2 and X_3 are the coded values of the independent variables *viz*. ALA, red rice mold and biomass of PSB, respectively. In this experiment, the obtained model was significant with a high determination coefficient (R^2 = 0.9848). The value of the adjusted determination coefficient (adjusted- R^2 = 0.9575) suggested that the total variation of 95.75% for the egg weight was to be attributed to the independent variables and about 4.25% of the total variation could not be explained by the model. The coefficient estimates of Eq. [1] and the corresponding *P*-values are shown in Table 4 demonstrating that the maximum egg weight significant depended on the ALA but PSB level was negative affected on egg weight. Hong et al. [28] and Wang et al. [29] also shows that the supplementation of ALA in the basal diet of Laying hen could affected of egg weight and yolk color.

The predicted egg weight was obtained by solving regression Eq. [1] and the maximization of egg weight were the 0.21 g ALA, 5.83 g red rice mold and 0.02 g biomass of PSB. The maximum response value for the egg weight was estimated as 63.31 g. The interaction of each variables were plotted based on Eq. [1] where one variable was kept constant at its moderate level and the other two variables were varying within the experimental range. A contour plot of egg weight, obtained by fixing the biomass of PSB at 0.15 g/kg (Figure 1) and the level of ALA and red rice mold at 0-0.30 g/kg and 0-10 g/kg, respectively, egg weight up to 62 g was obtained. The main effects of X_1, X_2 and X_3 and represent the average result of changeding one variable at a time from its low level to its high level. The interaction terms (X_1X_2, X_1X_3, X_2X_3, X_1^2, X_2^2 and X_3^2) show howY_1 changes when 2 variables are simultaneously changed. The negative coefficient for X_3 indicates an unfavorable effect on Y_1, while the positive coefficients for the interactions between 2 variable X_1X_2 indicate a favorable effect on Y_1.

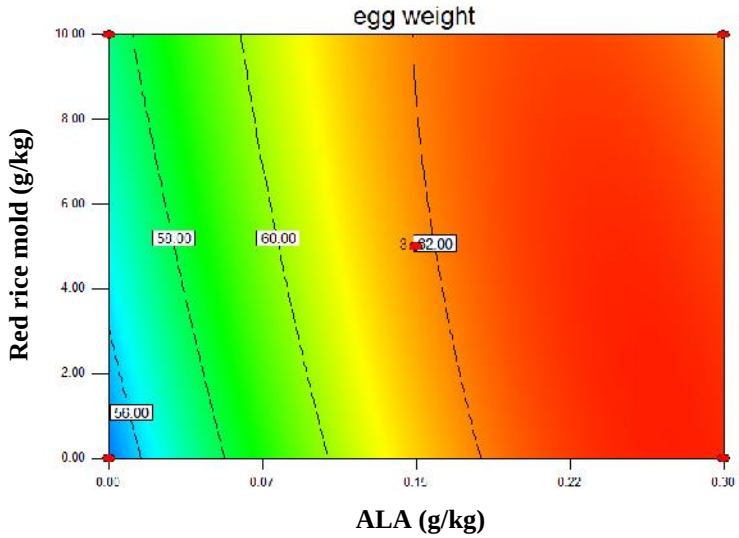

Figure 1 Contour plot showing the interaction of ALA (X_1) and red rice mold (X_2) on egg weight obtained by fixing biomass of PSB at 0.15 g/kg

2. Influence on yolk weight

Table 3 indicates that there was not a wide variation of yolk weight (13.09-15.67 g) obtained from experimental runs. The lowest yolk weight (13.09 g) was obtained from run No. 6, in which the supplemented 0.3 g/kg ALA, 10 g/kg red rice mold and 0.15 g/kg biomass of PSB into feed dairy. In contrast, the maximum egg weight (15.67 g) was obtained from run No. 2, in which the supplements of 5 g/kg red rice mold and 0.3 g/kg biomass of PSB into feed dairy. Runs Nos. 3, 4 and 6 were operated at 0.30 g/kg ALA. It should be noted that the yolk weight obtained from runs no. 7 was drastically different, although they were operated under the same ALA.The results of 15 runs were investigated to find the best model to represent the maximum yolk weight by entering the results of the experimental data obtained from the Box-Behnken design into the Design-Expert software. The quadratic regression Eq. [2] for egg weight was therefore given as follow:

$$Y_2\ (g) = +14.67883 + (2.46806 * X_1) + (0.34857 * X_2) - (2.43028 * X_3) - (0.65233 * X_1X_2) + (27.26667 * X_1X_3) + (0.10767 * X_2X_3) - (22.68519 * X_1^2) - (0.028447 * X_2^2) + (3.67037 * X_3^2) \quad [2]$$

Where Y_2 is the yolk weight (g) and X_1, X_2 and X_3 are the coded values of the independent variables *viz*. ALA, red rice mold and biomass of PSB, respectively. In this experiment, the obtained model was significant with a high determination coefficient (R^2 = 0.9138). The value of the adjusted determination coefficient (adjusted- R^2 = 0.7586) suggested that the total variation of 75.86% for the yolk

weight was to be attributed to the independent variables and about 14.24% of the total variation could not be explained by the model. The coefficient estimates of Eq. [2] and the corresponding *P*-values are shown in Table 4 demonstrating that the maximum yolk weight was significant depended on red rice mold level. ALA was significant negative affected on yolk weight but significant interaction with PSB.

The predicted yolk weight was obtained by solving regression Eq. [2] and the maximization of yolk weight were the 0.15 g ALA, 4.98 g red rice mold and 0.30 g biomass of PSB. The maximum response value for the yolk weight was estimated as 16.072 g. The interaction of each variables were plotted based on Eq. [2] where one variable was kept constant at its moderate level and the other two variables were varying within the experimental range. A contour plot of yolk weight, obtained by fixing the red rice mold at 5 g/kg (Figure 2) and the level of ALA and biomass of PSB at 0-0.30 g/kg and 0-0.3 g/kg, respectively, yolk weight up to 15 g was obtained.

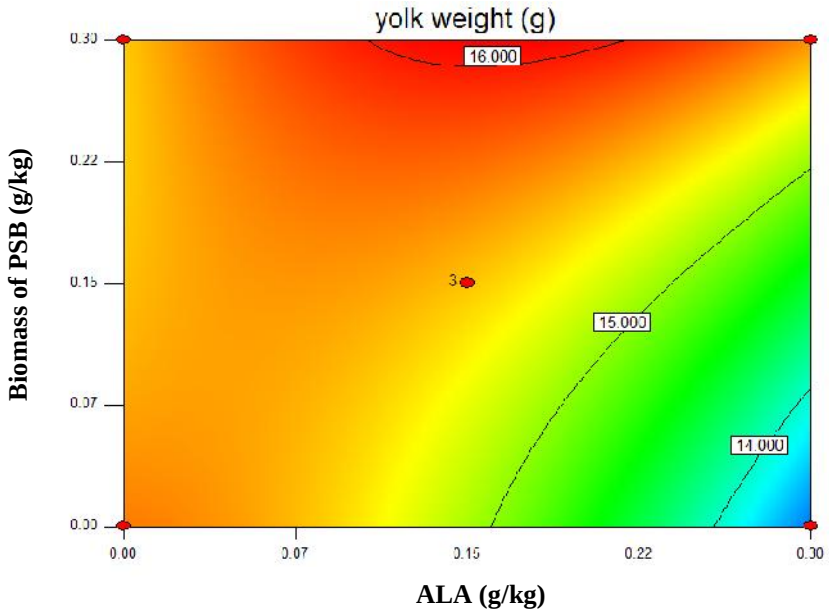

Figure 2 Contour plot showing the interaction of ALA (X_1) and biomass of PSB (X_3) on yolk weight obtained by fixing biomass of PSB at 0.15 g/kg obtained by fixing red rice mold at 5 g/kg

Table 3 The actual and predicted values of egg weight, yolk weight, shell weight and feed intake obtained from a Box-Behnken design from ALA, red rice mold and biomass of PSB

