
ICONSCI
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on Science, Technology and Innovation for
Sustainable Development:
Challenges Towards the Digital Society
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Welcome Message

With great pleasure, the Rajamangala University of Technology Phra Nakhon (RMUTP) welcomes you to "The 9th RMUTP International Conference on Science, Technology and Innovation for Sustainable Development: Challenges towards the Digital Society 2018 (9th RMUTP ICON SCi-2018)", organized by RMUTP and held on the 21-22 June, 2018 at the Sukosol, Bangkok, Thailand. We also welcome participants from overseas to Thailand and look forward to giving you a taste of Thailand's culture.

Our conference provides an outstanding international forum to present and discuss progress in research, development, standards, and applications of the topics related to Science, Technology and Innovation for Sustainable Development.

The 9th RMUTP International Conference will offer high quality activities including research and poster sessions. We feel sure to provide you an engaging environment with an excellent opportunity to exchange new research results, major ideas and start fruitful collaborations. International visitors are also encouraged to experience the Thai culture and attractions around Bangkok. We take this opportunity to thank you for your participation, we hope you enjoy your time and take advantage of our conference. We look forward to seeing you.

Sincerely Yours,

Supatra Kosaiyakanont

Assoc. Prof. Supatra Kosaiyakanont
President of Rajamangala University of Technology Phra Nakhon
Conference Chair, The 9th RMUTP International Conference

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General Information

Venue:

Place:	The Sukosol
Address:	477 Si Ayuthaya Road, Thanon Phayathai, Ratchathewi, Bangkok 10400, Thailand
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Place:	The Sukosol	
Hours:	Thursday June 21, 2018	08:00 am – 08:00 pm
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Presentation Instructions:

Oral presentations are required to be made by PowerPoint, which should be controlled by the speaker. The oral presentation will be 15 min plus 5 min questions. All speakers are required to load and check the files before the presentation. A PC-compatible computer and a LCD projector will be provided.

Poster presentations are to be mounted at the allocated area. The content of the poster should cover titles, objectives, methodology, results discussion and conclusion. The poster board size should not exceed 90 cm width x 120 cm height.

ICON-SCI Awards:

1. ICON-SCI Best Oral Presentation Awards
2. ICON-SCI Best Poster Presentation Awards

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Keywords: Design environment, Seniors, Elderly Welfare Development Center.

Introduction

With an average rate increase of 1 million people per year, most disabled people with health problems and a higher risk of health problems than the general population. A key element of the problem is that people with disabilities have limited health care. Including the ability to take care of themselves than people who have normal body. There are certain types of people with disabilities who have the disorder than the general disability. Need to be taken care of than normal. The cause and the problem. The government has set up an agency or shelter. Care to assist those with disabilities. Agencies are spread out geographically in order to assist and care for the disabled, these thoroughly. To be able to care for and help themselves. Improves quality of life and care as a fundamental right which should be given.

Welfare Development Center for the Elderly Pathum Thani, has opened a service and support for a long period, and the elderly to use the service a lot. The current state of disrepair The area should be designed and updated as appropriate. This will allow service providers. Seniors' quality of life improved. Education about the need for space applications is an important issue. Spatial needs to be aligned to real world applications. This will entail improving the quality of life in elderly Welfare Development Center. Pathum Thani

In this study, Oriented education to fix problems in the design environment to respond to applications for the elderly Welfare Development Center. Pathum Thani Researchers used data collection methods used by the target group. Focus on the involvement of people living in the area. By the authorities and local residents to participate in all activities in the research.

Literature References

Researchers have studied the concepts and theories related to research and research methodologies. The story is divided into four definitions of disability. The type of disability and welfare. The participatory design and design institutions and design standards thoroughfare for people with disabilities.

Definition of disability

Patip Assawaphom (2014) Said that disabled people are vital to the nation in many ways, but the well-being of people with disabilities are often socially omissions. Whether the environment is no easy life. The attitude of the society towards the disabled. Understanding about disability is essential. The society recognizes the importance of the matter. This will lead to the help and support so that people with disabilities can live like normal people.

Act for Empowerment of Persons with Disabilities 2550 under Article 4 provides that the definition of disability. "People who have limitations in performing everyday activities. Or participated in social activities. Due to impaired sight, hearing, mobility, communication, behavioral, mental, emotional intelligence, learning disabilities, or any other. The barriers in areas with special needs to receive help one area to be able to practice. In everyday life or social involvement with guests ".

From the above definition The medical definition of disability in terms of looking at the problems and difficulties of the life of ordinary people. The attitudes about people with disabilities as people who have been helping care. But the definition of disability in the social dimension. That disabled people have the same rights to everyone. It is the duty of society to encourage people with disabilities to participate in these activities as individuals.

The type of disability and welfare

Currently, there are many types of disabilities. Each type of defect are different away. The aid scheme is different. Sorting disabled by the Ministry of Social Development and Human Security disability guidelines on the type and No. 2, 2555 were categorized into 7 types of disabilities, including the visually impaired. Hearing disability or meaningful. Disability or physical movement. Disability, mental disability or behavioral intelligence. Learning Disabilities Disabilities and autism. (Ministry of Social Development and Human Security, 2013).

Welfare Development Center for the Elderly Pathum Thani Set up with the purpose of restoring health. Mental health and the rights of the elderly. Neglected and abandoned by their families and society. The optimum age for dependents aged 60 years and over who have contagious diseases. And people with physical disabilities or brain, and can help them in their daily lives. homeless Can not live with the family The orphanage will assist with the development and rehabilitation in areas they can help themselves. The purpose of this educational institution. Is another way to help designers understand the special nature and needs of different people. This will be used to guide the design. Improve the environment as well as allowing service providers to prioritize applications, which can increase the performance and speed of access to the service appropriately fast.

Design involved

Design participatory process that encourages stakeholders to exchange ideas. Offer solutions and create an understanding of the design work together. This will lead to the creation of partnerships for all parties. The decision to participate in the design process Information must come from those who actually use the building. This will create a sense of ownership. It also provides an opportunity to use the space to display their own needs. This approach brings to the design and the solutions to the problems which have come from the real needs.

Designed to foster and design standards for the disabled

Welfare Development Center for the Elderly Pathum Thani A key element to take into account the 4: 1) the composition of the primary users and secondary users such as service providers and service recipients, 2) component activities include the type of activity. Patterns of user behavior and characteristics in building support for activities 3) the location and the surrounding environment. Access to the building The social, cultural, and 4) economic factors include the budget to invest in building new or remodeling. Sources of funding The design may be more specific to different environmental conditions conducive to use. And facilities

Guide "recommendations designed facilities for all" has been identified as a thoroughfare that allows disabled people who can use it easily. To focus on two issues, namely the width of the path and the slope of the thoroughfare. The proper width will range between 0.90 to 1.50 meters and a slope of at least 1:12 if the ramp is longer than 2.50 meters must have handrails on both sides. If the length of the ramp-up period of 6.00 meters to a landing ramp has a width of 1.50 m, the surface of the ramp must not slip material is suitable for use. (Association of Siamese Architects under Royal Patronage, 2015).

Method

In the process of data collection The researchers collected survey data on the physical side of Welfare Development Center for the Elderly. Pathum Thani The interviews are the primary means of storing data with the stored image and to create an environment within the actual project. The research was conducted into space three times. The physical storage conditions and issues twice. Co-designed with participation once again.

The survey for the first time on December 1, 2017, aims to explore the place and met. The Welfare Development Center for the Elderly. Pathumthani include Executive agencies Procurement Officer Nurses Mentors, as well as provide more frequent. To get information about the place and the overall issues in general. The information is used to guide the research and plans are preliminary. Later on January 19, 2018, the researcher has studied the area again to collect insights. By means of interviews and participatory observation in detail. To understand the current conditions. Joint analysis of the problems and the needs of the staff interviewed in all sectors. The data obtained were analyzed for use in the design environment for seniors. In the preliminary stage, to be used in preparing the detailed design.

The sample consisted of interviews, the researchers selected a group of nurses, nurse aides, office staff and maintenance technicians within the Development Center for Welfare seniors. Pathum Thani Because the sample is based on those who actually work in practice. Information can be clearly Unlike patients who are handicapped and disabled. These groups, which are limited in their ability to provide information on the spatial applications. The researchers relied on data from the first sample-based.

On the 3rd day of March 4, 2560, the research provides the information and issues important to the design part. Using the information from the interview. Observations used as a guide to create the drawing. The new design environment's Welfare Development Center for the Elderly. Pathum Thani and take such an approach to be presented with the information from the various departments. The audience follows: Executive Agency Number 1 Provider Group of 12 and Group of the clients or those with disabilities who can communicate for 3 people, all participants can provide feedback and share ideas and make suggestions. To be used in the design environment. The layout of the building The new system, roaming the area with investigators. To make sure that all the parties. The draft development plan for the project can be used to cause a real interest in the work. It also can be used as documentation for presentation development budget Development Center for Welfare seniors. Pathumthani the executive decision to go.

Case study

Center for Social Welfare Development elderly home Khae. Bangkok With a total area of 48 acres with buildings for a total of 7 buildings divided into five buildings, service buildings and other buildings of 2 buildings, all with a single-storey building. All the information in Dalmatia Derived

from a joint survey and interview with nurse mentors and service providers in the Social Welfare Development Center for the Elderly Home Khae.

Results Conclusions

Barriers that result in inconvenience and delay in providing and receiving services today can be split into two major areas: the problems and difficulties of the route within the area of the building

Obstacles caused by road traffic.

The main obstacle occurs within the area. To modify applications that change based on actual usage in the area. The use of the building, according to the circumstances of each activity such as the increase of residential buildings for disabled children. It was found that there were more people with disabilities. Issue of a thoroughfare for vehicles and pedestrians occur immediately. The main route for commuters currently used mainly by vehicles. Nature trails current bridge is narrow and steep. As a result, access to the orphanage for disabled children in Pak Kret. Nonthaburi Continued inconvenience The road project is currently not linked to each other where possible. Make car travel Not accessible in all areas within the project. The land is still at large. Roads within the current size of just 4 meters, resulting in the car can run only one lane. It is impossible to access the building thoroughly. If there is an emergency such as a fire.

The pedestrian route traffic within the area is currently not designed to respond to the truly active, such as the link between building design is not contiguous. Both those with disabilities and service providers need to walk down the street with the car at some point. Although the wide walkways are wide enough for the use of disabled people, especially disabled people who use wheelchairs. The areas covered. Nevertheless, the slope of the ramp does not meet the standards for the use of disabled people in general. Some of the slopes are steep, the proportion of 1: 6, which is steeper than that disabled people are able to move up and down by themselves. Many point to rail Route traffic across multiple paths to serve as general entrance buildings 1 and 2 will be used together with the transfer of food. Or disabled access to buildings, hospitals need to walk down the road to get access to services and so on.

The tower is not appropriate

Located in the main building, in the improper access by Center staff and kitchen staff as the food can lead to the building. Building nurse disabled should be easily accessible and safe, but it is far greater than the disabled, remember to arrive in time. If there is an emergency Access the ambulance was not very convenient.

Based on the information received and state issues. The researchers found that the primary focus of the Center for Social Welfare Development elderly home Khae. Nonthaburi problem is the placement of buildings and road projects. This issue affects the providers and recipients of services within the area. The research focus is on the design of the project is to improve the layout. To determine the distance between buildings. Should put an end to the new building. By requiring them to be in the proper position. Taking into account the needs of each service provider and the recipient. Routing and roaming through the various trails in the area. Traffic routes should have continuous access to the center of Ban Bang Khae Social Welfare Development elderly friendly. Not interfere with each other and are safe if there is an emergency.

Results Conclusions

Data from the surveys and interviews, physical involvement with the informant. The research data were analyzed and the draft Plan. The placement of the building System traffic Design

environment for the handicapped and disabled. The design approach can be summarized as follows environments.

1) The position of the hospital building - physiotherapy. Buildings and facilities such as the kitchen, office buildings and activities. Should be located at the center of a building project by the recipient of the service is enclosed to the easy access of the client and increase the speed of service and the assistance of a service provider.

2) Route traffic within the Social Welfare Development elderly home Khae. Must be linked together and can shorten the travel time from the overall layout of the original. Either in the form of vehicular traffic and on foot. The width of the thoroughfare for vehicles to facilitate access for large vehicles. For quick service and assistance at the time.

The Rail Master Plan and design a new layout. Representing all sectors of the Elderly Welfare Development Center. Pathum Thani has offered a detailed layout of a building using segmented by type of building applications. To make it easier to understand Connect and respond to the needs of service providers, all within easy reach. Can be divided into zones as follows.

1.) The building's accessibility. Which classify disabilities are 2 types of people with disabilities and disability. To facilitate the allocation is appropriate to the nature of their disability. Each building will be classified according to specific characteristics such as disability disabled handicapped seat next to the bed with a wheelchair.

2.) Office building The staff work department. Both the Administration Procurement and Maintenance. In addition, the area is welcome to visit the project.

3.) Building nursing and physiotherapy. Placement near a residential building of the handicapped and disabled. Also connected to each other.

4.) The kitchen and dining area. Placed in the area to cater for services in various parts of the hotel.

5.) Auditorium and recreational buildings The area in front of the project It can accommodate a group of visitors in a group then. It is also an area for the joint activities of the disabled and those who visit them.

6.) The shelter's staff and the service provider is separate from the service. To ensure the privacy of its duties.

7.) Size is 2 lane roads surrounding the project. To facilitate And improve the trails for the project to be constantly connected.

The detailed requirements for each of the sub-group of buildings. Need to be designed to contribute more. Since each building is a form of active and functional requirements specific to different away. However, a draft of the Master Plan for the Welfare Development Center for the Elderly. Pathum Thani Is the starting point for the development of the quality of life of those involved in the area. This will lead to the development of future projects.

Acknowledgment

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A facile synthesis of self-catalytic PVP/PVA/ Citric acid hydrogel using sodium hydrogencarbonate as a gelling agent

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Keywords: Gelling Agent, Hydrogel, Microwave Irradiation, Self-Catalytic Synthesis.

Abstract. A simple and economic method for PVA/PVP/Citric acid hydrogel preparation using microwave-assisted irradiation is presented. The different ratios of staring components and also microwave irradiation parameters were studied to obtain hydrogel with high levels of gel fraction and a degree of swelling suitable for the application of wound dressings. The optimum conditions for hydrogel synthesis was 6:6:3 % (w/v) of PVA/PVP/Citric acid under 120 ^{o}C for 3 minutes of microwave irradiation. The ionic liquid-like structure of PVP- Citric acid possibly play an important role in terms of the crosslinking process. In addition, $NaHCO_3$ applied to the synthesized hydrogel also showed a significant effect in enhancing gel formation. The mechanism for three-dimensional network formation based on esterification and hydrogen-bonding interaction was also proposed in this work.

Introduction

The development of wound dressing materials has long been an important factor for wound healing and cleanliness among the patients. Generally, gauze or plaster is widely used to protect a wound from infection. However, these materials may cause possible damage to the new tissue, increase the size of the wound, and have a low absorption capacity of the secretions from the wound. Therefore, effective wound-dressing materials with an ability to enhance the healing efficacy of wounds have been intensively studied and developed. Hydrogels are polymeric materials with a three – dimensional network consisting of hydrophobic and hydrophilic parts. The former aspect prevents hydrogel from dissolving in a polar solution, while the latter part absorbs large quantities of water, resulting in the expansion of the hydrogel [1]. Hydrogels have the ability to carry not only water but several other kinds of molecules as well as drugs and oxygen through the pores within their structures [2]. Therefore, hydrogels have been widely developed and used in various applications, such as contact lenses, tissue engineering, agriculture, drug delivery, wound dressing, etc [3- 5].