Run No.	Variables (g/kg)			Egg weight (g)		Yolk weight (g)		Shell weight (g)		Feed intake (g/hen/day)	
	X_1	X_2	X_3	actual	predicted	actual	predicted	actual	predicted	actual	predicted
1	0.00	0	0.15	54.75	55.13	14.48	14.40	9.00	9.00	116.79	117.67
2	0.00	5	0.30	54.08	54.35	15.67	15.47	9.50	9.41	116.61	116.08
3	0.30	5	0.00	63.07	62.90	13.24	13.43	8.25	8.34	115.71	115.45
4	0.30	0	0.15	62.35	62.85	14.17	14.32	9.75	9.69	117.86	117.62
5	0.00	10	0.15	57.98	57.58	15.35	15.20	10.00	10.06	113.21	113.92
6	0.30	10	0.15	62.35	62.07	13.09	13.17	9.00	9.00	114.28	113.87
7	0.30	5	0.30	61.73	61.89	16.07	15.65	9.75	9.72	115.71	116.04
8	0.15	5	0.15	61.78	61.88	15.38	15.49	9.50	9.33	115.18	115.77
9	0.00	5	0.00	58.28	58.23	15.29	15.71	9.00	9.03	117.14	115.50
10	0.15	10	0.00	62.00	62.55	14.47	14.20	9.00	8.91	112.13	113.60
11	0.15	5	0.15	61.67	61.88	15.55	15.49	9.25	9.33	115.36	115.77
12	0.15	10	0.30	60.70	61.23	15.01	15.35	9.50	9.53	115.36	114.18
13	0.15	0	0.30	59.83	59.28	15.10	15.37	9.50	9.59	117.50	117.94
14	0.15	0	0.00	63.17	62.84	14.88	14.54	8.50	8.47	117.86	117.35
15	0.15	5	0.15	62.03	61.88	15.55	15.49	9.25	9.33	115.84	115.77

X_1= ALA, X_2 = Red rice mold and X_3 = Biomass of PSB

Table 4 Coefficient and *P*-values of egg weight, yolk weight, shell weight and feed intake obtained from the analysis of the results that are listed in Table 3

Coded of variables	egg weight (g)		yolk weight (g)		shell weight (g)		Feed intake (g/hen/day)	
	Coefficient	*P*-value	Coefficient	*P*-value	Coefficient	*P*-value	Coefficient	*P*-value
Intercept	61.83	0.0005	15.49	0.0326	9.33	0.0023	115.77	0.0010
X_1	3.05	<0.0001**	-0.53	0.0169*	-0.094	0.1029	-0.023	0.9445
X_2	0.37	0.1408	-0.088	0.5817	0.094	0.1029	-1.88	0.0001**
X_3	-1.27	0.0017**	0.49	0.0212*	0.44	0.0002**	0.29	0.3842
$X_1 X_2$	-0.81	0.0415*	-0.49	0.0686	-0.44	0.0012**		
$X_1 X_3$	0.71	0.0606	0.61	0.0337*	0.25	0.0132*		
$X_2 X_3$	0.51	0.1457	0.081	0.7182	-0.13	0.1191		
X_1^2	-2.30	0.0007**	-0.51	0.0681	0.052	0.4859		
X_2^2	-0.17	0.6111	-0.71	0.0232*	0.052	0.4859		
X_3^2	-0.23	0.4810	0.083	0.7228	-0.26	0.0132*		
Lack of fit		0.0576		0.0322		0.6148		0.1097

X_1= ALA, X_2 = Red rice mold and X_3 = Biomass of PSB

Egg weight: R^2 = 0.9848, Adjusted R^2= 0.9575; Yolk weight: R^2 = 0.9138, Adjusted R^2 = 0.7586

Shell weight: R^2 = 0.9717, Adjusted R^2= 0.9207; Feed intake: R^2 = 0.7591, Adjusted R^2 = 0.6934

* Significance level at 95%

** Significance level at 99%

3. Influence on shell weight

Table 3 indicates that there was not a wide variation of shell weight (8.5-10 g) obtained from experimental runs. The lowest shell weight (8.5 g) was obtained from run No. 14, in which the supplemented 0.15g/kg ALA into feed dairy. In contrast, themaximumshell weight (10 g) was obtained from run No. 5, in which the supplemented 10 g/kg red rice mold and 0.15 g/kg biomass of PSB into feed dairy. Runs Nos. 3, 10 and 14 were operated at 0 g/kg biomass of PSB and 0.15-1.3 g/kg ALA. Moreover, the shell weight obtained from run No. 2, 7, 8, 12 and 13were drastically higher when supplemented 0.15-0.3 g/kg biomass of PSB. The results of 15 runs were investigated to find the best model to represent the

maximum egg weight by entering the results of the experimental data obtained from the Box-Behnken design into the Design-Expert software. The quadratic regression Eq. [3] for shell weight was therefore given as follow:

Y_3 (g) = +8.42708 - (0.069444*X_1) + (0.11042*X_2) + (5.55556*X_3) – (0.58333*X_1X_2) + (11.11111* X_1X_3) - (0.16667*X_2X_3) + (2.31481*X_1^2) - (2.08333*10^{-3}*10^{-3}*X_2^2) - (11.57407*X_3^2).....[3]

Where Y_3 is the shell weight (g) and X_1, X_2 and X_3 are the coded values of the independent variables *viz*. ALA, red rice mold and biomass of PSB, respectively. In this experiment, the obtained model was significant with a high determination coefficient (R^2 = 0.9717).

The value of the adjusted determination coefficient (adjusted- R^2 = 0.9207) suggested that the total variation of 92.07% for the shell weight was to be attributed to the independent variables and about 7.93% of the total variation could not be explained by the model. The coefficient estimates of Eq. [3] and the corresponding *P*-values are shown in Table 4 demonstrating that the maximum shell weight depended on the biomass of PSB level. The ALA and red rice mold did not significantly affected on shell weight but significant interactive between ALA and PSB. Biomass of PSB is a group of probiotics have beneficial effect on the health and wellbeing of the host, direct stimulating of appetite, improve intestinal microbial balance, stimulate the immune system, produce the enzyme in digest tract, synthesize vitamins, utilize undigested carbohydrate, stimulated lactic acid and volatile fatty acids productions, decrease pH and release bacteriocin [30][31].

The predicted shell weight was obtained by solving regression Eq. [3] and the maximization of shell weight were the 0.29 g of ALA, 0.22 g of red rice mold and 0.25 g of biomass of PSB. The maximum response value for the shell weight was estimated as 10.05 g. The interaction of each variables were plotted based on Eq. [3] where one variable was kept constant at its moderate level and the other two variables were varying within the experimental range. A contour plot of shell weight, obtained by fixing the biomass of PSB at 0.15 g/kg (Figure 3a), shell weight up to 9.50 g was obtained. In figure 3b, when fixing the ALA at 0.15 g/kg, shell weight up to 9.60 g was obtained.

4. Influence on feed intake

Table 3 indicates that there was not a wide variation of feed intake (112.13-117.86 g/h/d) obtained from experimental runs. The lowest feed intake (112.13 g/h/d) was obtained from run No. 10, in which the supplemented 0.15g/kg ALA and 10 g/kg red rice mold into feed dairy. The results of 15 runs were investigated to find the best model to represent the maximum egg weight by entering the results of the experimental data obtained from the Box-Behnken design into the Design-Expert software. The results of multiple linear regression analysis reveal that, on increasing the red rice mold (Table 4) a decrease in feed intake is observed. It was concluded that if at higher level of X_2 a feed intake was decreased. The value of R^2 from Eq [4] for feed intake was therefore given as follow:

Y_4 (g/h/d) = +117.37643- (0.15333*X_1) - (0.37540*X_2) + (1.95*X_3) ……..[4]

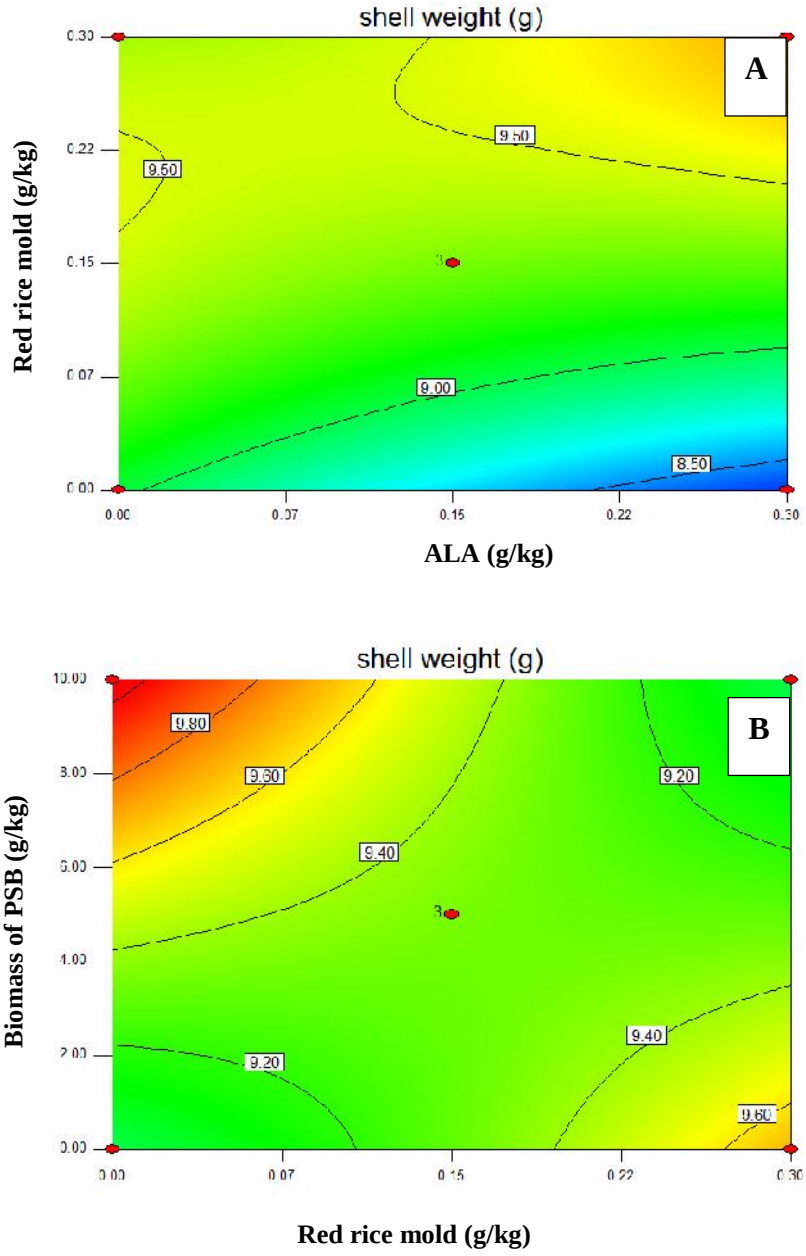

Figure 3 Contour plot showing the interaction of ALA and red rice mold on shell weight obtained by fixing of biomass of PSB at 5 g/kg (A) and effect of red rice mold and biomass of PSB on shell weight by fixing of ALA at 0.15 g/kg (B)

Where Y_4 is the feed intake (g/h/d) and X_1, X_2 and X_3 are the coded values of the independent variables *viz*. ALA, red rice mold and biomass of PSB, respectively. In this experiment, the obtained model was significant with a determination coefficient (R^2 = 0.7591). The value of the adjusted determination coefficient (adjusted-R^2 = 0.6934) suggested that the total variation of 69.34% for the feed

intake was to be attributed to the independent variables and about 31.66% of the total variation could not be explained by the model. The coefficient estimates of Eq. [4] and the corresponding *P*-values are shown in Table 4 demonstrating that the minimum feed intake depended on red rice mold.

Conclusion

Considerable research has been conducted to develop and to produce egg which has high egg weight, yolk weight and shell weight with minimum of feed intake. The results of the present study indicated that laying hen fed diet supplemented resulted in a significant increase of egg weight but decrease of yolk weight, red rice mold was significant decreased of feed intake, biomass of PSB was significant increase of yolk weight and shell weight but decreased egg weight. The interaction of ALA and red rice mold were significant decreased of egg weight and shell weight. The interaction of ALA and biomass of PSB were significant in creased of yolk weight and shell weight. From all results showed the predicted model of maximum egg weight, yolk weight, shell weight and minimum feed intake were found to be at 0.20 g/kg ALA, 4.53 g/kg red rice mold and 0.30 g/kg biomass of PSB which gave a maximization of egg weight (61.30 g), yolk weight (16.05 g), shell weight (9.65 g) and minimization of feed intake (114.06 g/h/d) with desirability at 72.5%. This is the first time in RSM optimization in laying hen. The optimum feeding of ALA, red rice mold and PSB in basal medium are the guideline for mass production in egg industry.

Acknowledgement

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The Use of Tempering and Pricking to Improve Quality of Cassava Drying

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Abstract

The tempering and pricking techniques were combined with tray drying to improve the drying characteristics of cassava slices. Five levels of drying temperatures, ranging from 60 to 120°C, were used in this experiment. The 5-mm cassava slices (Kasetsart 50 variety), initially holding a moisture content of 60-70 %, were dried to 12-14 %. As far as we have known that the increase in drying temperature will increase the drying rate or decrease the drying period, it was also found that results in this experiment. The drying rate was increased from 0.27 to 0.76 hr^{-1} when drying temperature increased from 60 to 120°C. However the dried cassava slices with 12–14% moisture content which have dry surfaces still moist inside by applying high drying temperature at above 90°C. And it was found that tempering and pricking could reduce the percentage of slices affected by moisture trapped underneath the dry surface. The amount of dried cassava slices presenting moist inside was decreased from 66 to 12 % with tempering drying and to 9 % with the pricking in the cassava slices. These results involved drying at 120°C. These techniques also affected the drying rates in two opposite ways: it increased when applying the pricking technique and it decreased when tempering drying was used. The drying rates of cassava slices at 120°C with pricking and with tempering were 0.83 and 0.28 hr^{-1} respectively.

Keywords: Cassava, Drying, Tempering, Pricking

Introduction

Cassava is one of the major crops of Thailand. The production yield of cassava is 28.6 million tons in 2014 and export mainly in form of cassava chip [1]. To produce cassava chip, an open sun drying is the most common practice for cassava chip industry in Thailand. But the contamination by birds, insect,rubble, sand and dust which constitutes a loss of quality, need of a lot of land area and time consuming are the important reasons for shifting from open sun drying to controlled drier. Some kinds of drier that were used to investigatethe drying characteristic of cassava were hot-air and microwave oven [2,3], rotary drier [4] and tray drier [5, 6]. In drying process, condition of dryinghas a great effect on quality attributes of dried product. Higher drying temperature reduced the drying time but may result in overheating or over-drying of the surface layer resulting in quality problem without major increase in the drying kinetics [7].Intermittent drying or tempering drying is considered one of the promising solutions for improving energy efficiency and product quality without increasing the capital cost of drier [8].There are numerous studieson quality aspects in intermittent drying which mostly of them are cracking or fissuring in grain such as by Aquerreta et al. [9], and color change in fruit with high sugar and high moisture

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content such as by Baini and Langrish[10]. Sarayut and Parichatfound the problem in cassava drying which differed from those aspects that the cassava still moist inside after drying at high temperature [6]. Pricking which known as a method to allow the steam to escape in cooking might be the other solution. The objective of this study was to explore the techniques that could overcome the problem of moisture trapped underneath the dry surface of cassava chip after using high temperature drying.

Materials and Methods

1. Material

Cassava roots (Kasetsart50variety) used in the present study were harvestedat 10 months of maturity from local plantation in Ratchaburi province, Thailand. They were taken to the laboratory,peeled and sliced to 5mm thick with approximately 55 mm in diameter.An additional preparation for pricking technique was required. Cassava slices were pricked with fork at the center of a slice in the pattern of asterisk shape. And all samples were sealed in polyethylene bags before testing to keep their moisture.

2. Drying experiment

In all experiment, approximately 600g of sampleswere used. The samples were uniformly spread in single layer on 3 perforated trays and placed in the drying chamber of laboratory tray dryer. Thetemperature of hot air was set at 60, 90, 100, 110 and 120°C for continuous drying. The intermittent drying was used for tempering technique with 10- min drying period at 110 and 120°C and rest for 30 min.

To monitor the weight loss during drying the trays with samples were weighed at10-min intervals.The product was examined for quality after drying to a moisture content of about 13% (w.b.). The target weight of the product to achieve this moisture content was precalculated based on the initial weight of the sample and its initial moisture content. Moisture content was determined by using infrared moisture determination balance (Model HB 43-S, Mettler Toledo) at 200°C.

3. Data analysis

Drying rate is defined by the loss of moisture from the wet solid per each unit of time and was calculated using the following equation:

$$DR = \frac{(M_i - M_f)}{t} \quad (1)$$

Where

DR=the drying rate, hr^{-1}

M_i = the initial moisture content (d.b.), decimal

M_f = the final moisture content (d.b.), decimal

t= the drying time, hr

Empirical models for drying kinetic of cassava slices at each temperature were also fitted to the experimental data using Henderson and Pabis model as presented in Eq. 2.

$$MR = \frac{M-M_e}{M_i-M_e} = a\exp(-kt) \quad (2)$$

Where

MR = the moisture ratio

M = the moisture content at time t, % (d.b.)