Several methods for hydrogel fabrication have been used including physical, chemical and radiation methods. In addition, the methods and substrates used for wound dressing also need to be safe from generating toxic components. The aspects of preventing the wound from external microorganism invasion and easy degradability are significant in terms of wound-dressing hydrogels. One of the most widely used polymers in the hydrogel study was polyvinyl alcohol (PVA), due to the low cost and low toxicity, with intensive applications in the pharmaceutical and biomedical aspects [6, 7]. However, to achieve the required properties of the wound-dressing hydrogel, other polymers or reagents were generally added since the material produced from PVA alone has a low level of water swelling and rather high stiffness. Several natural and synthetic polymers such as starch, chitosan, gelatin or poly (vinylpyrrolidone) (PVP) were mixed with PVA for hydrogel fabrications [6, 8-12]. Among others, PVP showed distinct properties of good

biocompatibility, high water solubility, excellent wetting property, a high degree of swelling, excellent film formation, very low toxicity with various application in blood plasma [5,7,13]. There was reported and applied PVA/PVP-based hydrogel synthesis via the radiation and chemical cross–linking process [5,11,14]. The obtained hydrogel demonstrated good physical properties suitable for wound-dressing application, and impermeable for bacteria. Since PVA and PVP are water-soluble polymers, the cross-linking protocol is therefore compulsory to obtain an insoluble hydrogel. The common cross-linking method used for the PVA/PVP-based hydrogel synthesis is gamma irradiation [5, 15], because PVP lacks a functional group to react with cross-linking agents to form three-dimensional structures of hydrogel. However, gamma radiation sources are not widely available, because it is relatively expensive. Recently, microwave irradiation has become one of the most intensively studied techniques used in chemistry synthesis, including hydrogel preparation, due to the fact that it is relatively economical, easy to operate, and safe compared to a high energy radiation source [16, 17]. The microwave-assisted irradiation technique provided several advantages in terms of chemical reactions such as reducing the use of catalysts, reaction times, organic solvent consumption, waste production, and the improved yield from the reaction [16, 18-20]. The PVA/PAA-based hydrogels with a large degree of swelling were prepared via esterification reaction using microwave irradiation and they showed only mild cytotoxicity towards a cultured human cell line [19].

A number of previous studies have examined the application of ionic–liquids (ILs) as catalysts for a variety of chemical reactions, such as Diels-Alder reaction [21], alkylation [22], Henry reaction [23], and isomerization [24]. Most of polymerization reactions involve esterification, and IL systems have been studied and utilized as catalysts in the reaction [25, 26]. Several lactam-base BrØnsted-acidic ILs were synthesized and applied to esterification reaction, and the results showed that the acidity and immiscibility of IL systems affected their reaction performance [27, 28] presented the formation of ILs-like structure between PVP – lactam-containing molecule – and heteropoly acids with an application as catalyst for the alcoholysis of cellulosic saccharides [28]. Therefore, this work presents the facial synthesis of PVA-based hydrogel in the presence of PVP and citric acid acting as catalyst for hydrogel fabrication, as well as forming a three-dimensional network with PVA molecules using a microwave-assisted irradiation system to enhance gel formation. In addition, the effects of sodium hydrogencarbonate on hydrogel neutralization and gel formation were also discussed.

Experimental

Materials and methods

Polyvinyl alcohol (PVA) with a molecular weight ranging from 85,000 – 124,000 g.mol^{-1} (87 - 89% hydrolyzed) and polyvinylpyrrolidone (PVP) were purchased from Sigma-Aldrich. Citric acid (CA) was purchased from Fisher Chemical, and sodium hydrogencarbonate ($NaHCO_3$) was purchased from Analytical Univar reagent Ajax Finechem

Hydrogel Preparation

Study on the effects of PVA/PVP/CA ratio on hydrogel formation

Different PVA/PVP/CA ratios were performed in the hydrogel fabrication as described in Table 1. Each of the starting substrates was separately dissolved in water prior to mixing, and the volume of the mixture was adjusted with water to 70 mL to obtain a requiring final concentration. The mixture was then heated with a microwave-assisted irradiation system (CEM MARS 6) at 120 ^{o}C for 3 minutes.

The viscous solutions created after microwave heating were dried in the oven at 37 ^{o}C overnight. The dried films were neutralized by soaking in 0.10 mol.L^{-1} $NaHCO_3$ solution, and then washed with three successive portions of distilled water. The properties of the synthesized hydrogels were evaluated by gel fraction and swelling degree.

Study on the effects of the concentration of $NaHCO_3$ on gel formation

$NaHCO_3$ was not only used to neutralize the pH of synthesized hydrogels but also used as gelling agent. Therefore, different concentrations of $NaHCO_3$, including 0.00 (distilled water), 0.05, 0.10, and 0.50 $mol.L^{-1}$ were applied to the dried hydrogels. Then, the degree of gel fraction and the swelling of the hydrogels were evaluated.

Study on the effects of temperature and reaction time on gel formation

The parameters of microwave irradiation including heating temperature and time for hydrogel fabrication were studies. The PVA/PVP/CA hydrogel with a ratio providing satisfactory gel fraction and swelling degree was further studied in order to achieve optimum conditions for microwave irradiation. The irradiation temperature was ranged from 100 ^oC to 160 ^oC, while the irradiation time was increased from 1 to 9 minutes. In addition, the hydrogel was also synthesized under ambient conditions to elucidate the influence of microwave irradiation. The properties of the synthesized hydrogels were evaluated by gel fraction and swelling degree.

Properties of Hydrogel Evaluation and Characterization

In terms of swelling degree measurement, the water absorption efficiency of the hydrogels was determined by the swelling degree (Equation 1) using the gravimetric method. The dried hydrogels were accurately weighed, approximately 1 g, and soaked in $NaHCO_3$ followed by distilled water. The weight of fully swollen hydrogel after immersion in distilled water at room temperature for 24 hours was measured. The swollen hydrogels were then blotted with soft paper to remove water at the surface prior to weighing the hydrogels.

$$\text{Swelling degree (\%)} = \frac{(W_1 - W_0)}{W_0} \times 100 \quad (1)$$

where W_0 and W_1 denote the weight of dry and swollen hydrogels, respectively.

With regard to gel fraction measurement, in order to determine the degree of gel formation, the gel fraction of the hydrogels was calculated using Equation 2. Approximately 1 g of the dried hydrogels was accurately weighed and denoted as W_s, then soaked in $NaHCO_3$ solution followed by three successive portions of distilled water at room temperature to remove the soluble parts. The swollen hydrogels were then dried under vacuum conditions using a lyophilizer until a constant weight was obtained and denoted as W_d.

$$\text{Gel fraction (\%)} = \frac{W_s}{W_d} \times 100 \quad (2)$$

With reference to gel degradation measurement, the initial dried hydrogels were accurately weighed around 1 g (W_i) and soaked in PBS buffer solution at room temperature for 2 weeks, 1 month, and 2 months, respectively. The hydrogels were then dried in an oven and weighed to obtain an accurate weight (W_f). The degradation of the hydrogel was calculated using Equation 3.

$$\text{Gel degradation} = 100 - \left(\frac{W_f}{W_i}\right) \times 100 \quad (3)$$

In this study, Fourier transform infrared (FTIR) spectroscopy was used to characterized chemical compositions of the synthesized PVA:PVP:CA hydrogels, which were analyzed by FTIR (Spectrum GX FTIR System, Perkin-Elmer, USA) using transmittance and attenuated reflection modes, respectively. FTIR spectra were obtained in the range of wave numbers from 400 to 4,000 cm^{-1} during 64 scans with 2 cm^{-1} resolution.

Scanning electron microscope (SEM) was also employed for observing the cross-sectional morphology of the synthesized hydrogels through a SEM (JEOL JSM-6510LV, Japan). Prior to the SEM experiment, the hydrogels were dried under vacuum conditions using a lyophilizer. The dried hydrogels were then coated with platinum.

RESULTS AND DISCUSSION

Effects of PVA/PVP/CA ratio on hydrogel formation.

Since PVA/PVP-based hydrogels have been reported for wound dressing applications, the methods of hydrogel fabrication were related to high energy irradiation for three dimensional structure formation via a free radical process. An application of a relatively lower energy source using microwave irradiation was also presented. In order to observe hydrogel formation under conditions of microwave irradiation, several PVA/PVP ratios (Table 1) in the presence of CA were studied.

The mixtures of PVA/PVP/CA were heated by microwave irradiation at 120 ^{o}C for 3 minutes (Formula 1-8 in Table 1). The results showed that only the mixtures containing all of the three substrates (Formula 4-8 in Table 1) were able to form hydrogels, but gel was not formed for the rest of the formulas containing only two of three necessary components. However, there were some studies reporting a polymerization reaction between PVA and CA through esterification [29–31], but we found that more than 7 minutes of irradiation time was required to obtain a stable polymer, that is one that would not dissolve in water, with a relatively poor swelling degree (data not shown). Therefore, the presence of all three components were needed to obtain stable hydrogels under mild conditions with a high degree of swelling. The gel fraction and swelling degree of the PVA/PVP/CA hydrogel with different ratios of PVA, PVP, and CA are shown in Fig. 1.

The average gel fraction values from different PVA/PVP ratios had insignificant differences ranging from 45.18% to 49.81%. However, with the higher percentage of PVA, a higher swelling degree was obtained. The hydrogel with the ratio of 9% (PVA): 3% (PVP) gave a very high degree of swelling at approximately 5513%. This indicates that the hydrophilicity of the hydrogel resulted from the PVA components. However, it was very soft and hard to handle, which caused difficulty in terms of material development although gel fraction and was not found to be different from other ratios. In the case of the hydrogel with 3% (PVA): 9% (PVP), a relatively low gel fraction (45.18%) and low swelling degree (1551.33%) was obtained. Hence, the hydrogel with 6% (PVA) : 6% (PVP) was chosen for further study, as it provided satisfactory gel fraction (49.81%) and a swelling degree (2145.35%) with good physical properties and easy to handle.

The CA component was generally used as a cross-linking agent in hydrogel formation. In this study, without the presence of CA, hydrogel formation was not achieved from the mixture of PVA/PVP. Hence, different concentrations of CA added to 6% (PVA): 6% (PVP) were observed and evaluated via gel fraction and swelling degree (Fig. 1). At the concentration of 1% CA, a hydrogel with a very high swelling degree (6043.26%) was obtained, but the gel fraction was relatively low at only 25.63%. This indicates less formation of three-dimensional cross linkage of the hydrogel. At 5% CA, the hydrogel showed slightly less gel fraction and also a swelling degree than those of the 3% CA. Thus, 3% CA was chosen for mixing with 6% (PVA): 6% (PVP) for the hydrogel fabrication.

Effects of the concentration of $NaHCO_3$ on gel formation

Because CA was added for hydrogel preparation causing acidic pH of the synthesized hydrogel, several successive washes with distilled water were initially performed to neutralize the pH of the hydrogel. Therefore, $NaHCO_3$ solution was applied to the hydrogel to reduce the time-consuming process of using distilled water alone. Interestingly, the texture of hydrogel in terms of hardness after being soaked in $NaHCO_3$ solution was enhanced compared to the use of distilled water. Therefore, the effects of the concentration of $NaHCO_3$ (0.00, 0.05, 0.10, and 0.50 $mol.L^{-1}$) on gel formation was studied by comparing the gel fraction and the swelling degree of the hydrogel (Fig. 2).

The oven-dried thin film of the solution mixture of PVA/PVP/CA at a ratio of 6:6:3 %(w/v) after soaking in distilled water alone became a swollen hydrogel with a very soft texture causing difficulties in material handling. As shown in Fig. 2, the higher concentrations of $NaHCO_3$ solution resulted in higher gel fraction, but a lower degree of swelling. This indicates that the concentration of $NaHCO_3$ influenced the formation of a cross-linking network within the hydrogel structure. An

experiment, adding $NaHCO_3$ directly to the solution mixture of PVA/PVP/CA prior to microwave irradiation and oven-drying afterwards, was conducted. In this case, the formation of hydrogel did not occur, since the acid-base reaction between $NaHCO_3$ and CA caused neutralization of the mixture solution. This result implied that the reaction mixture needs to be acidic to be able to form hydrogel, while $NaHCO_3$ helps to enhance the cross-linking network of the hydrogel.

Effects of temperature and reaction time on gel formation

Without the addition of CA, the polymerization reaction between PVA and PVP seemed to be dependent on the energy gained from microwave irradiation, as longer irradiation time resulted in gel formation, while the gel did not occur by applying short irradiation time. Therefore, both heating temperature and irradiation time were studied to optimize microwave irradiation condition for PVA/PVP/CA hydrogel synthesis.

As shown in Fig. 3, the heating temperature of microwave irradiation did not significantly affect gel fraction and also the degree of swelling of the hydrogel. Therefore, gel formation under oven-dried conditions at 37 ^{o}C to remove the solvent without microwave irradiation was observed. Interestingly, hydrogels with similar levels of gel fraction to those under microwave irradiation prior to drying at 37 ^{o}C in the oven were obtained. However, the swelling degree of the hydrogel without microwave irradiation was significantly lower than those under microwave irradiation. This implies that the different temperatures of microwave irradiation for 3 minutes did not influence the polymer crosslink, but might affect the pore size of the hydrogel network.

Since the heating temperature of microwave irradiation did not significantly affect the properties of hydrogels, 120 ^{o}C was chosen for an irradiation time experiment. The irradiation heating time applied to the PVA/PVP/CA mixture solution varied from 1 to 9 minutes. This study confirmed the influence of microwave irradiation on hydrogel formation. With a longer irradiation period, the gel fraction significantly increased, while the degree of swelling decreased. Therefore, microwave irradiation helps to enhance cross-linking network formation. In comparison between the hydrogels synthesized in 1 minute of microwave irradiation and without irradiation, the former showed a considerably higher degree of swelling degree that of the latter. This means that microwave irradiation highly affected the pore size of the hydrogel network. At 9 minutes of heating, the gel was very stiff and had some burnt areas. Therefore, the gel fraction and the swelling degree of the resulting gel were not measured.

Hydrogel degradation

Stability over time during storage and usage is one of the important aspects of the management of the material. Therefore, the degradation or mass loss of the synthesized hydrogels was monitored. Since irradiation time showed an obvious effect on gel fraction and the swelling degree of hydrogel, degradation of PVA/PVP/CA with a ratio of 6:6:3 %(w/v), prepared under microwave irradiation at 120 ^{o}C for 1 – 5 minutes and with a ratio of 3:9:3 %(w/v) under microwave irradiation at 120 ^{o}C for 3 minutes was observed over a period of two months (Fig. 5). At the same irradiation time of 3 minutes, although gel fractions of PVA/PVP/CA with a ratio of 6:6:3 %(w/v) and 3:9:3 %(w/v) did not significantly differ, the latter formula however, degraded slightly faster. Therefore, the ratio of each starting material affected the rate of gel degradation. In the case of different irradiation times, as expected, longer irradiation times showed less degradation of the hydrogel over time, since a longer time provided a higher level of gel fraction.

Hydrogel characterization and hydrogel formation mechanism

FTIR with ATR mode was used to characterize the functional groups contained in the PVA/PVP/CA hydrogel and the spectrum is shown in Fig. 6. In addition, the signals of functional groups presented in the hydrogel was assigned and concluded in Table 2 together with the signals of PVA, PVP, CA, and PVA/CA film.

FTIR spectroscopy in transmittance mode using the KBr disc method was employed for PVA characterization and several characteristic peaks of PVA were observed (Table 2). The broad bands

observed between 3000 cm^{-1} and 3500 cm^{-1} represented the hydroxyl group of O-H stretching from the intermolecular and intramolecular hydrogen bonds. The duplet peak appearing at around 2900 cm-1 to 3000 cm^{-1} refers to the C-H stretching attributed to the alkyl chain. The peak observed between 1700 cm^{-1} and 1720 cm^{-1} comes from the C=O stretching from the acetate group remaining from the PVA starting material, due to the incomplete hydrolysis reaction of poly(vinyl acetate), PVAc to PVA [32]. Additionally, the peak appeared at around 1400 cm^{-1} to 1450 cm^{-1} corresponding with CH_2 scissoring, a strong absorption peak at around 1080 cm^{-1} to 1090 cm^{-1} refers to C-O stretching, and a peak of 835 cm^{-1} to 840 cm^{-1} was assigned to C-C stretching. These signals are similar to the IR signals obtained from PVA/CA film characterization.

Moreover, by comparing the IR signals of PVA/PVP/CA and PVA/CA films as shown in Fig. 6, it can be seen that they are very similar apart from the signals around 1648 cm^{-1} to 1710 cm^{-1}, in which the PVA/CA showed a strong signal at 1710.65 cm^{-1}, corresponding to C=O stretching, while the PVA/PCP/CA obviously showed an intense signal at 1648.57 cm^{-1}, referring to the presence of the carbonyl group of amide in the structure, and the signal of C=O stretching from PVA and CA at 1726.24 cm^{-1} was also presented, but had a relatively smaller peak. This indicates that the formation of hydrogel can be described as an interaction between each components of the starting materials.

In addition, the SEM was utilized for cross-sectional morphology studies in order to explain the physical properties of the hydrogels. Fig. 8 (A-C) shows SEM images of the PVA/PVP/CA hydrogel synthesized under microwave irradiation at 120 ^{o}C for 3, 5, and 7 minutes, respectively. The longer irradiation times resulted in a denser cross-linking network of the hydrogel, causing smaller pore sizes and a lower degree of swelling. At 7 minutes of irradiation, the pores at the surface of hydrogel are not clearly visualized via SEM, because irradiation heating time was too long. This explains the reason of the low swelling degree of the hydrogel when long irradiation times were applied.