M_e = the equilibrium moisture content, % (d.b.)

M_i = the initial moisture content, % (d.b.)

a = the drying parameter

k = the drying rate constant

A Color spectrophotometer (Model ColorFlex,HunterLab) was used for color determination. The color spectrophotometer was set to an illuminant D_{65} and a 10^{o} standard observer. Color measurements were made in fivepositions on samples placed in a powder cell. The color was measured in CIE L*, a*, b* color space. L* is a measure of the lightness from black (0) to white (100). Parameter a* describes red-green color with positive a*-values indicating redness and negative a*-values indicating greenness. Parameter b* describes yellow-blue color with positive b*-values indicating yellowness and negative b*-values indicating blueness.

All pieces of product were broken in half to check the quality of drying. The amount of dried cassava slices presenting moist insidewas calculated in percentage and shown as defect.

Results and Discussion

The initial moisture content of cassava slices varied from 58.9 to 69.8 %(w.b.) with an average value of 63.2 % (w.b.). After drying, moisture content was between12.3and 13.4% (w.b.). The drying characteristic of cassava slices with continuous drying is illustrated in Figure 1 as plots of the moisture content (% d.b.) versus time.Drying at 90, 100, 110 and 120°C produced steeper curves than at 60°C which indicated the faster rate of moisture removal.Total drying period was shorter at the higher temperature. The longest drying period of 290 min was at 60°C whereas the drying period at 90, 100, 110 and 120°Cwere 180, 140, 130 and 110 min respectively. Thesedrying periods are quite long compared to work done by Watyotha [2] and Kajuna et al. [5] but extremely short compared to work done by Wilaipon [3] and Mookkhan et al. [4].

The Henderson and Pabis modelof drying kinetics was fitted to the experimental data by using non-linear regression technique. The drying rate constant (k), the drying parameter (a), and coefficient of determination (R^2) of the five drying temperatures were given in Table 1.For all temperatures, it was found that R^2 was higher than 0.98. The drying rate constant ranged from 0.0114 to 0.0239 depends on drying temperature. The drying parameter was between 1.1526 and 1.2061 which deviated from 1.0 about 15-21%.

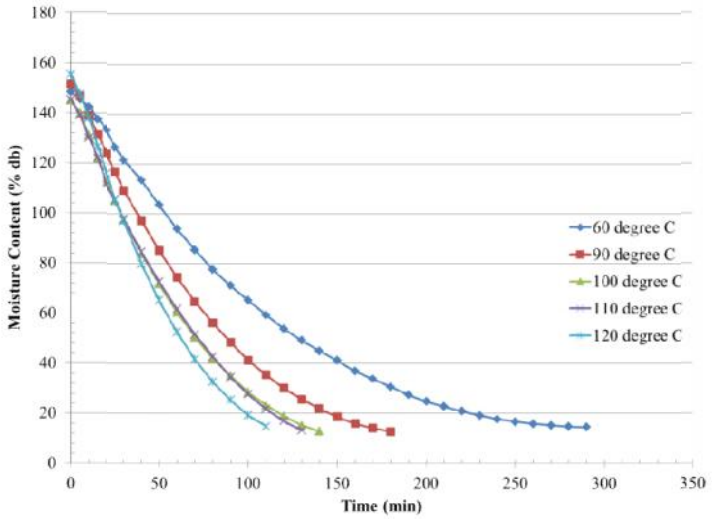

Figure 1 Drying curves of cassava slices at 60, 90, 100, 110 and 120°C.

Table 1 The drying constants and parameters of fivedrying temperatures

Drying temperature (°C)	*a*	*k*	R^2
60	1.2061	0.0114	0.9866
90	1.1526	0.0155	0.9956
100	1.1749	0.0195	0.9883
110	1.1664	0.0218	0.9938
120	1.1782	0.0239	0.9961

Table 2 Drying rate of cassava slices at each condition

Drying temperature (°C)	Drying rate (hr^{-1})			
	Continuous	Tempering	Pricking	Tempering & Pricking
60	0.27 ± 0.00^{a}	-	-	-
90	0.45 ± 0.03^{d}	-	-	-
100	0.56 ± 0.03^{e}	-	-	-
110	0.60 ± 0.01^{f}	0.29 ± 0.01^{ab}	0.61 ± 0.01^{f}	0.32 ± 0.01^{bc}
120	0.76 ± 0.03^{g}	0.28 ± 0.01^{a}	0.83 ± 0.03^{h}	0.33 ± 0.02^{c}

Remark: Means with standard deviations followed by different superscripts are statistically different ($p< 0.05$).

Table 3 The color L*a*b* of dried cassava slices at each temperatures

Drying temperature (°C)	Color		
	L*	a*	b*
60	95.96^{b}	-0.50^{ns}	6.93^{a}
90	96.00^{b}	-0.44^{ns}	7.15^{a}
100	96.06^{b}	-0.48^{ns}	7.01^{a}
110	95.29^{a}	-0.43^{ns}	8.56^{b}
120	95.48^{a}	-0.34^{ns}	8.09^{b}

Remark: Means in column followed by different superscripts are statistically different ($p< 0.05$).

The relative influences of temperature and technique on drying rate are quantitatively represented in Table 2. Although the high temperature in continuous drying has been shownthe high drying rate, the drying quality of products did not perform well.The effect of drying temperature on color of dried cassava slices has also been reported in Table 3. It was observed that drying at 110 and 120°Cresulted in darker color than drying at 60, 90 and 100°C. Moreover, drying at above 90°Cresulted in moisture trapped underneath the dry surface. From Figure 2, it can be seen clearly the zone of moist area that lay down in the middle layer of cassava slices. As drying temperature increased, the defect was also increased from 9 % at 100°C to 66 % at 120°C (Table 4). In order to overcome this problem, tempering and pricking technique were added in drying at high temperature.

Figure 2 Cross-section of dried cassava slice containing moist inside.

The results indicated that both tempering and prickingtechniques could reduce the defect at high drying temperature from 24 % to 19 % and 5 % at 110°C and from 66 % to 12 % and 9 % at 120°C. The drying was also faster when pricking was applied in continuous drying. Similarly to our results, drying time reduction was also observed in amla, the Indian Gooseberry, which had pricking treatment prior to solar drying [11]. The amount of defect products obtained by pricking with continuous dryingwas similar to that with intermittent drying at 110°C, and lesser than intermittent and continuous drying without pricking. Conversely, the amount of defect products obtained by intermittent dryingwith pricking was similar to that without pricking at 120°C, and greater than continuous drying with pricking. Thus, these data demonstrated that pricking had the major influencewith drying at high temperature resulting in

reducing the defect ofproduct while tempering would suppress the advantage of pricking at extra high temperature. Nevertheless tempering technique also gave somewhat benefit.

Table 4 The amount of dried cassava slices presenting moist inside at each conditions

Drying temperature (°C)	Defect (%)			
	Continuous	Tempering	Pricking	Tempering & Pricking
60	0	-	-	-
90	0	-	-	-
100	9	-	-	-
110	24	19	5	6
120	66	12	9	12

Figure 3 and 4 present the comparison of drying characteristic for each condition at 110 and 120°C respectively.It is seen clearly that the tempering gave the longer drying period than continuous drying whilethere was not much difference in drying period between pricking and without pricking. Even though the drying period of pricking technique seems to be longer than continuous drying without pricking, the higher drying rate was observed due to the greater initial moisture content.

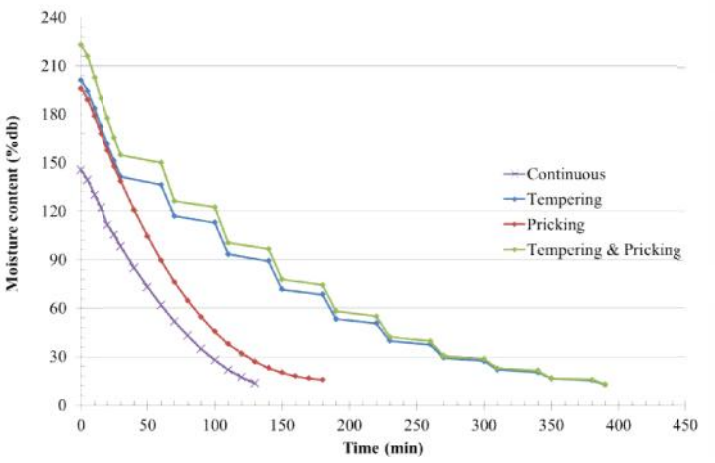

Figure 3 Drying curves of cassava slices at 110°C with different techniques.

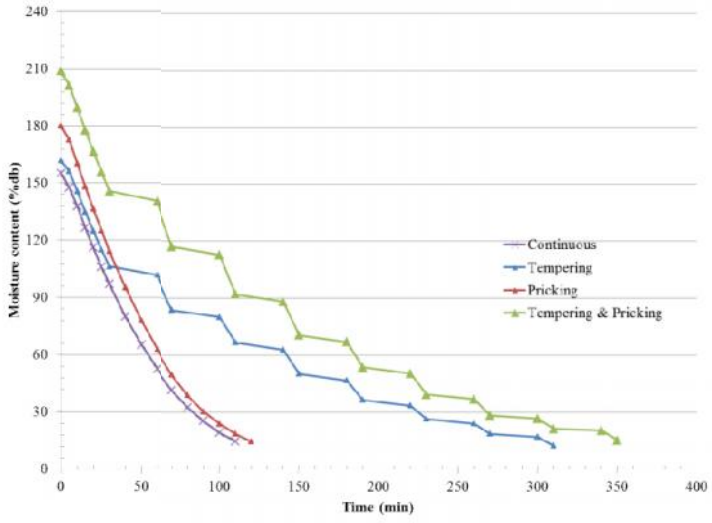

Figure 4 Drying curves of cassava slices at 120°C with different techniques.

Conclusion

From this study, it was apparent that improvements in drying quality should be possible by employing additional techniques; tempering and/or pricking.However the reducing of defect obtained by tempering technique would decrease the drying rate or gave the longer drying period. The pricking technique takes advantage of the rapid drying possible at high temperatures and also reduces the product defect. Amongthe twotechniques within the experimental range, pricking was observed to be the best way to cope the problem of moisture trapped.

Acknowledgement

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The Study on Using Hydrolyzed Protein from Nile Tilapia By-products in Beverage Products as Stabilizer.

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and Jittawan Kubola[1]

Abstract

Nile Tilapia is one of the most famous fish for consumption in Thailand, but its by-products still have limitation for using. This research was studied on using hydrolyzed protein of Nile Tilapia By-products as a stabilizer in pineapple and carrot juices. The beverage stability was measured by the calculation of initial emulsion height and height of the sedimentation phase as a percentage of sedimentation. The result revealed the relation between the beverage stability and the hydrolyzed protein gel- powder level on the percentage of sedimentation. The 1.0 gel powder had shown the better stability than the 0.5 and the control by lower percentage of sedimentation (respectively.). The results can use for studying of alternative stabilizer in beverage and emulsion products.

Keywords: *Nile Tilapia , Oreochromis niloticus*, Hydrolyzed Protein, Beverage, Stabilizer

Introduction

Nile tilapia (*Oreochromis niloticus*) is one of the most famous fish for consumption in Thailand. The Nile tilapia industry also has grown, especially on exportation. Thailand's export of Nile tilapia to overseas market is several millions a year, and is likely to increase every years [1]. On the same pace, its by-products also has left out of the processing. The head and rib part are useful by-products, they still have some meat and skin in this part. The protein content of both parts can be useful in many ways such as nutrition and hydrocolloid properties. The hydrolyzed protein from animals such as gelatin can be used as emulsion stabilizer [2]. This research was assumed that hydrolyzed protein from Nile tilapia's head and rib part can be used in beverage as stabilizer. In beverage industries such as fruit and vegetable products, they also need hydrocolloids for stabilizing their dregs after processing and storage. Fruits and vegetable beverage industries need their products have colloidal or larger particles suspended in juices or drinks. Karl has studied about proteins that bind polyphenols in beverage [3]. The results found that protein–polyphenol interaction had affected haze formation in beverages. In the other way, Juan and Ana [4] also found that protein content has affected to physical properties of fluid by protein-polysaccharide interactions, which means that hydrolyzed protein should be use in any liquid products. Moreover, there are many studies were focused on hydrolyzed protein from by-products and their stabilizer properties. For example, Rhicha *et al*. has studied about stabilization of beverage that

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mixed with enzymatically hydrolyzed whey protein [5], and the results showed the highly positive relation of hydrolyzed whey protein and beverages stability.

Materials and Methods

1. The hydrolyzed protein preparation

Nile tilapia's head and rib part were prepared to be hydrolyzed protein by boiling the head and rib part in water (the ratio was 1:5) for 3 hours, the aqueous hydrolyzed protein was dried by hot air for 12 hours before ground to be gel powder. The powder had kept in Aluminium Foil Bag until use.

2. The beverage preparations

Pineapples and carrots were peeled and extract their juices by a juice extraction machine. Pineapple and carrot juices were mixed with Nile tilapia's hydrolyzed protein powder (0.5 and 1.0 percent), the natural juices (0 percent) were used as control.

3. The degree of sedimentation test (stabilization test)

15 ml of pineapple and carrot beverages were transferred into 20 ml test tube and stored for a week at room temperature. The beverage stability was measured by the calculation of initial emulsion height and height of the sedimentation phase as a percentage of sedimentation. The method was adapted from the creaming test of emulsion stability (Mirhosseini *et al*. [6]).

4. The protein content determination

The mixture parts (Top) and dregs part (Bottom) of the pineapple and carrot beverages were measured their protein content by AOAC 2000.

The data were recorded as means ± standard deviation of triplicate measurements. Analyses of variance were presented by ANOVA test and a comparison of means was carried out by Duncan's multiple-range test. The level of significance was set at 0.05.

Results and Discussions

1. The degree of sedimentation test (stabilization test)

The results has revealed the relation between the beverage stability and the hydrolyzed protein gel powder level on the percentage of sedimentation that has shown in table 1.

The high percentage of sedimentation test has shown low stability of the beverages. The beverage that has higher hydrolyzed protein content would have more stability, that depend on their protein content.

Table 1 The degree of sedimentation test of beverages mixed with hydrolyzed protein gel powder.

Hydrolyzed protein (%)	Pineapple juice (%)	Carrot juice (%)
0 (Control)	82.95±0.52[b]	65.31±0.26[c]
0.5	79.04±0.13[a]	53.26±0.15[b]
1	78.53±0.12[a]	49.62±0.08[a]

2. The protein content of beverages mixed with hydrolyzed protein gel powder

The results of protein content of pineapple and carrot beverages were studied in two sub-sections, they were total protein content (table 2) and separated protein content (table 3).

Table 2 The total protein content of beverages mixed with hydrolyzed protein gel powder.

Hydrolyzed protein (%)	Pineapple juice (%)	Carrot juice (%)
0 (Control)	0.31±0.03[a]	0.85±0.03[a]
0.5	1.06±0.04[b]	1.24±0.03[b]
1	1.22±0.04[c]	1.84±0.04[c]

Table 3 The separated protein content of beverages mixed with hydrolyzed protein gel powder by beverages separation after storage.

Hydrolyzed protein (%)	Pineapple juice (%)		Carrot juice (%)	
	Top	Bottom	Top	Bottom
0	0.25±0.05[a]	0.36±0.01[a]	0.17±0.02[a]	0.28±0.02[a]
0.5	0.31±0.01[b]	0.78±0.01[b]	0.51±0.02[b]	0.55±0.01[b]
1	0.58±0.03[c]	1.13±0.03[c]	0.77±0.10[c]	0.99±0.11[c]

The comparison of the total protein content and the separated protein content has revealed the difference of protein content. The number of protein content from hydrolyzed protein had shown the relation of beverage stability and its protein amount.

The height of sediment parts (bottom) and their protein level can show the hydrocolloid characteristic, the protein content can swell and hold the particle in the beverages. The hydrolyzed

protein gel powder was combined the dregs of the juices to be colloidal, while the control beverages had shown the highest degree of sedimentation (low stability).

Conclusion

The results has shown the significant relation between the beverage stability and the hydrolyzed protein gel powder level on the degree of sedimentation. The 1.0 gel powder has revealed the better stability than the 0.5 and the control that they have lower percentage of sedimentation than the 1.0 percent (respectively.) in the both of beverages. The results can use for a studying of alternative stabilizer in beverage and other emulsion products.