The PVA/PVP/CA hydrogel can be prepared easily even under very mild conditions, with no heating or irradiation required. Therefore, the mechanism of hydrogel formation was very interesting. Although the mechanism is still unclear, we believe that it was related to catalytic reaction of esterification between PVA and CA in the presence of PVP, because stable polymers from the PVA and CA mixture cannot be obtained under microwave conditions unless the irradiation time was up to 7 minutes, while PVA/PVP/CA hydrogels were achieved without microwave irradiation. As there is no active functional group in the structure of PVP to form covalent bonds with either PVA or CA, the esterification reaction of PVA-CA is convincing to occur. In addition, a longer time of microwave irradiation caused higher levels of gel fraction with lower swelling degrees implying that more cross-linking networks were formed. The presence of PVP in the acidic conditions of CA may result in an IL-like structure. Since ILs have been reported in many studies on the property to act as a catalyst for several chemical reactions including esterification [26,27,33], and the ILs-like structure of PVP and heteropoly acids was reported as catalysts for the alcoholysis of cellulosic saccharides [28], and in this case nitrogen atom of the lactam on PVP structure was protonated by CA.

Moreover, because $NaHCO_3$ showed the results of enhancing a degree of gel fraction with slightly less swelling based on an increase of $NaHCO_3$ concentration after the dried gel was soaked in the $NaHCO_3$ solution, this indicated that another interaction force for network formation occurred in the hydrogel due to an increase in pH. Owing to $NaHCO_3$ addition, the acidic proton in hydrogel from CA was removed. Therefore, more concentration of $NaHCO_3$ added resulted in more free citrate groups existing in the hydrogel structure. This lead to stronger hydrogen bonding between free citrate groups and protonated PVP structures. Thus, not only esterification, but also strong hydrogen bonding causes the PVA/PVP/CA hydrogel network formation as the mechanism presented in Fig. 8.

CONCLUSION

Generally, crosslinking between PVA and PVP to form a three-dimensional network can occur via free radical generation using high energy source of gamma irradiation. In addition, esterification reaction between PVA and CA requires a rather long heating time. However, this work presents the PVA/PVP/CA hydrogel preparation process using an economic and a relatively low energy source of microwave irradiation. The PVA/PVP/CA mixture solution with a ratio of 6:6:3 %(w/v) under microwave irradiation at 120 ^{o}C for 3 minutes was found to be the optimum conditions for the hydrogel fabrication as determined by gel fraction and swelling degree. Moreover, 0.1 mol.L^{-1} NaHCO3 was applied to the dried gel to neutralize pH and also enhanced gel fraction of the hydrogel. The network structure of the hydrogel is believed to involve catalytic esterification between PVA and CA, in the presence of PVA, which can form IL-like structure to act as catalyst in the reaction. In addition to esterification, hydrogen bonding also plays an important role on hydrogel formation. As basic solution of $NaHCO_3$ can remove acidic protons from the hydrogel, therefore carboxylate group can interact strongly with the protonated nitrogen lactam of the PVP structure. The proposed hydrogel structure is well consistent with the IR spectrum of PVA/PVP/CA hydrogel as the spectrum shows both the signals of PVA and PVP. Thus, the presented protocol of hydrogel formation can be applied to a real application of material preparation such as wound dressing development.

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Figure Legends

Figure. 1 Gel fraction and swelling degree of hydrogel with different PVA/PVP/CA ratios (Formula 4-8) under microwave irradiation at 120 ºC for 3 minutes (n = 5).

Figure. 2 Gel fraction and swelling degree of the 6% (PVA): 6% (PVP) : 3% (CA) hydrogels under microwave irradiation at 120 ºC for 3 minutes after soaking in different concentrations of NaHCO3 solutions (n = 4).

Figure. 3 Gel fraction and the swelling degree of the 6% (PVA) : 6% (PVP) : 3% (CA) hydrogels under microwave irradiation at the temperature ranging from 100 oC to 160 oC for 3 minutes, and no irradiation (n = 5).

Figure. 4 Gel fraction and swelling degree of the 6% (PVA) : 6% (PVP) : 3% (CA) hydrogels under microwave irradiation at the temperature of 120 ºC for 1 to 7 minutes (n = 4).

Figure. 5 Gel degradation of the PVA/PVP/CA hydrogels synthesized under microwave irradiation at 120 oC for 1 to 5 minutes (n = 4).

Figure. 6 ATR-FTIR spectra of the hydrogels: PVA/PVP/CA hydrogel (upper line) and PVA/CA film (lower line) synthesized under microwave irradiation.

Figure. 7 SEM images of the PVA/PVP/CA hydrogel synthesized under microwave irradiation at 120 ºC for (A) 3 minutes, (B) 5 minutes, and (C) 7 minutes.

Figure. 8 The proposed mechanism of network formation in the PVA/PVP/CA hydrogel structure.

Figure. 1

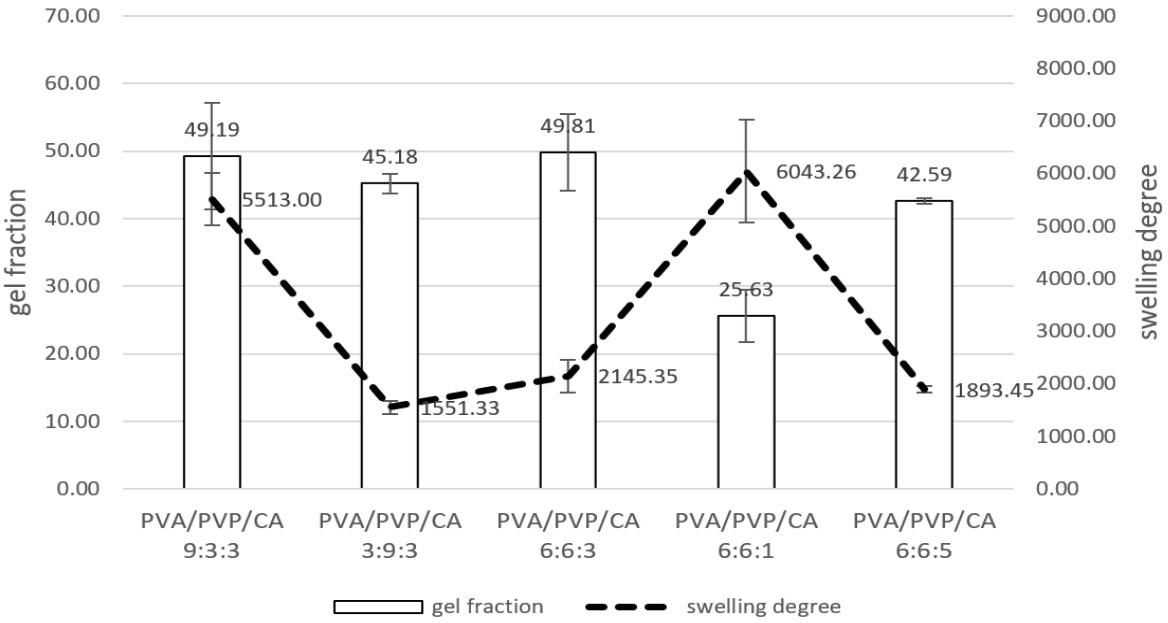


Figure. 2

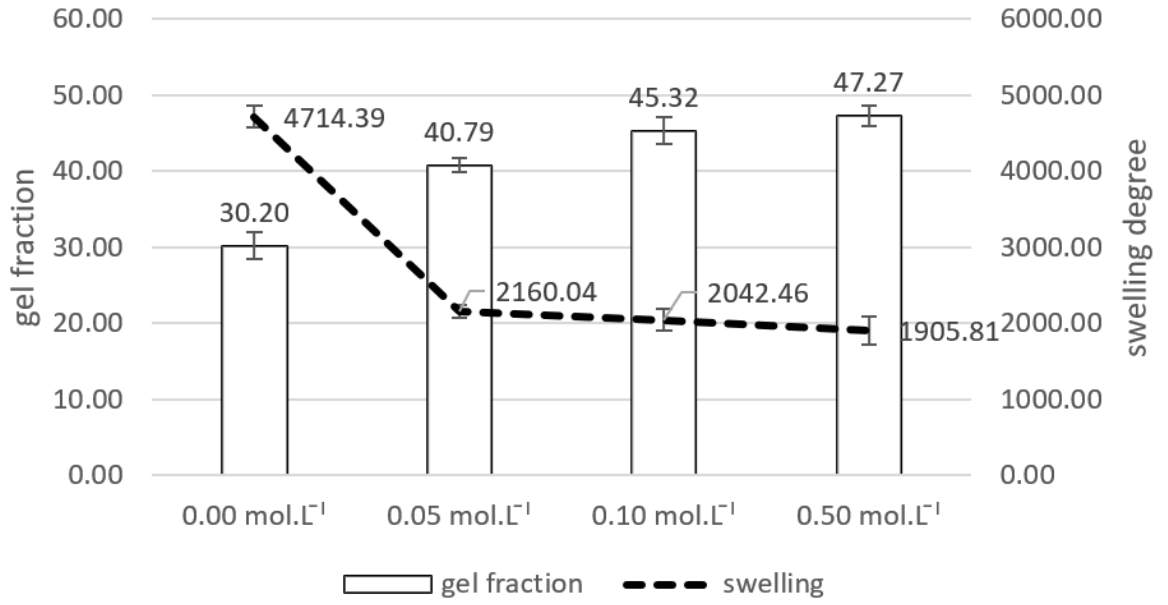


Figure. 3

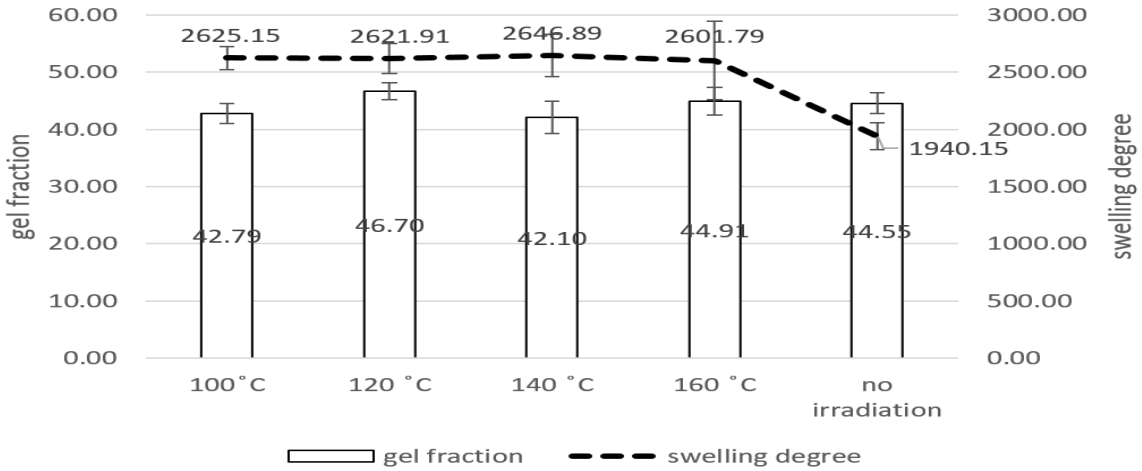


Figure. 4

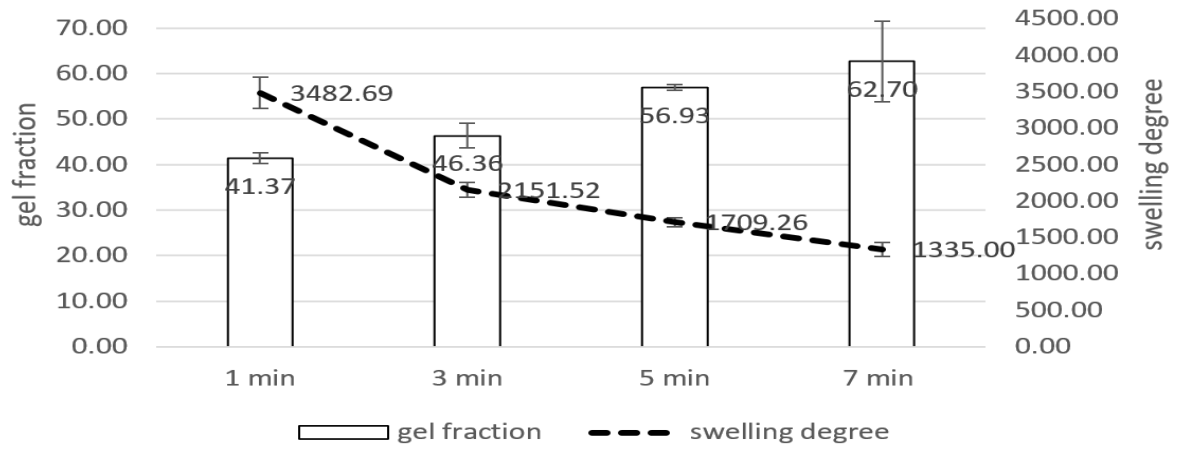


Figure. 5

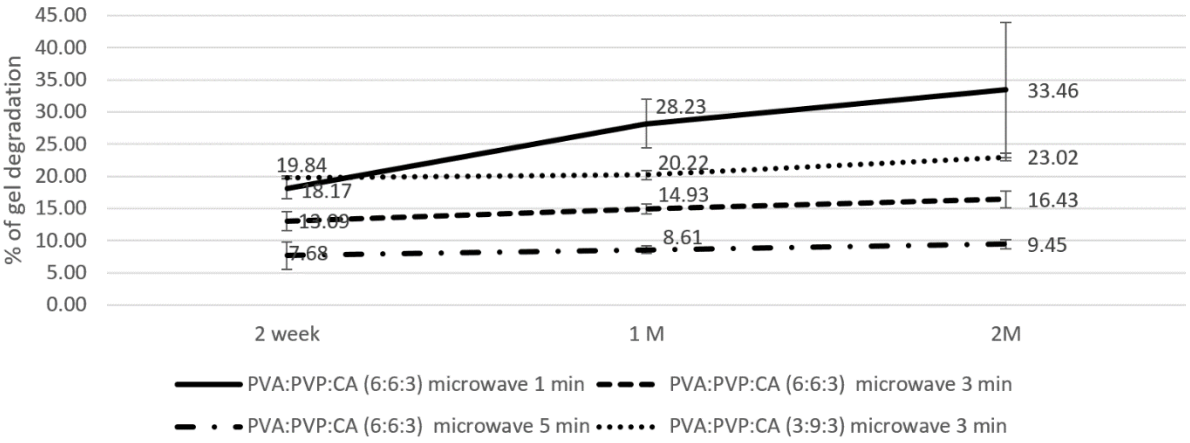


Figure. 6

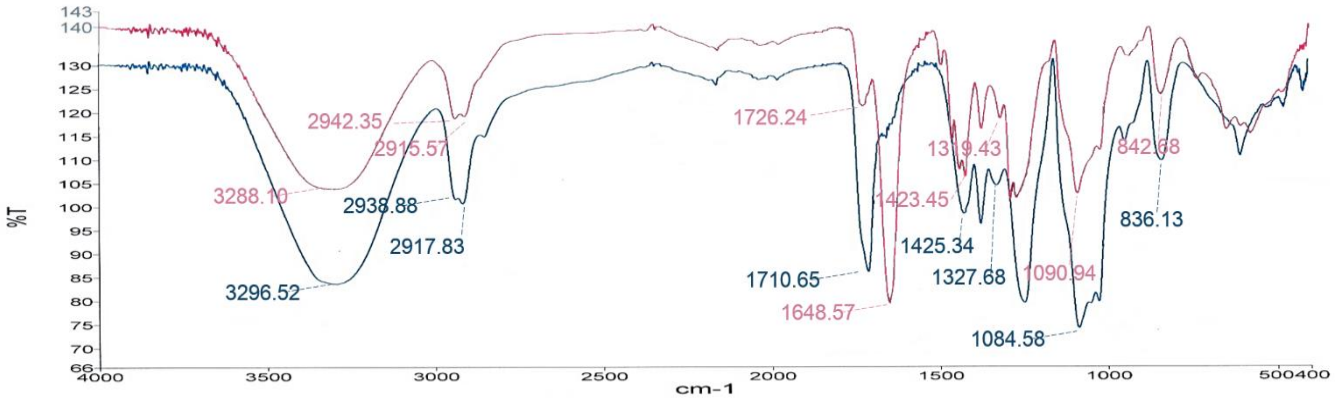


Figure. 7(A-C).

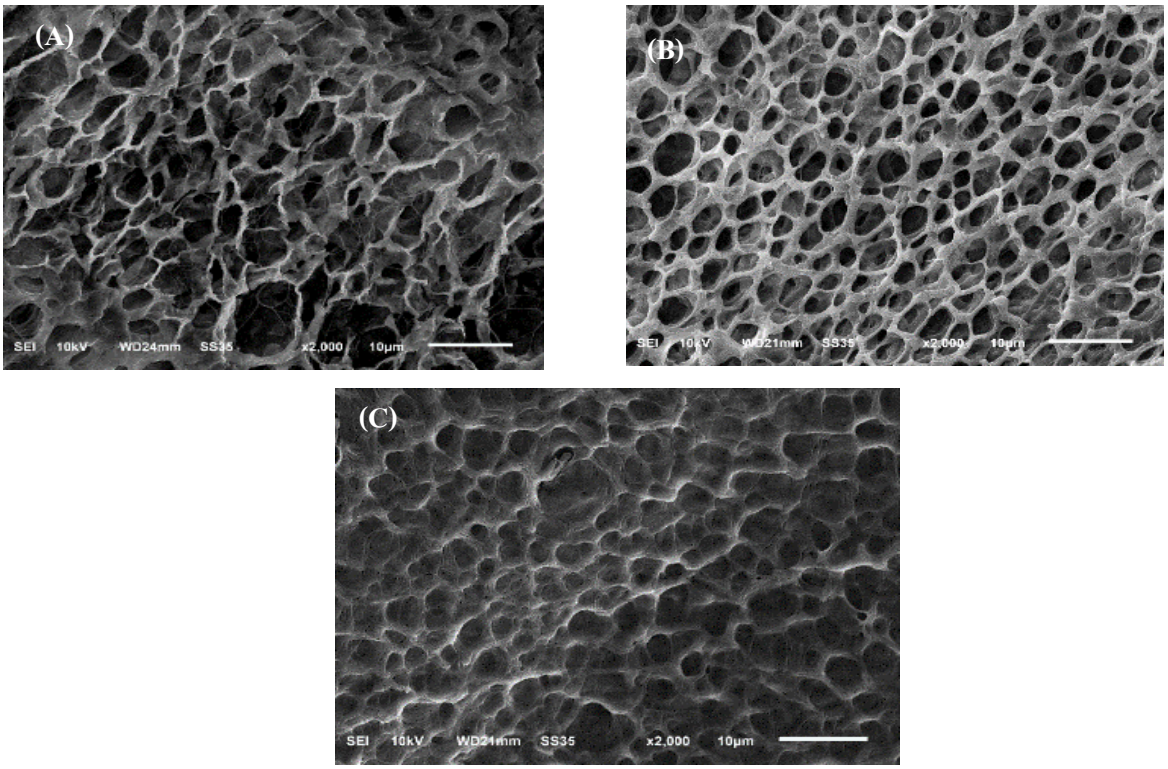


Figure. 8

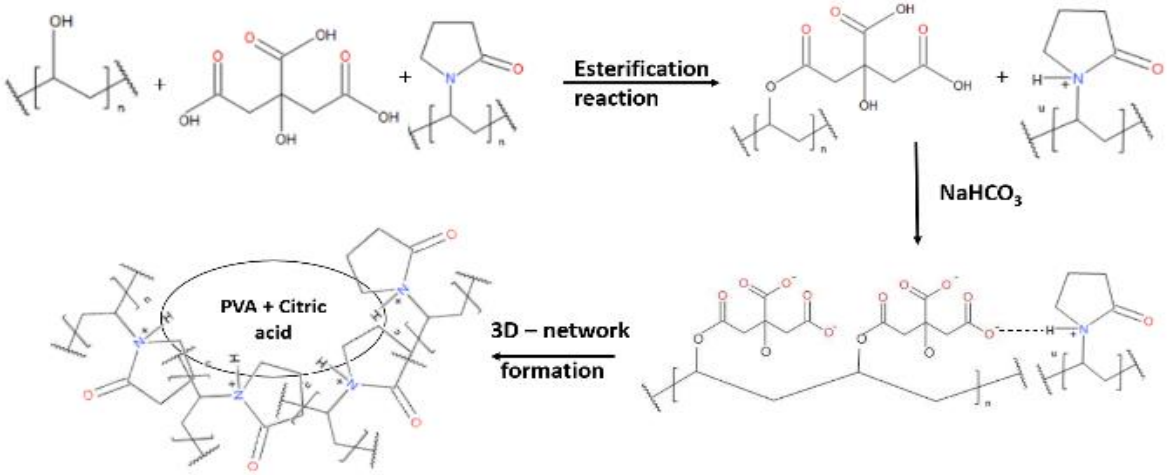


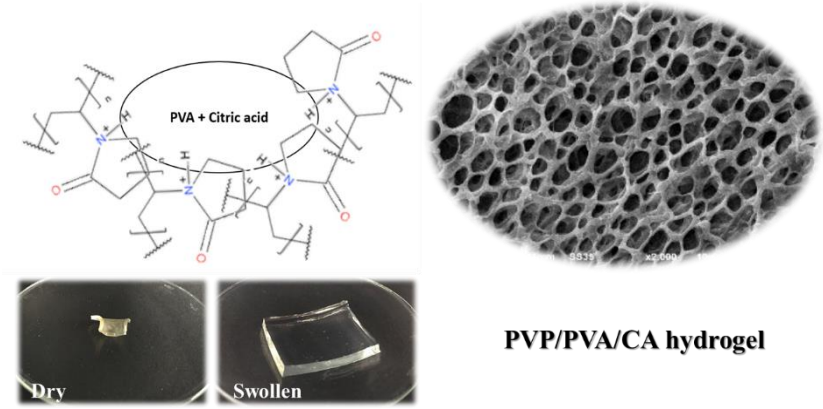
Table 1 The ratios of PVA/PVP/CA for hydrogel preparation under microwave irradiation heating at 120 ºC for 3 minutes.

Formula	Substrate (% w/v)		
	PVA	**PVP**	**CA**
1	6	6	0
2	0	6	3
3	6	0	3
4	6	6	3
5	3	9	3
6	9	3	3
7	6	6	1
8	6	6	5

Table 2 FTIR signal assignments from the analyses of PVA, PVP, CA, dried PVA/PVP/CA hydrogel, and dried PVA/CA film.

Wave number (cm^{-1})					**Assignment**
PVA	**PVP**	**CA**	**PVA/PVP/CA**	**PVA/CA**	
3294.50	3385.70	3283.36	3288.10	3296.52	O-H stretching
2938.55, 2918.07	2956.70, 2925.71	3009.06, 2958.71	2942.35, 2915.57	2938.88, 2917.83	C-H stretching
1714.12	-	1720.14	1726.24	1710.65	C=O stretching
-	1638.48	-	1648.57	-	NC=O stretching
1424.52	1422.60	1419.38	1423.45	1425.34	CH_2 scissoring
1327.01	-	1318.37	1319.43	1327.68	O-H bending
1087.04	1073.57	1080.66	1090.94	1084.58	C-O stretching
839.48	844.44	884.56	842.68	836.13	C-C stretching

Graphic Abstract



A LOW PRESSURE PLASMA TREATMENT FOR QUALITY IMPROVEMENT OF RICE FLOUR

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Keywords: Low pressure plasma, Rice Flour, Medicine and Cosmetics.

Abstract. Nowadays, rice products are studied to enhance its value such as in medicine and cosmetics. This research using the low pressure plasma (LPP) to study the properties of rice flour after plasma treatment. Rice flour samples were treated of various rf powers at 50, 75, 100, 125 and 150watts. During the plasma treatment, the plasma species were observed by optical emission spectroscopy (OES). The major of the optical emission lines from OH, N_2, H_β, C_2, N, H_2, H_α radicals and Ar atom were observed. The emission intensities of each species increased by increasing of plasma power. Surface morphology was studied by scanning electron microscope (SEM). The fine grains found on the surface after plasma treatment. The effect of the roughness and fine grains structure on the surface of rice flour were increased by increasing the plasma power. Then, the surface chemistry were analy by reflectance-Fourier transform infrared)ATR-FTIR) and X-ray photoelectron spectroscopy (XPS). Static contact angles were measured the water and oil adsorption. After plasma treatment, the water absorption were decreased and the oil absorption were increased at 100 watts due to the roughness of surface and addition of functional groups. In the conclusion, LPP can be a promising technology for improving functionality of flour and enhance its value in various new products.

Introduction

Rice (*Oryza sativa L.*) is amongst the most widely consumed staple food, especially in Asia . About 20% the total production is further milled and processed into parboiled rice worldwide [1] . Many studies enhanced the rice products value, not only in food products but also in various goods such as in pharmaceutical, medical and cosmetics products .One product using rice as a raw material is powder puff due to it not containing any hazardous substance such as talcum .As well as it has biological molecules with antioxidant properties, inhibiting enzymes that darken the skin and helps to slow down the ageing process .As the substance reduces inflammation it helps cure acne .It can be rinsed thoroughly without leaving any chemical residue [2] .Besides bio deterioration of rice by decay fungus which degrades the cell wall components there are fungi which can cause discoloration on the surface or deeper in the rice but cause no strength loss [3].

Cold plasma processing has been used for sterilization, functionalization, inactivation of enzymes, altering the hydrophilic/hydrophobic properties and etching [4]. The plasma technologies have been intensively developed for more than three decades, there are successful progress as key manufacturing technologies for a variety of industrial applications such as surface modification and biomaterial processes .Low pressure plasmas are sustained in vacuum due to insufficient collisions between electrons and gas molecules. In these low pressure plasma, the gas temperature is maintained usually at temperatures much less than the electron temperature of a few electron volts . The low pressure plasma sources are attractive in that the low pressure plasma can provide enhanced gas chemistry via a production of high density reactive species. While the gas temperature

is maintained as low as the level acceptable for processing of organic materials and biomedical applications .The attractive features of the low pressure plasma have led to open intensive research activities that require low temperature processes in materials in biological and biomedical applications [5] .

Materials and methods

In this experiment, argon plasma treatments were carried out using a home-made 13.56-MHz inductively coupled plasma reactor [6]. The rice flour samples were put into the quartz cylinder of the plasma reactor and then the cylinder was evacuated to a base pressure of 0.01 Pa. For improvement of rice flour the samples were treated by Ar plasma at 3.5 Pa and a radiofrequency (RF) power of 50, 75, 100, 125 and 150 watts for 4 min. Optical emission spectroscopy (OES) (Fiber Optic Spectrometer: AvaSpec-2048) was used for observed the active plasma species. The schematic diagram of the low pressure plasma was show in the figure 1.

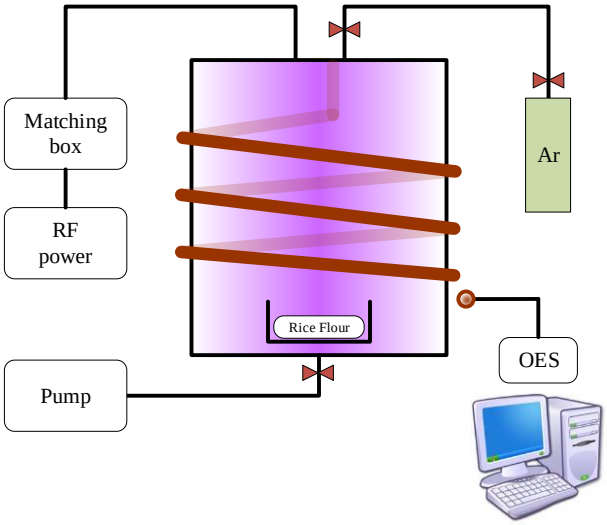

Figure 1. The schematic diagram of low pressure plasma using to modification the functionals of the rice flour.

The characteristic of the rice flour property after treatment for cosmetic powder were used. The physical and chemical properties such as the water and oil absorption, surface morphology and sterilization were studied. Static contact angles were measured using 2-µl droplets of deionised water and squalane oil, respectively, at room temperature. Three replicates of each condition of treatments were analyed. The deionization water represents the humidity from the environment after using the powder and the squalane oil was used to represents the human sweat. Attenuated total reflectance-Fourier transform infrared)ATR-FTIR) (Perkin Elmer model Spectrum GX) and X-ray photoelectron spectroscopy (XPS) (KRATOS analytical, UK) was used to study the chemical structure of the powder. The surface morphology was observed by scanning electron microscope)SEM((LV-Scanning Electron Microscope: JSM 5910 LV) .

Results and discussion

1 .Plasma species

The overall emission spectra during the treatment process at the different energy levels are show in the figure 2. The graph shows the major optical emission lines of OH, N_2, H_β, C_2, N, H_2, H_α and Ar .By increasing energy the emission intensities of each species were increased .The higher rf power that delivered an increased energy to the system [7]. The greater collision rate in plasma space which consequently leads to higher emission intensity by argon emission lines were mainly observed in the 651–843 nm range. The emission lines of OH at 308 nm and O_2 at 516 nm. The

peak at 394 – 452 nm and at 556 nm can be ascribed to N_2 and N [8]. And the emission lines of hidrogen were observed; H_β at 486 nm, H_2 at 603 nm and H_α at 656 nm.

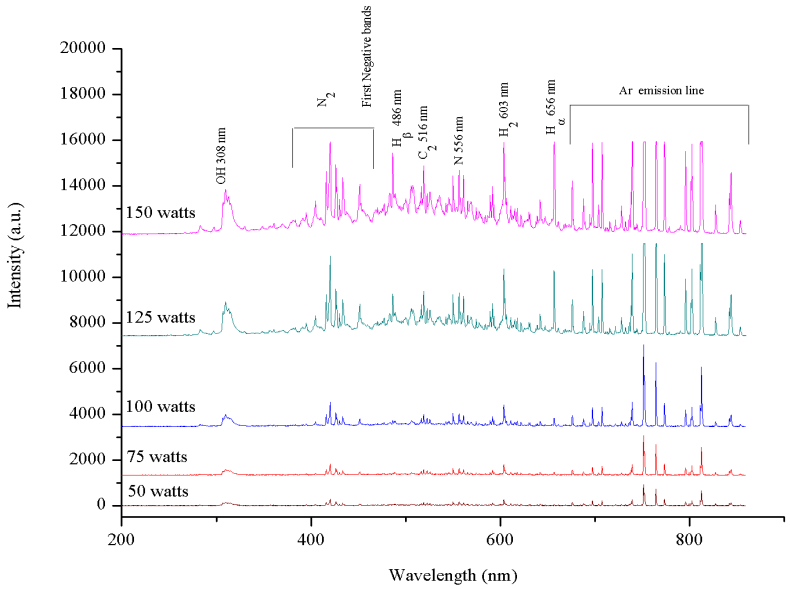

Figure 2. The emission spectra of the different RF power treatment.

2 .The chemical properties

The result of analysis with ATR-FTIR as shows in the figure 3. It was found that in the after plasma treatment samples have the functions of CH_2, CH_3, C=O, C=O-OH, C-O, C=C and C-N groups [9-13] with the similar structures as untreated sample. However, the results of the study showed the difference between untreated and treated samples at the CH_3 positions. Almost treatments the peak are shifted to higher wavenumber, however, which one of the CH_3 positions peaks shifted to lower wavenumber at the rf power treatment of 75 watt. It seem like that if the peak wave number shift to the higher values that represents the decreasing of the bonding length. If it is decreases, the bond length is increases. Which the bond length changes may occur due to the change in electronegativity of the neighboring atom. This is like hydrogen bonding. Hydrogen bonding is a fundamental element in protein structure and function. When plasma radical breaking a single hydrogen bond may impair the stability of a protein. For hydrogen-bonding interactions with polar side-chain groups the C=O stretching versus O-H stretching, may be employed to identify the specific type of hydrogen-bonding interaction.