Acknowledgement

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Effect of Nitrogen Concentrations on Growth and Development of Petunia in Soilless Culture

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Abstract

The effect of nitrogen concentrations on the growth and development of petunia was carried out in soilless culture system. This experiment was studied at the Agricultural Technology Research Institute, Rajamangala University of Technology Lanna, Lampang province during February-July 2013. The experimental design was completely randomized design (CRD). There were 5 treatments, each with six replications, i.e. nitrogen concentrations of 0, 56, 112, 224 and 448 mg/l. The result showed that the 448 mg/l treatment had greater canopy width than the 56 - 224 mg/l, while the 0 mg/l had the lowest. However, the plant height and stem diameter were similar trend. The nitrogen concentrations did not affect the new shoot length, new shoot diameter or leaf number/branch. The nitrogen concentration at 112 mg/l treatment gave the greatest on leaf width and length. In addition, the nitrogen concentrations of 448, 224 and 112 mg/l gave greater green color of the leaves than that of 56 and 0 mg/l. There was no difference in flowering. The 112 mg/l treatment had the most number of flowers per branch. The increasing and decreasing of nitrogen concentrations had lower the number of flowers. The effect of nitrogen on dry weight accumulation suggested that nitrogen concentrations at 112 and 448 mg/l gave the highest dry weight of flowers, leaves and stem, but did not affect root dry weight. The nitrogen concentrations of 112, 448, 224 and 56 mg/l yielded greater shoot/root ratios than that of at 0 mg/l.

Keywords: Nitrogen, Petunia, Soilless Culture, Growth, Dry weight

Introduction

Petunia is a biennial flowering plant and belonged to the Solanaceae family. There are 2 popular types in the Northern Thailand, i.e. *Petunia integrifolia* and *Petunia axillaries*, that have been widely grown for potted plants, hanging containers and cultivated plants. Soilless culture is a method of growing plants in any medium different from soil. Many crops are grown in soilless systems: leafy and fruiting vegetables (e.g. lettuce, celery, spinach, tomato, cucumber, sweet pepper and cantaloupe), fruit crop (strawberry), cut flowers (e.g. rose and chrysanthemum), flowering bulbs (e.g. tulips and lily), flowering and foliage potted plants (e.g. cyclamen and ficus), among others [1] [2] [3]. The plant are growing in an inorganic substance (such as sand, gravel, perlite, or rockwool) or in an organic material (such as sphagnum peat moss, pine bark, or coconut fiber) [3]. The substrates in Thailand are locally available and relatively

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cheap such as, coconut fiber, coconut coir, rice hull, rice husk charcoal and sand. The gardener grows plants in soilless culture due to ease for transportation and plant nutrition management. Nitrogen is a major element, as it is an essential component of chlorophyll, amino acids, protein, nucleic acids and enzymes [4] [5]. Nitrogen is primarily required for increasing plant growth, development and yield of plant more than any other nutrients. The absence of nitrogen in the plants is often associated with slow growth, reduced leaf size, yellowing; short branches, premature fall color and leaf drop, as well as, increasing the likelihood of some diseases. The optimum nitrogen levels in nutrient solution are essential for growth of petunia. The lack of nitrogen causes slower growth rate and development, while too much nitrogen affects plant growth so rapidly that may lead to weak and spindly appearance, as well as, increase the cost of nutrient solution. The objectives of this experiment were to study the effects of nitrogen levels on growth and development, as well as, dry matter. This information was considered to be essential for petunia growing in soilless culture system.

Materials and Methods

The study was performed on petunia grown in the mixtures of coconut coir and burnt paddy husks at the ratio of 1:1 by volume. This experiment was conducted during February - July 2013, at the Agricultural Technology Research Institute, Rajamangala University of Technology Lanna, Lampang Province, Thailand. A CRD experimental design was used and consisted of 5 treatments of nitrogen levels in the nutrient solution, i.e. 0, 56, 112, 224 and 448 mg/l. As nitrogen sources, $Ca(NO_3)_2$ and NH_4NO_3 were used, and the other ion concentrations were (mM) 3 PO_4^{3+}, 4 K^-, 6 Ca^{2+}, 4 Mg^{2+}, 7 SO_4^{2-}, and other microelements in the concentrations suggested by [6]. Only nitrogen concentrations were varied, all other nutrients were kept constant. The pH was maintained within the range of 6.5 by addition of sulfuric acid. Measuring attributes were plant height, stem diameter and canopy width at every 2 weeks. The growth rate percentages were calculated based on an equation proposed by [7], as followed:

$$GR = \frac{(Xt-Xo) \times 100}{Xo}$$

GR = Growth rate (%)

Xt = 1st measure

Xo = 2nd measure

New shoot growth was recorded after leaf flushing. At the end of experiment each treatment was measured for biomass and shoot/root ratio.

Data were analyzed using the analysis of variance (ANOVA), and the level of significance was accepted at the $p < 0.05$.

Results and Discussions

The effect of nitrogen levels on stem growth indicated that stem height and stem diameter were similar among treatments (Fig. 1 and 2). However, the 448 mg/l treatment gave the highest canopy width at 8 – 14 weeks after treatment. The 56 - 224 mg/l nitrogen concentrations yielded greater canopy width than the 0 mg/l (Fig. 3).

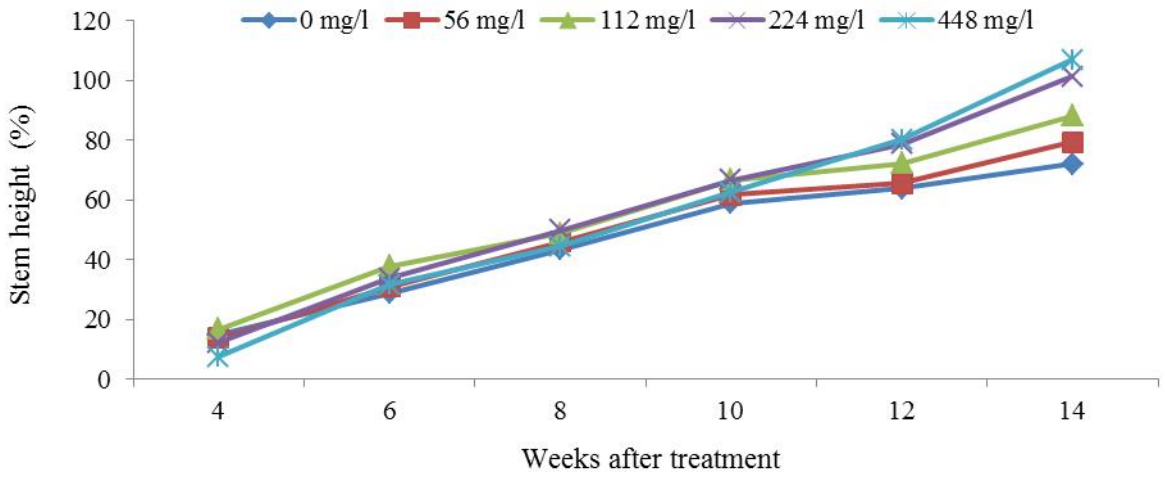

Figure 1 Changes of stem height of petunia after treatment with different nitrogen concentrations.

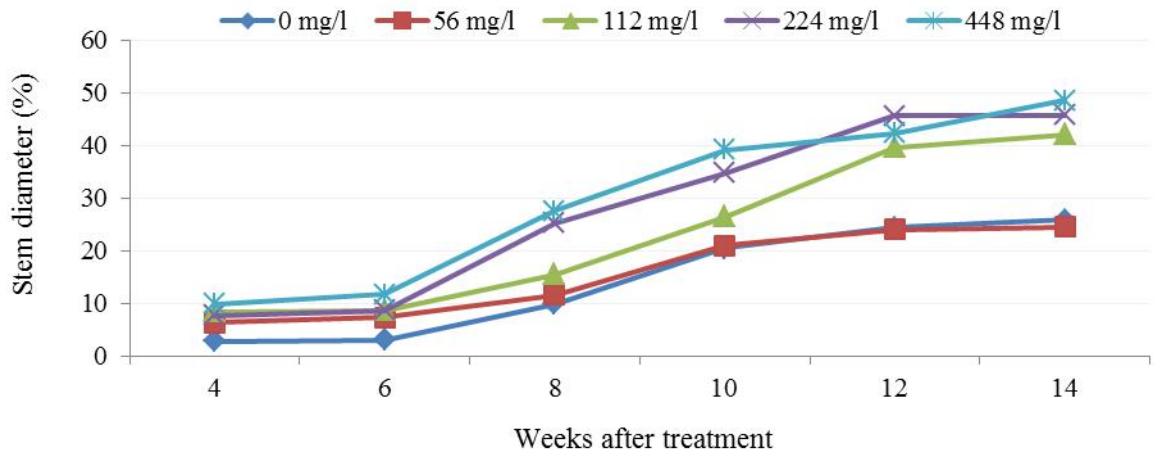

Figure 2 Changes of stem diameter of petunia after treatment with different nitrogen concentrations