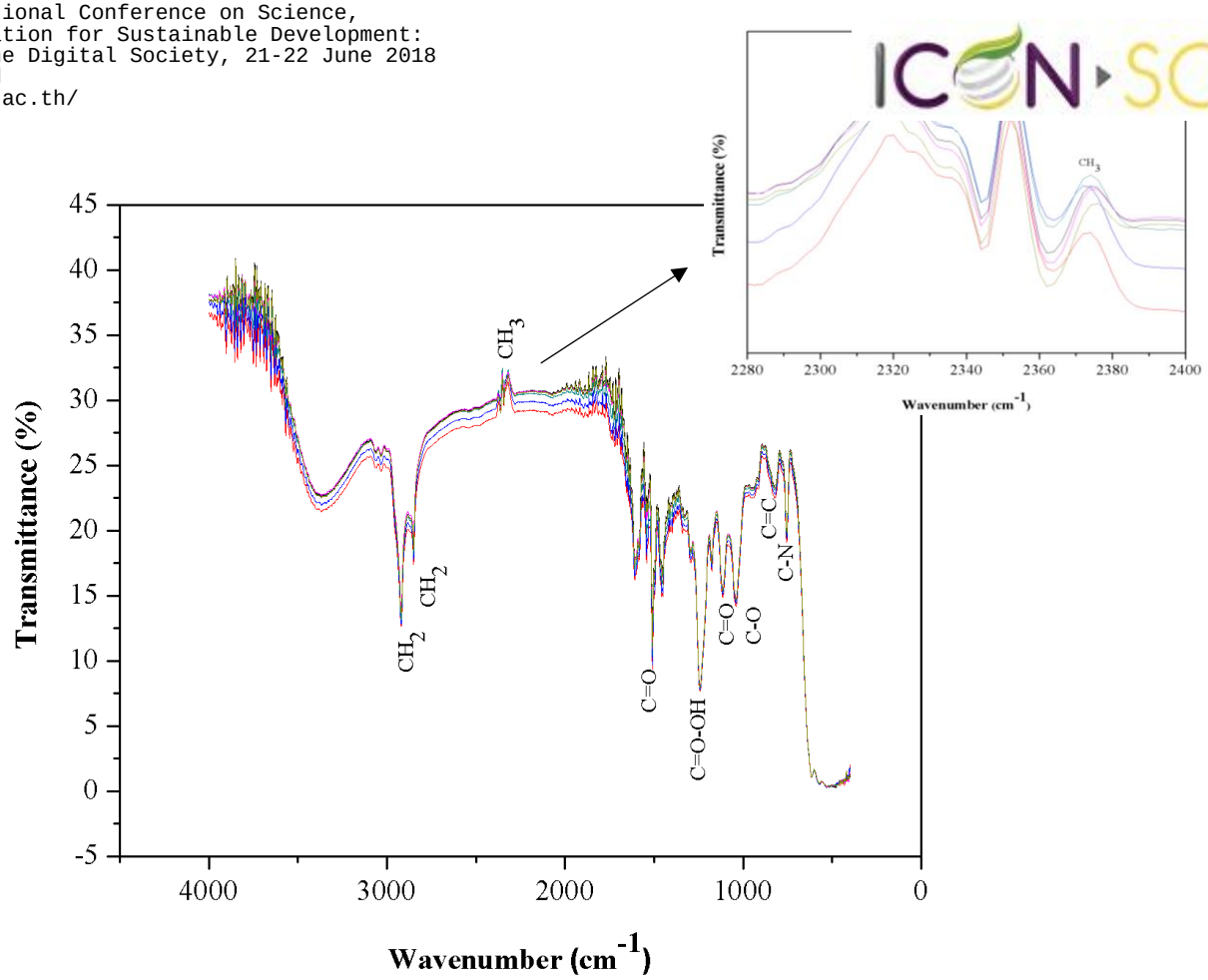

Figure 3. ATR-FTIR spectra for rice flour at different magnifications

3. X-ray photoelectron spectroscopy (XPS) analysis

The elemental analysis of rice flour components was characterized by XPS. Three atoms elements (C, O and N) were detected with the plasma discharged at rf power 0, 50, 75, 100, 125 and 150 watts, respectively. The deconvoluted of the untreated sample shows in the figure 4. The main peak carbon (C1s) was deconvoluted into five peaks at 285.0 eV (C–H/C–C), 285.6 eV (C – N), 286.4 eV(C–OH/C–O–C), 288.0 eV (N−C=O) and 289.0 eV (CO/O–CO). The N1s peaks was deconvoluted into two peaks at 399.8 eV and 401.5 eV there were assigned to the amine group (C–NH) and amide group (CO–NH). After plasma treated the nitrogen of the amine and amide group were redused. And oxygen could be subdivided into three peak C = O, C-OH and O – C = O. The peak at 531.7 eV, 532.9 eV and 533.7 eV, respectively [14-16]. The C/O and C/N stoichiometry for rice flour unterated and treated sample are shown in the table 1. The result of the chemical reaction of sample process reflects the degrees of cross-linking. It has been reported that a low water resistance for adhesive is mainly the result of high hydrophobicity and cross-linking, and low hydrophilicity [17].

Table 1 Show the elemental analysis of rice flour components measured by XPS

Power (watts)	Functions				
	C	N	O	C/N	C/O
Control	76.25	3.72	20.03	20.50	3.81
50	80.09	1.10	18.81	72.81	4.26
75	78.51	2.19	19.30	35.85	4.07
100	70.43	1.28	28.29	55.02	2.49
125	71.20	0.81	27.99	87.90	2.54
150	69.09	2.35	28.56	29.40	2.54

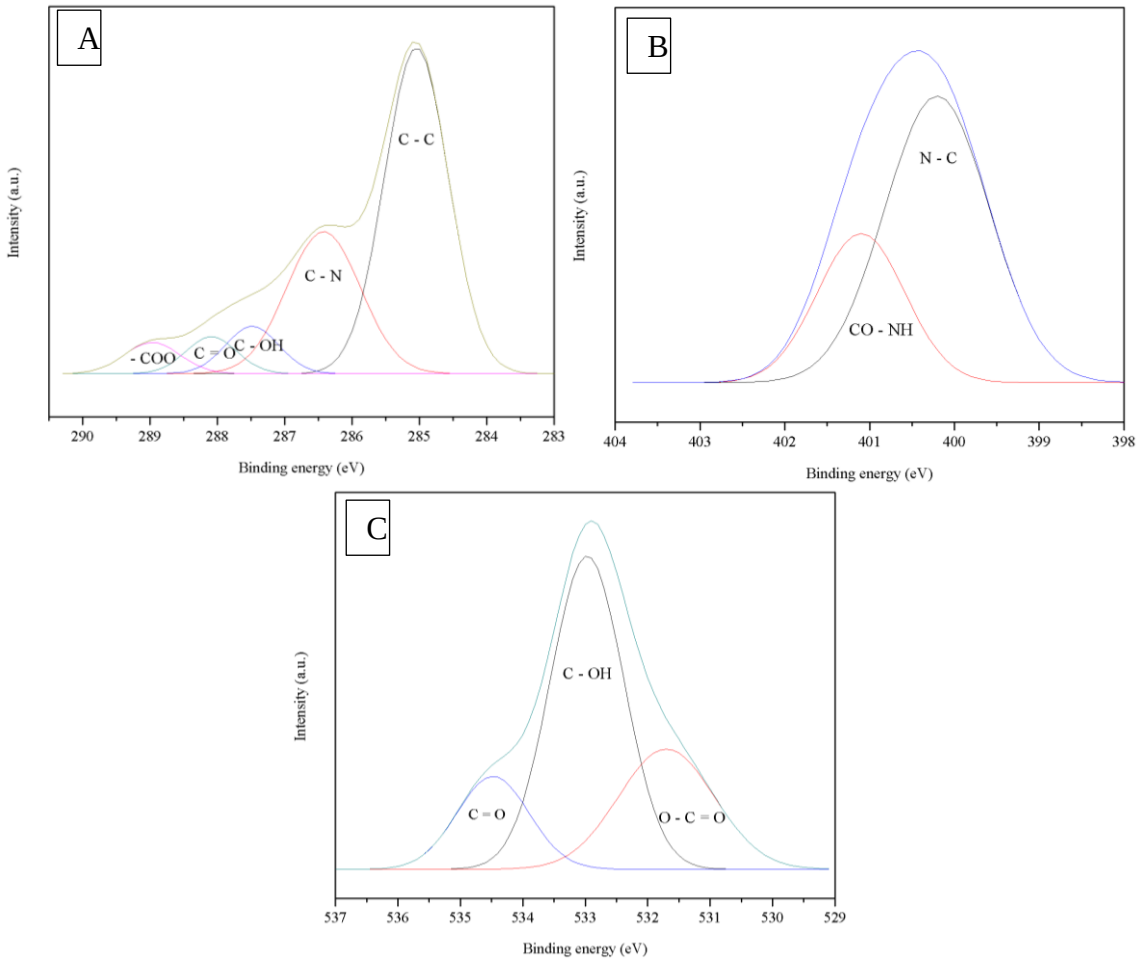

Figure 4. Show the XPS spectra of rice flour. (a) XPS spectra of carbon, (b) XPS spectra of nitrogen and (c) XPS spectra of oxygen.

4 .The surface morphology

The surface morphology was observed by SEM .The untreated and plasma treated rice flour samples are shown in figure 5 .The untreated sample has a smooth surface morphology .In the vacuum sample no observable change in the morphology was found but fissures on the surface of the sample were discovered. After the plasma treatment the morphology of the sample had surface roughness and fine grains which were caused by plasma particles reacting or etching on the surface. With the plasma power energy increased the roughness and fine grains effect on the surface of rice powder increase. Thechange of the surface was most evident when the sample was treated at 120 watts and 150 watts. It was observed that the morphological structure of the control sample was unaltered, whereas the native structure of rice flour was disturbed by plasma treatment .The extent of fissures increased with an increase in plasma power .These shallow depressions might be due to plasma etching by immanent reactive species such as ions and electrons generated during the plasma treatment .Similar types of changes in morphological structure were seen in plasma treated black gram [18]. One of the reason of the water and oil absorption is due to the change in surface to a rough one .

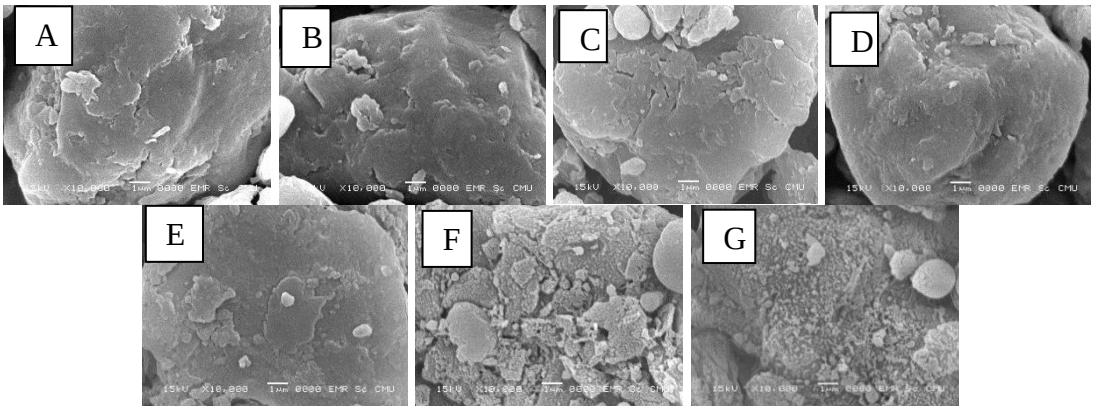

Figure 5. SEM micrographs of rice flour a (Control)untreated (b (Vacuum control c (plasma treatment at 50 Watts d (plasma treatment at 75 Watts E (plasma treatment at 100 Watts F (plasma treatment at 120 Watts G (plasma treatment at 150 Watts.

5 .The water and oil absorption

The water and oil adsorption were analysed by the time adsorbed. Untreated sample can absorbed the water better than the plasma treated samples. The drop of the water was adsorbed into the rice flour rapidly, after treatment the water was slightly delay adsorbed. However, the squalane oil absorption was shown the opposite trend. The untreated sample was used very long time to absorb the squalane oil but when passed through the plasma, it was found a higher squalane oil absorption capacity and a maximum at 100 watts. When the energy was increased, the ability of water absorbtion was decreased but the ability of squalane oil absorbtion was increased. Due to the polarity of the rice flour structure. After the plasma treatment incresing of the cross-linking of the rice fluor structure was redused the the polar function on the surface. Moreover, the surface morphology are the case of hydrophobicity resulting in reduced water absorption.

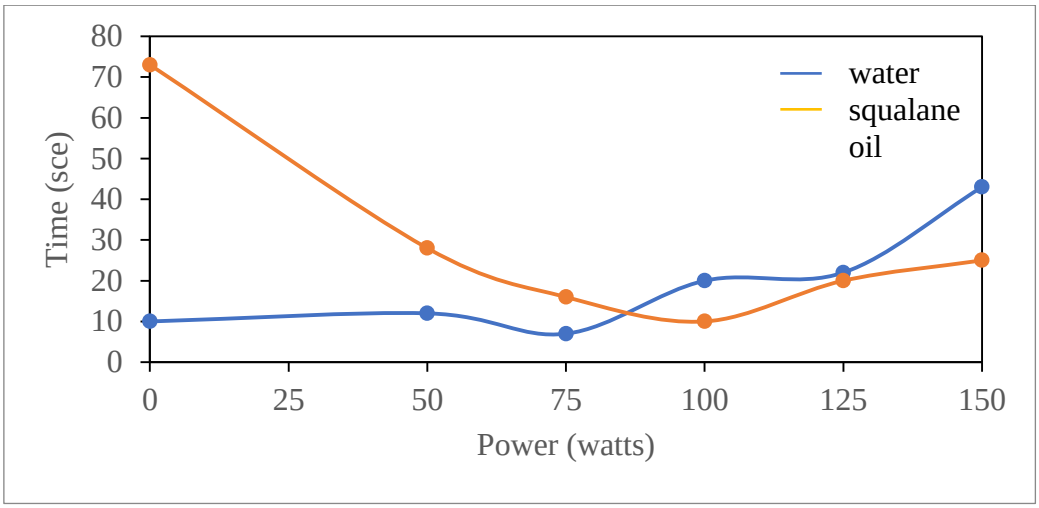

Figure 6. shows the water and oil absorption result of the plasma discharged at rf power 0, 50, 75, 100, 125 and 150 watts.

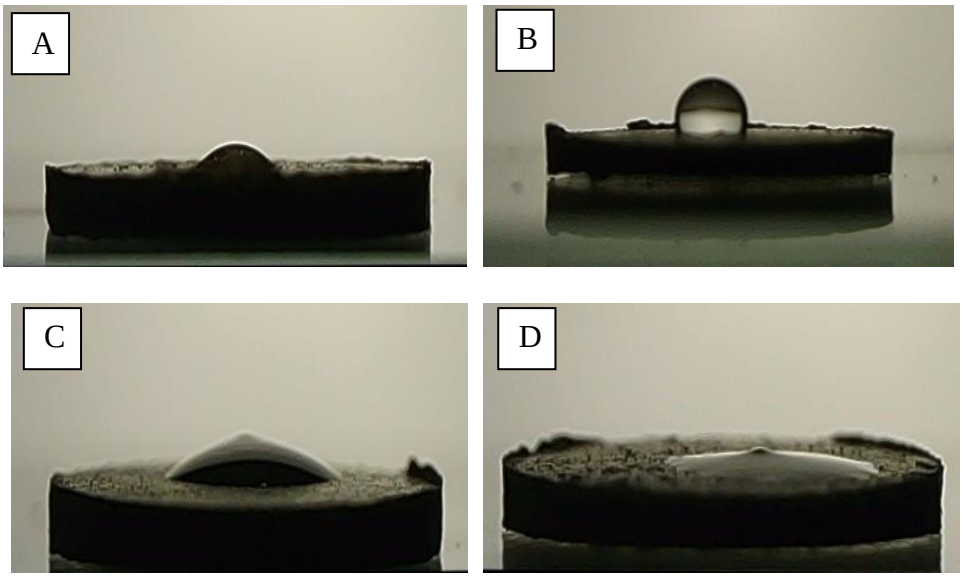

Figure 7. Show the result of the absorption samples (a) the water absorption of control)untreated(. (b) the water absorption of treated. (c) the squalane oil absorption of control)untreated(. (d) the squalane oil absorption of treated**.**

Conclusion

In this study, the improvement of rice flour properties by plasma treatment were approved. The untreated sample of rice flour has a smooth morphology surface .After plasma treatment it was found the roughness and fine grains which were caused by plasma particles reacting or etching on the surface .When the plasma power energy increases the roughness and fine grains on the surface of the rice flour also increased. ATR-FTIR analysis found that elemental breakdown with the cross-linking of the surface structure. XPS also supported the conclusion of the FTIR. XPS analysis found that result of the chemical reaction of sample process reflects the degrees of cross-linking. Therefore, the treated samples have the water absorption decrease but the squalane oil absorption increased at 100 watts. Due to surface morphology and chemical structure. It can concluded that the plasma treatment can be a promising technology for improving functionality of flour and enhance its value in various new products.

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A NOVEL SACHA INCHI (*Plukenetia volubilis* L.) INNER SHELL AS A MODIFIED-POROUS ACTIVATED CARBON PRODUCT

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Keywords: activated carbon, sacha inchi shell, agricultural waste utilization

Abstract. Activated carbon (AC) has been an ideal material for the separation of a variety of chemical pollutants. Its extensive use is limited due to the cost of production, which has triggered the researches on the possible option for cost-effective production, especially using low cost materials. This study aimed at the development of activated carbon derived from industrial processing residue for sustainable waste management. The optimized condition for carbonization of inner Sacha inchi (*Plukenetia volubilis* L.) shell after oil extraction process was conducted by varying combustion temperature between 500-700 ºC under air atmosphere for 1 h. Chemical activation using o-phosphoric acid with impregnation ratio of 1.5 was performed. The AC was characterized by iodine and methylene blue adsorption, FT-IR and scanning electron microscopy (SEM) measurements. The results showed that the inner shell of Sacha inchi was proved to be more promising AC materials due to high percentage of fixed carbon and lignin contents (29.93% and 72.66%, respectively). The optimum pyrolysis temperature was found to be 600°C with the yields of 66%. The adsorption capacities towards methylene blue and iodine were 330 mg/g and 1,517 mg/g, respectively. The functional groups were also studied for further application in cosmetic and nutraceutical products.

Introduction

Sacha inchi (*Plukenetia volubilis* L.), also known as Inca peanut, is a plant of Euphorbiaceae family [1] with a great economic expansion in both Central and South America and South East Asia including Thailand. Their seeds contain approximately, on average, 48% oil and 27% proteins that are rich in cysteine, tyrosine, threonine and tryptophan [2]. Sacha inchi oil has a great health and nutritional benefits because of its high contents of polyunsaturated fatty acids (47-51%), comprised of approximately 34% linoleic acid (ω-6) and 51% linolenic (ω-3), and also vitamin E (34-37%). [3].

Recently, Sacha inchi has been growing interests and demands among Thai consumers leading to an increase in its production not only in the food manufacturing, but also in the pharmaceutical and cosmetic industries. Accordingly, Sacha inchi is widely cultivated to meet the demands across Thailand. It is estimated that the cultivation area of Sacha inchi in Thailand has been increased and it accounts for more than 20000 rai, in 2018. However, these cause large amounts of bio-waste in terms of peanut shells and reported that the peanut shells after oil extraction process were nearly 2500 ton/year. There has gained a lot of concerns regarding to environmental problems which need more solutions for the sustainable and ecofriendly waste management.

There are some conventional methods mostly used for agricultural waste managements. Incineration process is one of the most common used as it can produce three main products that are

bio-oils, char and synthetic gases depending on the biomass structure and components [4, 5]. Moreover, biotechnological methods using enzymatic or microbiological processes are also widely applied to convert agricultural biomass into different valuable products such as fertilizers, biomaterials, bioenergy and bio-sorbent [6, 7, 8]. The peanut shells of Sacha inchi and its extracts have been reported to be used as a copper and lead bio-sorbent and nanoparticles synthesis intermediary [7, 9]. Recently, the waste biomass derived catalyst from shea nut or coconut shell and food corps residues was created as a new precursor in the field of bioethanol and biodiesel production [10, 11]. Although, there are many advantages of biotechnological processes, there are still limited applications of each type of agricultural biomass, especially Sacha inchi shells due to their complexity and high operation costs. Therefore, more strategies for the Sacha inchi shells handling need to be developed.

Activated carbon (AC) is a commonly adsorbent which widely used for odors, dyes, gases and other contaminants especially in water or air purification [12]. Generally, the materials that are suitable for activated carbon production should contain high amount of carbon but less inorganic contents. Practically, using of agricultural waste for activated carbon production has gained a lot of interests due to their low cost and locally available, e.g. coconut shell [13], bamboo [14], oil palm shell [15], sugarcane bagasse [16].

Over a few decades, Thai populations has changed into elderly society where increasingly health-conscious consumers have concerned more on nutrition, healthy food and organic products. As consumer behaviors and demands have been changed, it has gained a lot of opportunities for new healthy businesses and value-added products that could expand to overseas markets. Aggressive competition continued to be seen recently in health and wellness. Consequently, the producers need to consider the new healthy and wellness products or innovations that offer a combination of functions, environmental awareness, low-cost, and easy available precursor.

There are few documents relating to the production of cosmetics and nutraceuticals ingredient from agricultural waste. Cabot Corporation [17] produced the color additive made from 100% vegetable based activated carbon for foodstuff. Maulion et al. [18] studied the oil adsorption capacity of activated carbon from corncob. Coffee Processing By-Products, unroasted coffee beans were extracted to be the jelly-like extract. It was observed to be improved natural skin cell renewal, promoted an even skin tone for a radiant complexion and reinforced the epidermal barrier. Tomato Processing By-Products, peels, pulps and seeds, also called “tomato pomace”, that are extremely rich in anti-oxidant compounds: in particular the lycopene, a compound known for its role in disease prevention, is in high demand from food, pharmaceutical and cosmetic industries [19].

Sacha inchi shell has been reported to be used as fuel gas generation [20] and local tea production. However, there is currently no information available about the activated carbon production from Sacha inchi shell. In this study, the activated carbon from Sacha inchi shell left after oil production process was prepared by chemical activation method using phosphoric acid with various activating temperatures. The value-added activated carbon products obtained from Sacha inchi shell waste is aimed for further applied for cosmetic and nutraceutical useful.

Experimental methods

Biomass preparation. Sacha inchi shell was kindly provided by Omega 3.6.9 and lycopene, Co., Ltd., Thailand. They were initially soaked with distilled water at 80 °C for 2 h to remove all dust particles and water-soluble organic compound before being wash with distilled water, followed by drying at 105 °C for 24 h. After that, the dried biomass was crushed and grounded to get a size between 106-425 µm [21] (Fig. 1). The powdered biomass was stored in air tight box for physical and chemical analysis further experiments.

Activated carbon preparation. Before activation process, the biomass powders were treated with 85 % wt. H_3PO_4 solution with the impregnation ratio of 1:1.5 (g powdered biomass /g H_3PO_4) at 80 °C for 6 h. They were then dehydrated in an oven at 110 °C for 24 h. After impregnation process, the treated biomass was pyrolyzed in the muffle furnace operating at different activation temperatures (500, 600 and 700 °C) for 1 h with the heating rate of 5 °C/min under air atmosphere

[21]. After returning to the room temperature, the activated carbon was soaked in 0.5 M HCl for 24 h and washed with hot distilled water until a pH 7 was obtained. The activated carbon was dried in a hot air oven at 110 °C for 24 h. The % yield of the activated carbon was calculated as follows:

$$\%\text{yield} = \frac{\text{Weight of activated carbon}}{\text{Weight of raw material}} \times 100 \quad (1)$$

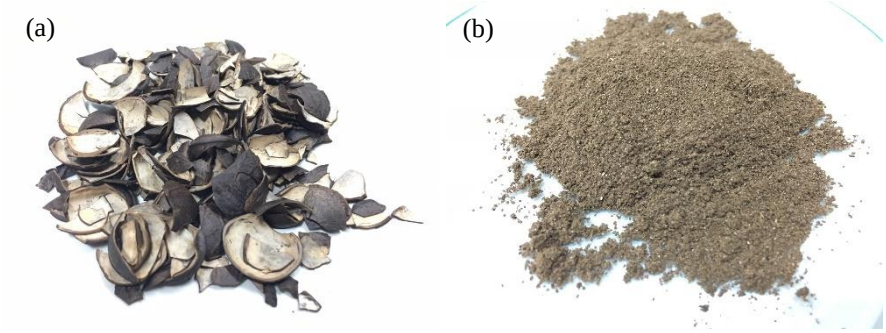


Fig. 1. Sacha inchi shell (a) soaked and dried biomass (b) grounded biomass size 106-425 µm

Characterization of activated carbon. The proximate analysis of raw materials and activated carbons including moisture, volatile matter and ash content were identified according to the ASTM procedures [22, 23, 24]. Moreover, Cellulose, hemicellulose and lignin contents in raw materials were analyzed based on the detergent method. The FT-IR spectra of dried-raw materials and activated carbons were also performed by mixing with KBr, and the mixtures were pressed into the pellets for further analysis using Fourier transforms infrared spectrometer (PerkinElmer spectrum RX I) with the wavelength range between 4000 – 400 cm^{-1}. The surface morphology of activated carbons were determined by using a scanning electron microscope (JEOL JSM5410LV). The iodine number of activated carbons were studied based on ASTM method [25].

Batch adsorption test. To analyze the adsorption capacity of the activated carbon samples, the methylene blue adsorption capacity was studied in batch experiments. A known quality of sample (0.05 g) was added to 50 mL methylene blue solution (50 mg/L) and shaken continuously at 50 rpm under 37 °C in an orbital shaker (WIGGENS WS-600S) for 60 min. The concentration of methylene blue was recorded using UV-vis spectrophotometer (BMG LABTECH SpectroStarNano) at the wavelength of 663 nm. The amount of methylene blue adsorbed by adsorbent at an equilibrium (q_e) (mg/g) was determined as the following equation:

$$q_e = \left[\frac{(C_i - C_e) \times V}{m}\right] \quad (2)$$

Where,

C_i (mg/L) is the initial concentration of methylene blue solution;
C_e (mg/L) is the equilibrium concentration of methylene blue solution;
V (L) is the volume of methylene blue solution;
m (mg) is the mass of activated carbon added.

The removal efficiency of methylene blue was determined as the following equation:

$$\text{Removal efficiency } (\%) = \frac{C_i - C_e}{C_i} \times 100 \quad (3)$$

The effect of contact time, pH and activated carbon dosage on the adsorption capacity was also studied.

Adsorption isotherms. Adsorption isotherms equations of Langmuir (equation (4)) and Freundlich (equation (5)) were used in this study:

$$\frac{Ce}{q_e} = \frac{1}{q_e K_L} + \frac{1}{q_m} Ce \quad (4)$$

Where,

q_e (mg/g) is the methylene blue adsorbed capacity at equilibrium;
q_m (mg/g) is the maximum adsorption capacity;
K_L (L/mg) is the constant of Langmuir adsorption model.

The Freundlich isotherm is represented as the following equation:

$$\ln q_e = \ln K_F + \left(\frac{1}{n}\right) \ln Ce \quad (5)$$

Where,

K_F (L/g) is the constant of Freundlich adsorption model;
n is the heterogeneity factor.

Results and Discussion

Characterization. The result of proximate analyses of raw Sacha inchi inner shell and the prepared activated carbons are given in Table 1. The finding shows that the amount of fixed carbon content is more in the activated carbons as compared to the raw biomass. The prepared activated carbons show lower percentage of moisture, ash and volatile matters (Table 1). This is because the raw biomass has been completely carbonized. Generally, the weight fractions of hemicellulose, cellulose and lignin contained in natural lignocellulosic materials present in different compositions. Lignin has been reported to be one of the components that relate to the quality of activated carbon. Higher lignin contents in the biomass, the most appropriate structure for porosity development, especially microporosity during the pyrolysis stage and also the most promising for the high yield production [26]. Interestingly, it was found that the lignin contents in Saha inchi inner shell was almost two times higher than other biomass as shown in Table 2. However, there was some extractives found from raw Sacha inchi inner shell and this amount was successfully removed after treated with H_3PO_4 [26].

Table 1 Proximate analyze of raw biomass and activated carbon

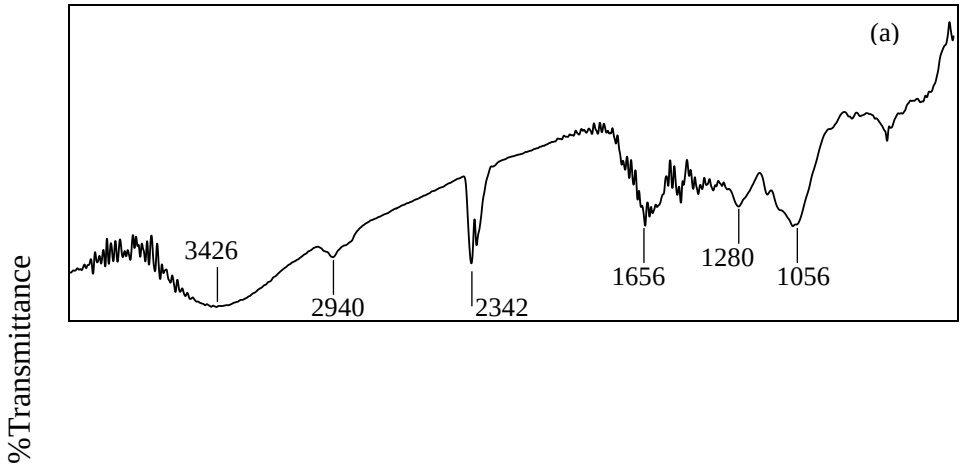
Sample	Proximate (% wt)				%Yield	Ref.
	Moisture	Volatile matter	Ash	Fixed carbon*		
Rice husk	4	53	2	41	34	[27]
Wheat straw	6	38	1	55	31	[27]
Corn cob	7	22	1	70	25	[27]
Raw Sacha inchi inner shell	9	60	2	30	-	This study
Activated Carbon**	4	26	1	69	66	This study

* By difference
** Carbonized at 600 °C

FTIR Spectra. The FT-IR spectra of Sacha inchi inner shell and its activated carbons that with various temperatures were measured to determine the functional groups that were available on the surface. The results indicated that there is a large difference in the surface chemistry between activated carbons and their raw biomass as shown in Fig. 2a and 2b. The missing of functional groups occurred depends on activation and carbonization process. This indicated that the activation process has been successfully. The bands around 3500-3200 cm^{-1} indicate O-H stretching variations of cellulose, pectin, absorbed water, hemicellulose and lignin. The bands around 3000-2800 cm^{-1} represent the aliphatic saturated C-H stretching vibrations of lignin polysaccharides including cellulose and hemicelluloses. The band at 2342 cm^{-1} represents the C=O stretching in ketene groups. The bands around 1600-1500 cm^{-1} represent C=C streching in an aromatic group in lignin. The bands around 1300-900 cm^{-1} represent all C-O stretching vibration bands of carboxilic acids and alcohols [29]. Also, results indicate that the carbonization temperatures at 500 °C failed to effect a complete carbonize of the raw material. An increase in the temperature (600 and 700 °C) considerably led to the reduction of the spectrum of the sample between 3500- 1600 cm^{-1}, which was indicated as cellulose and hemicellulose compared with the same in the parent precursor [30], while the band at 1600-1500 cm^{-1} still appeared as the presence of lignin . The yield obtained at higher temperature was decreased due to H_3PO_4 that worked efficiently as activating reagents. When the heat was supplied to the sample, the functional groups of raw biomass were vaporized as volatile matters such as water, acetic acid, methanol and furan derivatives [30], which led to the destruction of the functional group.

Table 2 Cellulose, hemicellulose and lignin content studies

Biomass	Structural component (% wt)				Ref.
	Cellulose	Hemicellulose	Lignin	Extractive	
Coconut shell	14	32	46	8	[28]
Soft wood	36	19	31	15	[28]
Plum pulp	7	15	39	40	[28]
Sacha inchi inner shell	3	15	73	10	This study



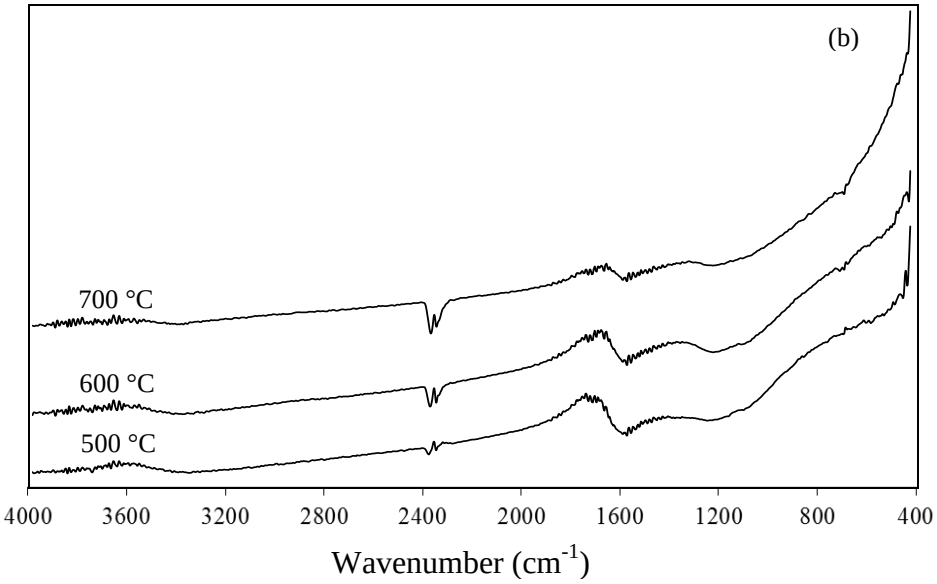


Fig. 2 FT-IR spectrum (a) raw Sacha inchi shell and (b) activated carbons

SEM analysis. The surface physical morphology of activated carbons prepared from Sacha inchi inner shell was investigated (Fig. 3a-3c). Verification of micrographs corresponding to the activated carbon obtained under different activation temperatures (500, 600 and 700 °C), shows a considerable difference in the porosity between samples. It was found that the surface of the activated carbon after activation at 700 °C was channel-like wall (Fig. 3c), while the one at lower temperature showed more well-developed porous structures with various sizes and shapes (Fig. 3a and 3b). Cracks and crevices on the external surface of the activated carbons could be a result of the H_3PO_4 evaporation at various temperatures during the carbonization step [31].