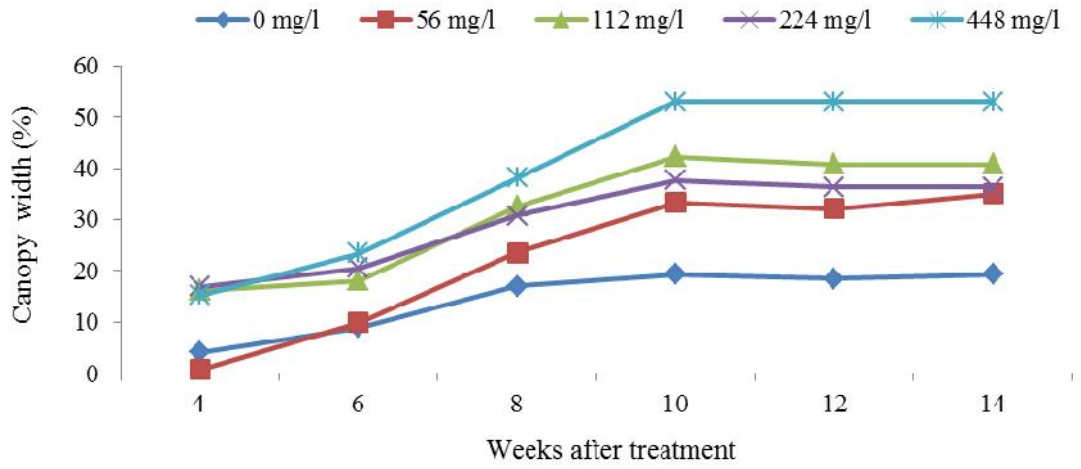

Figure 3 Changes of canopy width of petunia after treatment with different nitrogen concentrations

The nitrogen treatments had no effect on new shoot length, new shoot diameter, leaf number/branch, flowering or flower number/branch. Whereas, the 112 mg/l treatment gave the greater leaf width than that of the other treatments. The 112 – 448 mg/l treatments had leaf length and leaf green color better than those of the 56 and 0 mg/l treatments (Tab. 1).

The 112-448 mg/l treatments gave higher new shoot length than 56 and 0 mg/l treatments. Furthermore, the 224 and 112 mg/l treatments yielded the largest flower and greater leaf dry weight. Moreover, the 112- 448 mg/l treatments increased stem dry weight. The 0 mg/l produced the lowest shoot/root ratios (Tab. 2).

Table 1 Effect of nitrogen concentrations on new shoot growth, leaf greenness (SPAD), percentage of flowering and number of flower per branch of petunia

Treatments	Growth of new shoot						Flowering (%)	Flower number/branch
	Length (cm.)	Diameter (mm.)	Leaf number/ branch	Leaf width (cm.)	Leaf length (cm.)	Leaf greenness (SPAD)		
0 mg/l	0.80c	2.95	3.20	1.00c	2.90b	27.30c	100	4.80
56 mg/l	4.20b	2.69	5.60	1.10c	3.10b	33.18b	100	4.00
112 mg/l	7.00a	3.05	7.00	2.50a	3.90a	42.44a	100	6.60
224 mg/l	6.40a	2.96	5.40	1.90b	3.90a	42.86a	100	5.60
448 mg/l	6.20a	2.96	6.00	1.80b	3.80a	48.36a	100	5.60
F-test	*	NS	NS	*	*	*	-	NS
CV (%)	20.09	15.69	35.93	24.09	10.24	11.39	-	21.48

* = Means within column with different alphabets differed significantly at $p<0.05$,

NS = Not Significant

Table 2 Effect of nitrogen concentrations on dry matter and shoot/root ratio of petunia

Treatments	Plant parts (g)				Shoot/root ratio
	Flower	Leaves	Stem	Root	
0 mg/l	0.55c	1.00c	2.23b	1.80	1.92b
56 mg/l	0.77bc	2.89bc	3.90b	2.00	4.73a
112 mg/l	1.02ab	6.01a	8.10a	1.81	7.70a
224 mg/l	1.35a	4.18ab	8.78a	1.95	5.97a
448 mg/l	0.76bc	2.91bc	8.00a	1.63	6.79a
F-test	*	*	*	ns	*
CV(%)	22.49	34.17	19.41	21.62	28.94

* = Means within column with different alphabets differed significantly at $p<0.05$,

NS = Not Significant

From this experiment the 112 mg N/l treatment produced the best plant growth. However, the lower nitrogen decreased growth, leaf chlorophyll and dry matter. The increasing nitrogen enhanced growth, leaf chlorophyll and dry matter, while the 448 mg N/l reduced leaf growth and dry matter of petunia. The nitrogen deficiency reduced leaf area, chlorophyll and photosynthesis resulting in lower total biomass in castor [8]. Nitrogen-deficient plants had significantly lower leaf nitrogen and chlorophyll a contents [9]. The nitrogen deprivation affected a decline in cell density and smaller final leaf size because of inhibited cell division, a reduced growth rate and other development processes leading to decreased dry matters in plant [8] [10]. The nitrogen deficiency induced sink limitation within the whole plant due to decreased growth [11]. High amounts of nitrogen resulted in excessive shoot and foliage growth but reduced root growth. The highest level of nitrogen solution had a negative effect on petunia growth that this result was similar with [12] who studied on taro which found that dry matter and leaf area increased up to 2 mM N and decreased at the highest. In longan tree found that increasing nitrogen from 2-16 mM/l raised the SPAD value, chlorophyll a, chlorophyll b and chlorophyll fluorescence in the leaf, while the 16 mM/l treatment dropped the total dry matter [13].

Conclusion

The 448 mg/l treatment gave the greatest canopy width. In addition, the 112-448 mg/l had higher shoot, leaf length, leaf width and leaf greenness than the other. The 112 mg/l gave the most number of flowers per branch. The increasing and decreasing of nitrogen concentrations yielded lower the number of flowers. The 112 and 448 mg N/ l treatments had the highest dry weight. The 0 mg/l gave the lowest on

shoot/root ratios. Thus, it was suggested that the range of nitrogen concentration in nutrient solution should be in the range 112-224 mg N/l.

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Performance of A Low-Cost Direct Passive Solar Dryer for Pineapple Drying: Case Study of Cha-am District, Petchaburi Province, Thailand

Phisit Suvarnaphaet[1*]

Abstract

In this study, a low-cost direct passive solar dryer was designed and constructed with available local materials. Field level experiments on solar drying of pineapple using solar dryer was conducted at Faculty of Animal Science and Agricultural Technology, Silpakorn University, Phetchaburi IT campus, Cha-Am, Phetchaburi, Thailand. The solar dryer which was direct type was tested with pineapple (*Ananas comosus* L.), in order to evaluate the drying rate of these product. The moisture content of 87.4% (w.b.) for 500 g pineapple was reduced to 15.2% (w.b.) in 3 days of drying in the low-cost direct passive solar dryer while it took 3 days of drying to bring down the moisture content of similar sample to 22.6% (w.b.) in traditional method. The pineapple dried faster with the low-cost direct passive solar dryer than with the sun drying. The pineapple dried in the low-cost passive solar dryer was completely protected from insects and dust.

Keywords: low-cost solar dryer, moisture contents, pineapple

Introduction

Thailand is blessed with large areas appropriate for pineapple growing. The leading thirteen provinces for pineapple production in Thailand are Prachuapkhirikhan, Chumphon, Phetchaburi, Chonburi, Rayong, Trat, Chacheongsao, Kanchanaburi, Ratchaburi, Uthai Thani, Nong Khai, Nakhon Phanom and Lampang. Large-scale cultivation of pineapple for fresh fruit consumption depends on a few varieties of the Cayenne group. The variety “Pattavia” of the Smooth Cayenne group is the most popular of all because of its fruit size, high production yield and acceptable eating quality. The pineapple fruit has vitamins, minerals, fiber and enzymes that are beneficial to the digestive system and help in maintaining ideal weight and balanced nutrition. It is also a good source of vitamin C, minimal fat and sodium with no cholesterol, delicious, healthy and nutritious and can be eaten raw or used in cooking. The stage of maturity at harvest depends on the market that the pineapple is transported to. Pineapple for the domestic market is harvested at the fully ripe stage while unripe but mature fruit are for the export market. Maturity is important in eating quality of pineapple. The small difference in maturity of pineapple at

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harvest makes the large difference in eating quality and consequently consumer satisfaction [1]. As mentioned before, Phetchaburi is one of the main pineapple production provinces of Thailand and because of a number of native sweet and dessert are produced it also recognized as Thailand's Sweet and Dessert Capital. Therefore, it is possible to create a new signature of Phetchaburi dessert by local dried as a snack.