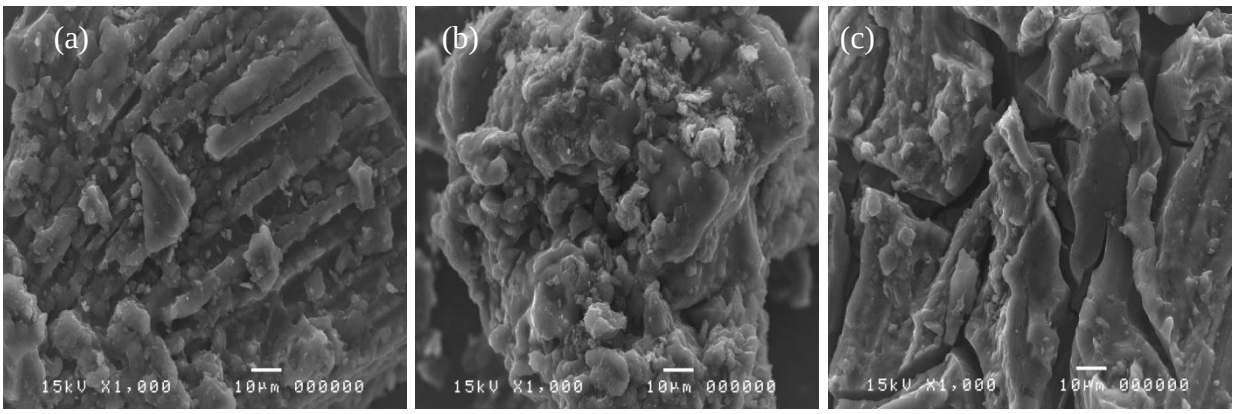


Fig. 3. SEM images of AC with various temperatures at (a) 500 °C (b) 600 °C and (c) 700 °C

Effect of contact time. The effect of contact time on the adsorption of the activated carbon was conducted. The result showed that the percentage of methylene blue removal has been increased with an increase in contact time (Fig. 4). This is because the pores of the activated carbon are initially free leading to the rapid methylene blue removal. The adsorption of methylene blue occurs gradually slower when pores gets occupied and no more adsorption observed when the surface of the adsorbent becomes saturated [27]. It was clear from Fig. 4 that 91.3, 92.5 and 89.7 % of the methylene blue was removed by activated carbon that carbonized at temperature of 500, 600 and 700 °C, respectively after 20 min. The variation of methylene blue removal efficiency has been observed in this work. This is due to the differences between physical and chemical nature of the pores of the activated carbon. At 40 min, however, almost 94 % of methylene blue was removed from all treatments by 600 °C carbonized activated carbon. After this time, the rate of adsorption has slowly decreased and reached equilibrium. Supaporn [32] has been reported that the adsorption

equilibrium of activated carbon from coffee ground was established within 90 min, which was longer that the one obtained from this study.

Effect of pH. Fig. 5 shows the effect of pH on methylene blue adsorption onto the activated carbons. The pH of methylene blue solution was varied from 1 to 10, while activated carbon dose and time were fixed at 0.05 g and 40 min, respectively. The percentage removal of methylene blue has been increased with increase in the pH values. It was found that the methylene blue removal increased from 88.2, 91.4 and 91.9 % at pH of 2 to 92.1, 94.8 and 94.0 % at pH of 10 for activated carbon that carbonized at temperatures 500, 600 and 700 °C, respectively. This implies that the electrostatic interaction and repulsion forces are significant mechanism is the adsorption process. It is obvious that higher removal efficiency at higher pH has been observed is this study and the most effective methylene blue removal in this study has also been detected by the 600 °C carbonized activated carbon at the pH value of 6, which is greater than pH_{pzc}. This could explain that there is the electrostatic attraction force between the negative charge on the carbon surface the carbon surface and the positive charge of methylene blue [27, 33].

Effect of dosage. To determine the effect of activated carbon dose on the adsorption of methylene blue was shown in Fig. 6. The pH and time were fixed at 6 and 40 min, respectively. As the dose of activated carbon increased from 0.01 to 0.05 g. Due to increase in availability of number of active sites according to the presence FT-IR spectra at the 1600-1500 cm^{-1} (Fig. 2) for adsorption, it was observed that the methylene blue removal percentage increased from 87.2, 87.8 and 83.2 % to 95.7, 96.2 and 95.1 % for activated carbon with carbonized at temperatures 500, 600 and 700 °C, respectively. The greatest adsorption dosage was illustrated by the 600 °C carbonized activated carbon. As the dosage has been increased from 0.04 to 0.05 g, the percentage removal of methylene blue was found to be slowly increased which may be attributed to the equilibrium adsorption [33].

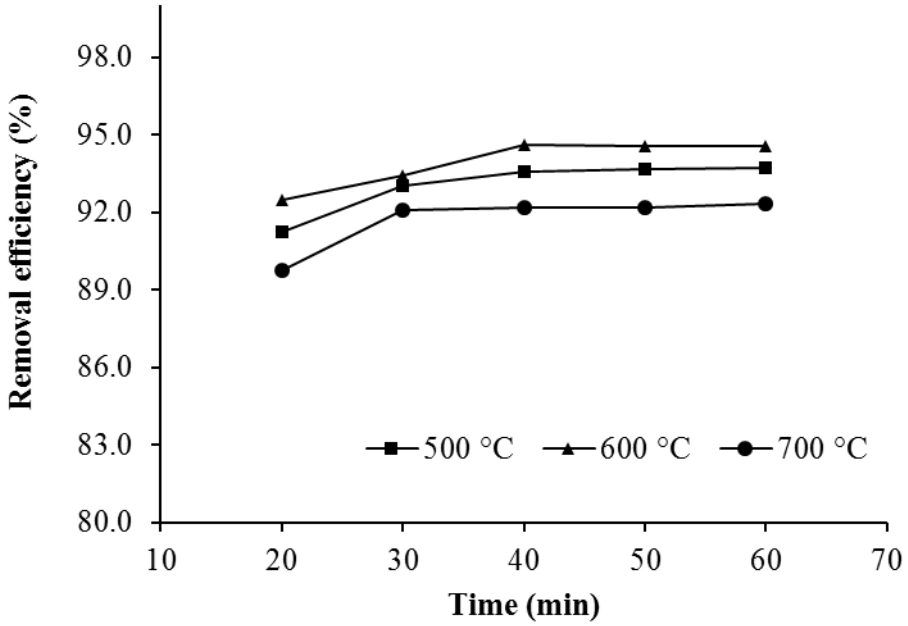


Fig. 4 Effect of time on removal efficiency

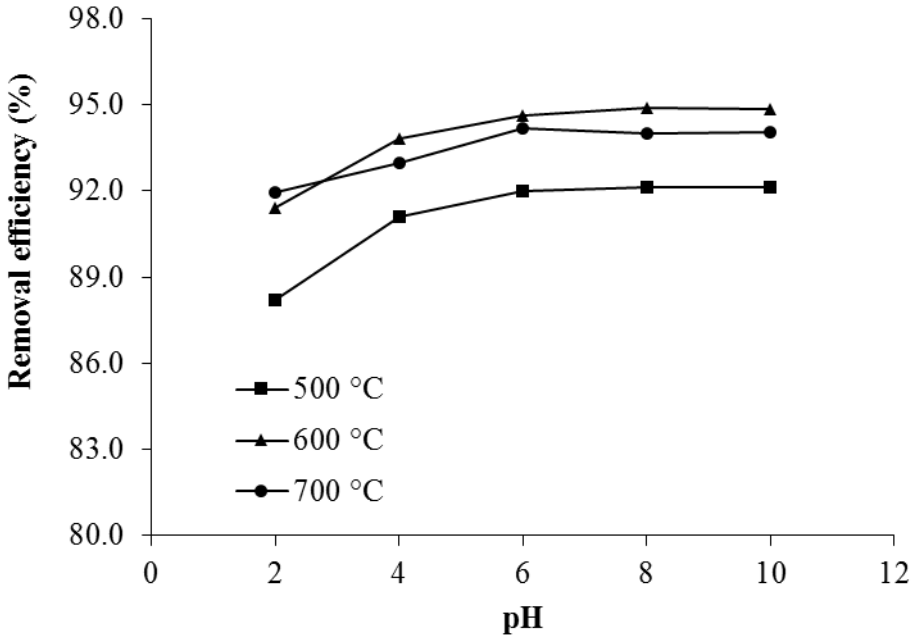


Fig. 5 Effect of pH on removal efficiency

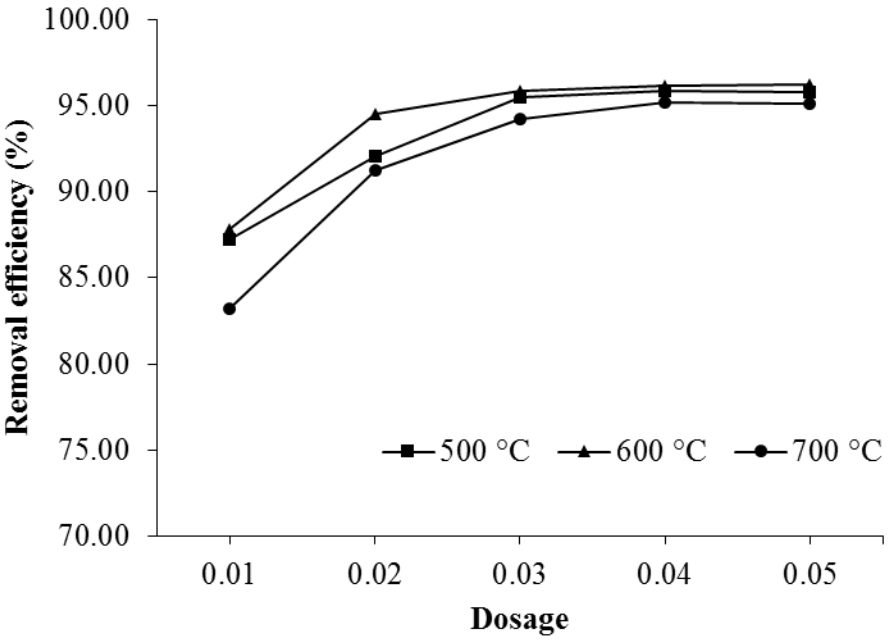


Fig. 6 Effect of dose on removal efficiency

Analysis of isotherms. Adsorption isotherm data was obtained using 0.03 g activated carbon per 50 mL of methylene blue solution at different initial concentrations ranging from 25 to 100 mg/L. The obtained values of different parameters of Langmuir and Freundlich isotherms are shown in Table 3. The applicability of both isotherms were evaluated by comparing the values of correlation coefficient, R^2. It can be observed from Table 3 that the values of regression coefficients are better for Langmuir isotherm as compared to Freundlich isotherm for all activated carbons. This proves that the Langmuir model fits to the adsorption data better than the Freundlich model. The applicability of the Langmuir model suggests that the adsorption of methylene blue on activated carbon is a homogeneous and monolayer adsorption. There is no intermolecular interaction among the adsorbed molecules of methylene blue. As obviously shown from Table 3, the 600 °C carbonized activated carbon had the highest adsorption capacity (90.9 mg/g).

Table 3. Langmuir and Freundlich isotherm parameters

Temperature (°C)	Langmuir		Freundlich	
500	q_m (mg/g)	21.18	n	2.1
	K_L (L/mg)	5.5	K_F (L/g)	15.4
	R^2	0.9971	R^2	0.8796
600	q_m (mg/g)	54.2	n	2.3
	K_L (L/mg)	0.9	K_F (L/g)	6.7
	R^2	0.9995	R^2	0.9378
700	q_m (mg/g)	45.2	n	1.04
	K_L (L/mg)	1.8	K_F (L/g)	1.68
	R^2	0.9991	R^2	0.9091

Conclusion

In the present study, activated carbon was prepared from Sacha inchi inner shell by chemical activation with phosphoric acid. Activation of Sacha inchi inner shell with high lignin contents impregnated with the phosphoric acid resulted in reasonable carbon yield and produced microporous activated carbon. The optimum activation temperature and impregnation ratio for the highest surface area of activated carbon was found to be 600 °C and 1.5, respectively. The FT-IR spectrum showed the presence of aromatic functional groups which indicated as lignin. The SEM micrographs showed that pores of different shape was obtained from chemical activation agent. The batch adsorption of methylene blue was further determined using isotherm adsorption experiment with the optimum condition of 40 min contact time, 0.03 g dosage and pH at 6. The isotherm study was proved that the adsorption of methylene blue on activated carbon was fit the Langmuir model (R^2 of 0.995-0.997) showing that it was a homogeneous and monolayer adsorption.

Acknowledgement

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ALUMINA THIN FILM SYNTHESIS FOR IMPROVING SEMI-PRECIOUS STONE QUALITY WITH PLASMA ENHANCED ATOMIC LAYER DEPOSITION (PE-ALD)

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Keywords: Alumina thin film**,** Semi-precious stone**,** Plasma enhanced atomic layer deposition.

Abstract. In semi-precious stone quality improvement to be resistant with scratches and factors as a result of making ornamental bodies, alumina thin film is another alternative to be used for coating surface of semi-precious stone because alumina is hard and transparent. Plasma enhanced atomic layer deposition technique is selected for synthesizing film. Films are originated from the deposition of trimethylaluminum and plasma of oxygen. In the experiment, it will be a study of suitability in being applied on semi-precious stone such as increasing hardness and transparency of film that does not affect color of the stones. According to the study, it will be an examination of X-ray photoelectron spectroscopy, contact angle machine, hardness testing and UV-visible spectroscopy.

1. Introduction

Gemstones can be categorised by using five quality criteria: mineral components, sources, rarity, popularity, and market price [1], but the universal property used to examine every gemstone is 'Hardness', the scientific value which shows the resistibility of scratching. The 'Hardness' of gemstone is called 'Mohs' scale'. Mohs' scale is the universal tool used to compare minerals' hardness. It is scaled from 1, the softest, to 10, the hardest. For example, diamond has the mohs' scale 10, corundum is 9, topaz is 8, and quartz is 7 [2]. Mohs' scale is also used to classify gemstones to precious and semi-precious stone. Gemstones with 9 or above hardness in Mohs' scale are called to be 'precious', while the gemstones with 8 or below hardness in Mohs' scale will be called 'semi-precious' [3]. Both precious and semi-precious gemstones are valuable, but the cost is varied depending on colour, weight, shape, rarity, and transparency.

The report about gemstones and jewellery exports of Thailand in January 2017 from The Gem and Jewellery Institute of Thailand (Public Organisation) showed that gemstones gave the fourth highest value from the total gem and jewellery exports. The major products were polished precious stones which had been increased because of the market expansion to America and India. In contrast, the number of polished semi-precious stones was decreased [4].

The development and improvement in semi-precious stones using new invention can help strengthen and increase the value of semi-precious stones. More than that, it is the way to protect semi-precious stones which can be easily scratched in daily routines. Keeping semi-precious stones in a box can be harmful because the limit space increases the probability of contact and collision of different hardness gemstones which lead to form scratching scar on gemstones' surface [3]. Thin

Alumina Film Coating is one way to protect semi-precious stones which contain beauty with their own. Thin alumina film coating (in nano-scale) is used in various industry. For example, eyeglasses to prevent scratching, machinery to prevent corrosion, and hard-disc in computer. The chemical formula of Thin alumina film is Al_2O_3 which has the same properties as corundum [5]: strength, transparency [6], and high corrosive resistance [7].