The traditional method of drying, known as 'sun drying', involves simply laying the product in the sun on mats, roofs, or drying floors. To reduce the processing losses during the drying and to retain the quality of dried product, it is necessary to dry the food in the close chamber with preventing product from dust, insect, larva, birds and animal. The process is labor intensive, results in nutrient loss (such as vitamin A), and the method totally depends on weather conditions. Because the energy requirements (for sun and wind) are readily available in the ambient environment, little capital is required. [2], by keeping importance of pineapples drying in region. Development of a relatively low-cost dryer that can function efficiently are therefore emerged and necessary.

The objective of this research is to develop a low-cost direct passive solar dryer for drying of pineapple under the metrological conditions of Cha-Am, Phetchaburi, Thailand. The experiments were conducted during the period from February to April 2014. The performance of a low-cost direct passive solar dryer and drying characteristics of pineapple are discussed in this paper

Materials and Methods

1. Material

The fresh pineapple fruits were collected from local market during February to March 2014. The average dimensions of fruit vegetable were 163 mm long and 103 mm average diameter and yellow colored fruits were selected for the study. The pineapple fruits were thoroughly washed and sliced into 5 mm (±1.5mm) thickness using sharp sterilized knife. The slices were carefully cut in halves and the hard core was cut off as circularly as possible. With a scale that measured with two decimals' accuracy, each pineapple slice was weighed before being placed into a solar dryer.

2. Construction of low cost direct passive solar dryer

The low cost direct passive solar dryer is a cabinet type of dryer. The inside was constructed of polypropylene sheets; its solar collector cover was made of transparent polypropylene sheets material of 3.0 mm thick. The total dimension of the dryer was 45×57×37 cm. The bottom cover of the dryer was insulated with sawdust. Two air vents were constructed on the bottom for easy air movement into the dryer so as to obtain a higher drying efficiency. The air vent was covered with mosquito net so that

insects cannot gain entrance into the dryer and also platform constructed as in Figure 1. Area of surface area of drying platform is about 0.3 m^2, which is made up of galvanized wire mesh. And its inner surface is coated with black color. Vents are provided for natural air flow in dryer. Capacity of this tray is 0.5 kg.

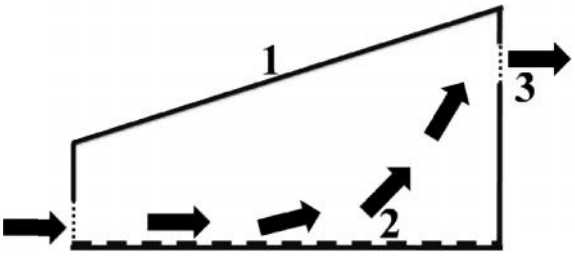

Figure 1 Schematic Diagram of a low-cost direct passive Solar Dryer

1. Transparent polypropylene sheet cover, 2.Wire mesh platform, and 3.Vent for air flow

3. Experimental Procedure

The low cost direct passive solar dryer was installed at Silpakorn University Phetchaburi IT Campus, Cha-Am, Phetchaburi, Thailand. The solar dryer was placed on raised platform and it was not shaded by trees or building. The direct sun and solar drying experiments were carried out during the periods of February-March 2014 under the clean climatic conditions of Cha-Am, Phetchaburi, Thailand. Each experiment started at 8:00 am and continued till 17:00 pm. To determine the moisture loss from drying samples during experiments, pineapple samples were taken out of the solar dryer and weighed at various time intervals, ranging from 30 min at the beginning of the drying to 1hr during the last stage of the process. The moisture loss from samples was determined using a digital electronic balance having an accuracy of 0.01 g. The loss in weight of pineapple was monitored at every hour interval and the moisture content was determined using oven method. These were again spread in the dryer in the next morning and the drying process was continued until no further changes in their weight were observed. Also, to compare the performance of the solar dryer with that of direct sun drying, both samples were dried simultaneously under the same weather conditions

4. Moisture content (M.C)

The percentage moisture content was determined by using the following formula, [3].

$$\text{M.C.(w.b.)}\% = \frac{(W_1 - W_2)}{W_1} \times 100$$

$$\text{M.C.(d.b.)}\% = \frac{(W_1 - W_2)}{W_2} \times 100$$

Where, W_1= weight of sample before drying, (g) and W_2= weight of bone dried sample, (g).

5. Drying Rate

The drying rate of pineapple sample during drying period was determined as follows,

$$\text{Drying rate (D. R.)} = \frac{\Delta W}{\Delta T}$$

Where, ΔW = weight loss in one hour interval (g) and ΔT = difference in time reading (h)

The drying was carried out by loading the weighted pineapple fruits in dryer from morning 8:00 am to 17:00 pm. The pineapple fruits were dried up to the final moisture content of 14% (w.b.). Similar procedure was adopted for drying of pineapple fruits sample in open sun drying. The drying time required for drying the pineapple fruits sample from initial moisture content to 22% (w.b.) in solar dryer and under open sun drying condition was critically observed [4].

Results and Discussions

Experimental Results

Comparison of the moisture contents of pineapple in the solar dryer with those obtained by the samples dried in open sun drying method for the Pattawia variety for a typical experimental run during drying is shown in Figure 2. The moisture content of pineapple of a typical experimental run reached to 15.2% (w.b.) from 87.4% (w.b.) in 3 days of drying in the solar dryer while it took 3 days of drying to bring down the moisture content of similar sample to 21.52% (w.b.) in open sun drying method. The faster drying of pineapple slices inside the solar dryer is due to the fact that the pineapple in the solar dryer received energy both from the collector and from incident solar radiation, while the control samples received energy only from incident radiation and lost significant amount of energy to the environment.

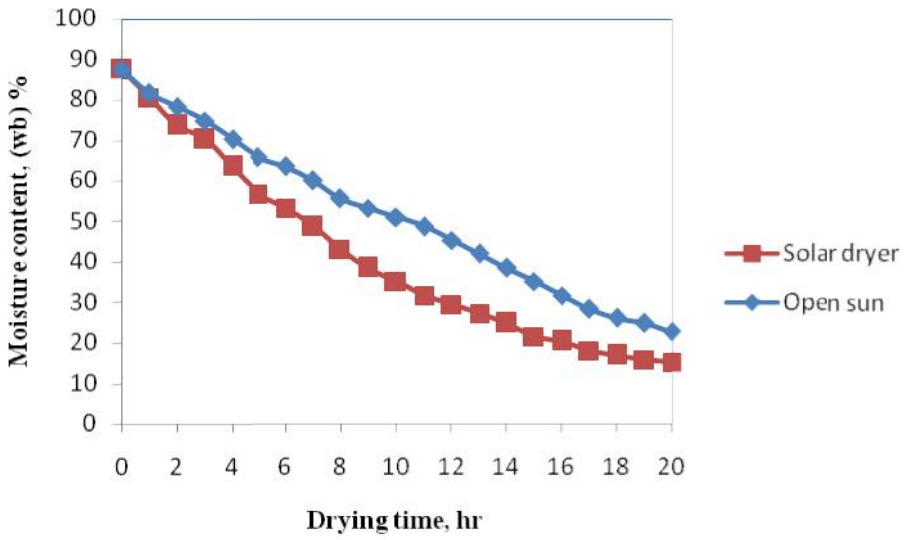

Figure 2 Drying curve of different drying techniques of dried pineapple slices.

The rate of drying of pineapple sample in the solar dryer was higher than in the open sun. The drying rates of the sliced pineapple in the solar dryer and in open-sun were 21.3 g/hr and 20.9 g/hr respectively.

For pineapple, the drying rate was significant ($p<0.05$, $t=9.694$) on drying temperature in open sun drying and solar dryer. The paired t-test analysis shows that the final product moisture at the end of the three days is lower in the solar dryer than that in the open sun drying.

Conclusion

The two drying methods studied greatly affected the drying of pineapple. The solar dryer was found to be more efficient than the open sun drying. In addition, open sun drying has been found to be less effective than the solar drying techniques and is susceptible to insects, dust, birds and other animals, which can lead to reduction of mass losses.

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