In this paper, plasma enhanced atomic layer deposition (PE-ALD) method will be used to synthesise thin film alumina. PE-ALD is the synthesis of thin film via deposition in atomic scale using plasma to help in film forming system. Thus, the filming can be occurred under low temperature [8]. The process of the thin film synthesis is trimethylaluminium (TMA; $Al(CH_3)_3$) forms chemical bond with ground substance and cover all the surface. After that, inert gas is introduced to eliminate the remaining TMA from the reaction chamber. Then, add gas of the second substrate, which is plasma of oxygen instead of using water plasma (H_2O), to react with the covering substances and introduce inert gas to eliminate the remaining plasma from the reaction chamber. Repeat the process until the film is thick enough [9].

2. Experimental

Synthesis of thin film alumina with plasma enhanced atomic layer deposition (PE-ALD), the glass slide and rose quartz (or semi-precious stones) are cleaned by acetone, ethanol, and deionised water for 10 minutes each under ultrasonication machine. Then, dry with nitrogen and keep in a glove box [8]. The synthesis is done in a reaction chamber under vacuum in a range 4 x 10^{-2} torr. Clean the surface of the glass slide and rose quartz with argon plasma[10] for 20 minutes. A cycle of thin film is done by the following step;Trimethylaluminium (TMA), the substrate of the process, is introduced into the reaction chamber for 2 seconds, Argon gas used to purge the remaining substrates is released for 3 seconds, the gas of second substrate oxygen plasma is released for 5 seconds, and purge the remaining components with Argon gas for 3 seconds. The process of synthesis is shown in figure 1. Temperatures used in coating process are 150 and 200 degrees celsius and the numbers of cycles are 400, 600, and 800.

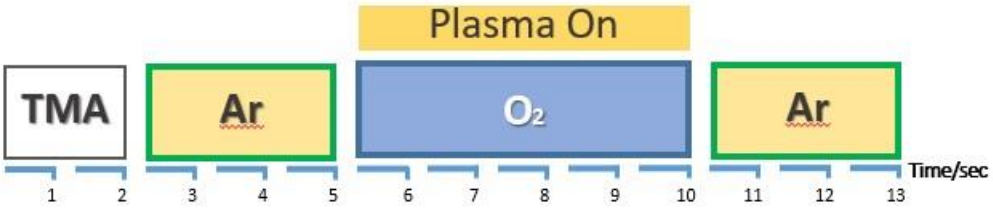


Figure 1: Diagram of thin film alumina synthesis

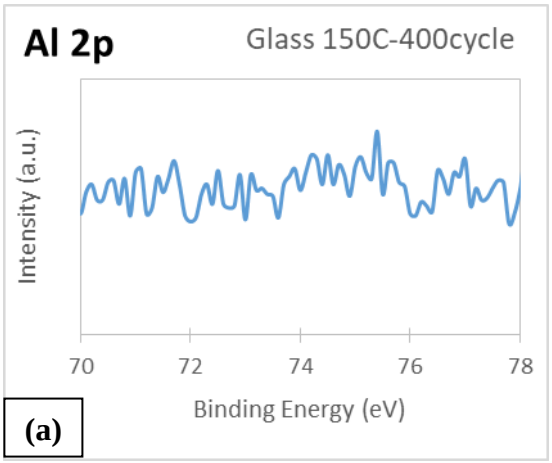
Thin film alumina on the glass slide and rose quartz (or semi-precious stones) will be further studied about component elements with X-ray photoelectron spectroscopy (XPS), the surface properties via contact angle of water droplet with contact angle machine (CA), tolerance of scratching or hardness of the thin film by hardness test, and changing of colour of the glass slide and rose quartz or semi-precious stones by interpreting absorbance with UV-visible spectrophotometer.

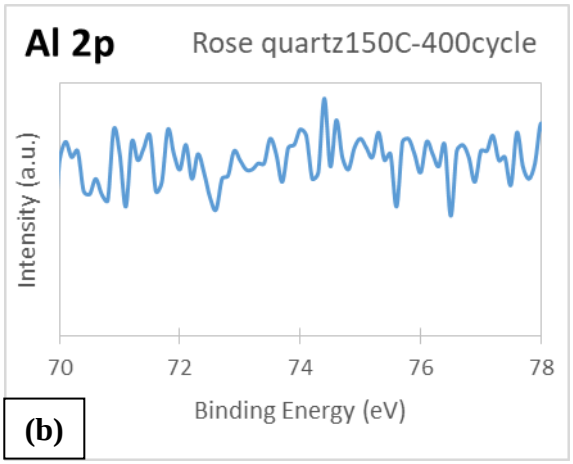
3. Results and discussion

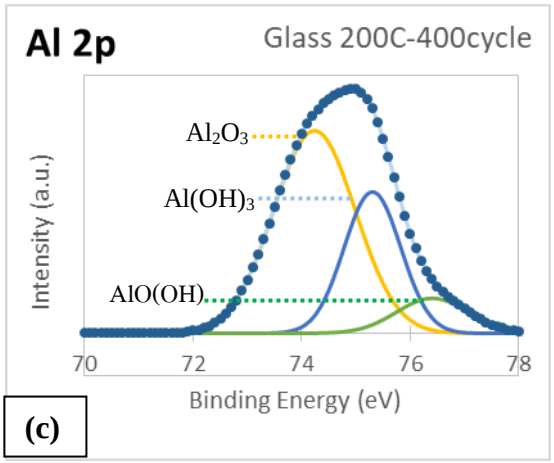
3.1 Compositional Analysis

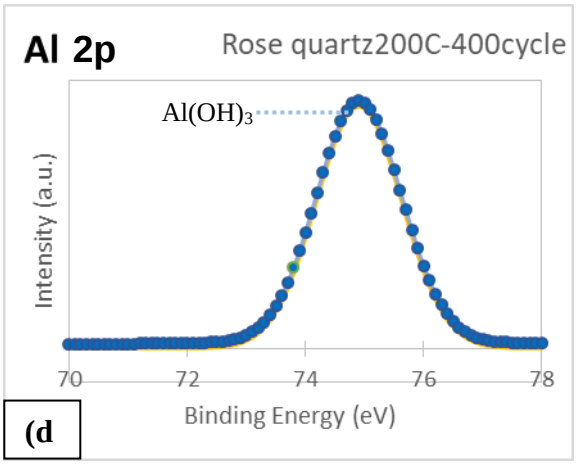
Chemical composition analysis of alumina thin film on slide and rose quartz with X-ray photoelectron spectroscopy (XPS) method. The numbers of cycles for glass slides and rose quartz are 400, 600, and 800 at 150 and 200 degrees celsius. Figure 2 shows binding energy of Al 2p on the film surface. At 74.4 eV peak is the aluminium atom (Al) bound to oxygen atom (O) in Al_2O_3, while the 75.5 eV peak is the Al in $Al(OH)_3$, and at the 76.4 eV peak is the Al 2p in AlO(OH) [11].

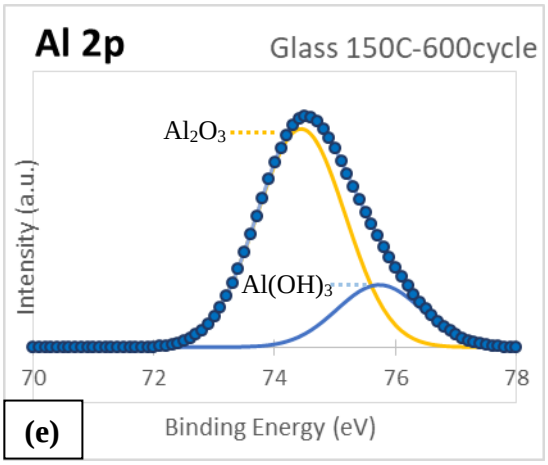
Binding energy of Al 2p is not found in the glass slides and rose quartz at 150 degrees celsius with 400 cycles of coating, also in the slides at 200 degrees celsius with 600 cycles of coating.

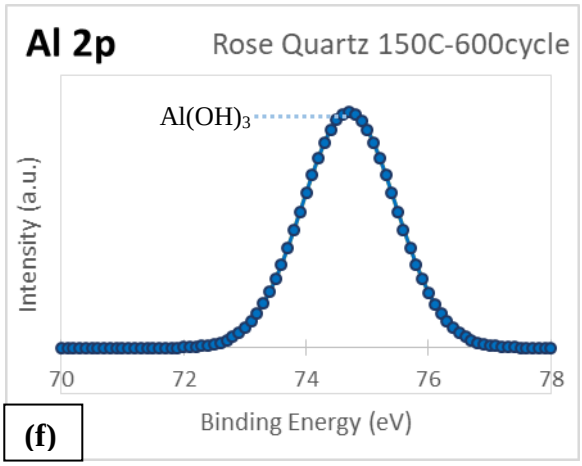












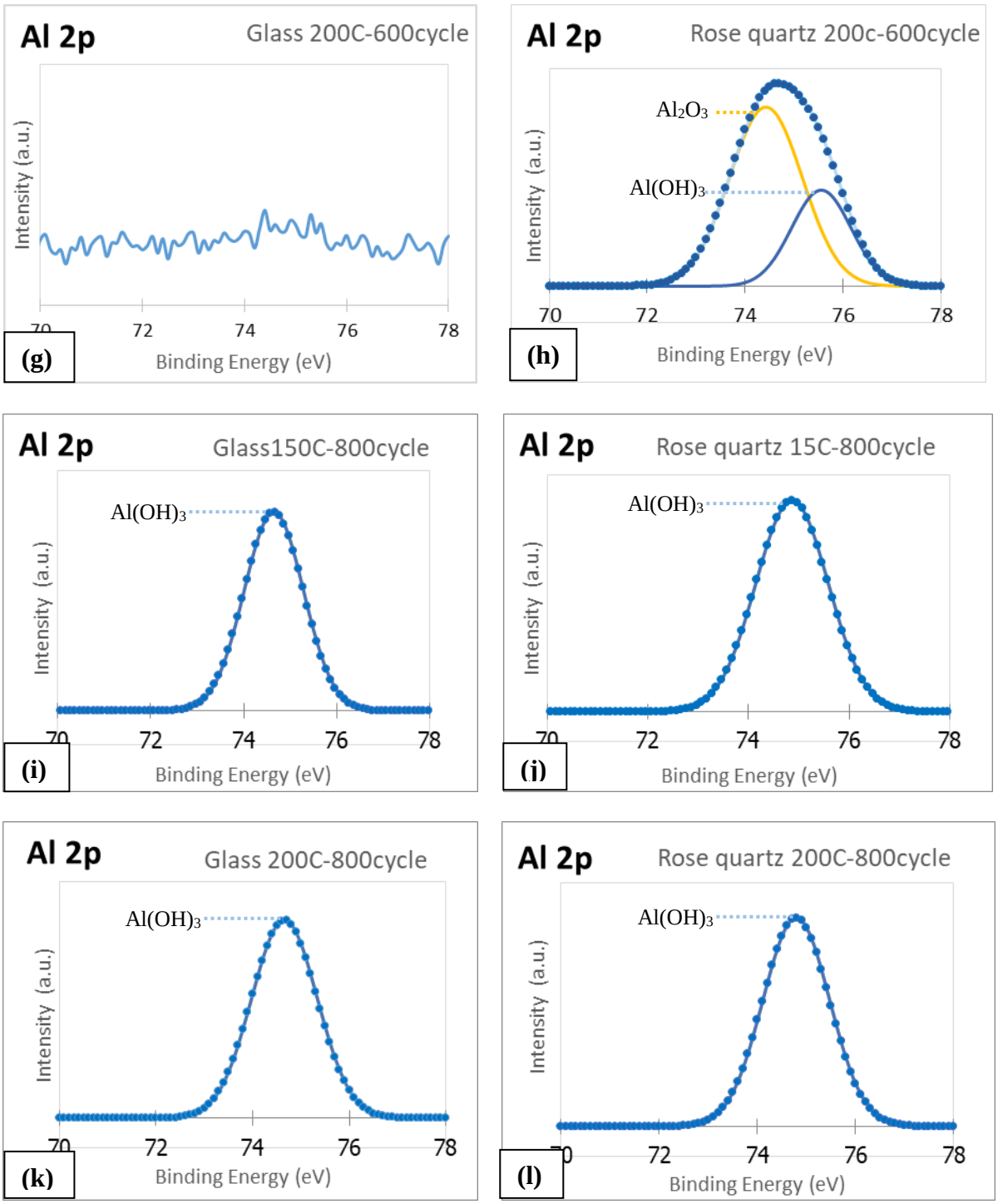
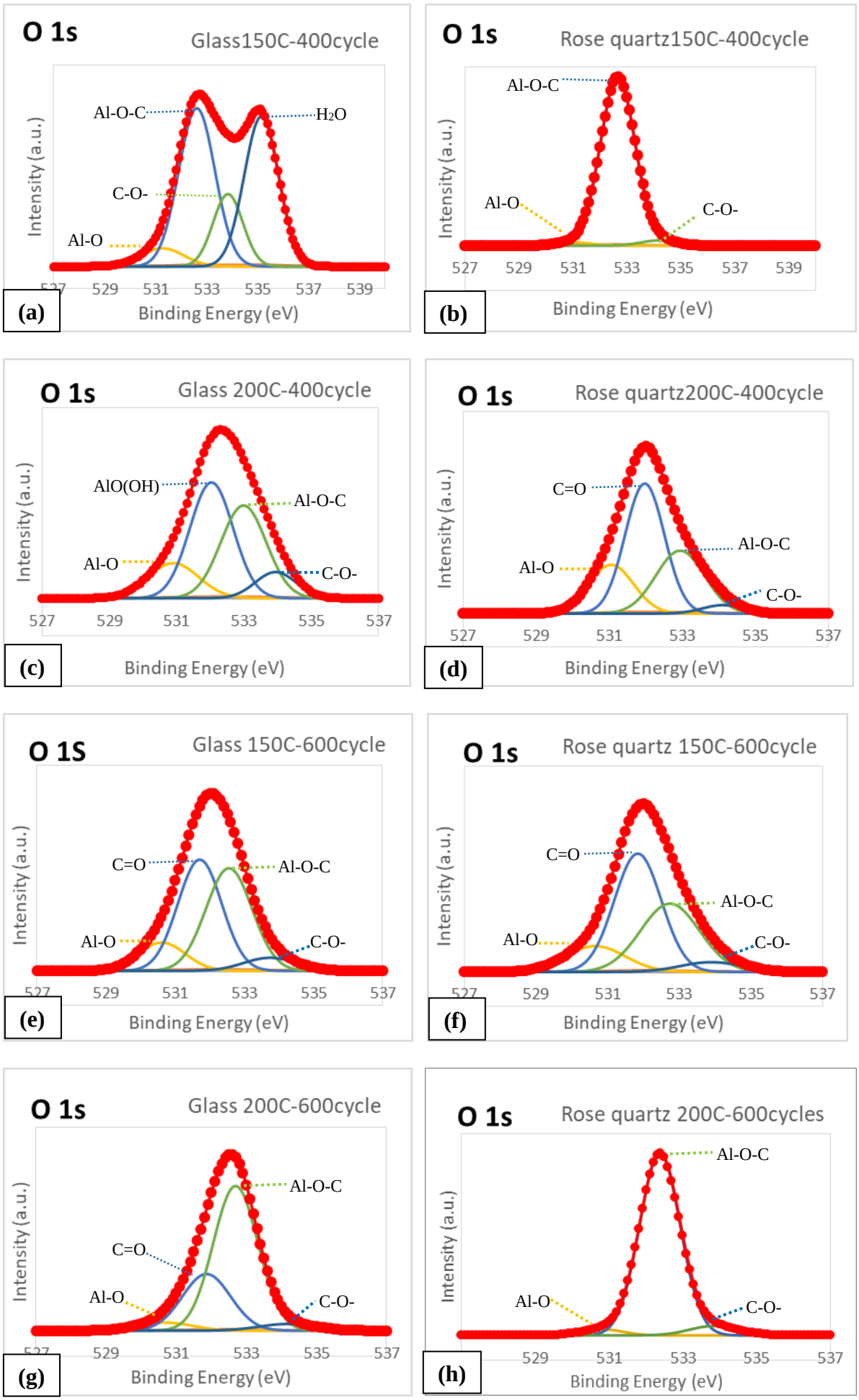


Figure. 2 XPS spectra of Al 2p peaks for (a-b) glass and rose quartz150°C-400cycle, (c-d) glass and rose quartz 200°C-400cycle, (e-f) glass and rose quartz 150°C-600cycle, (g-h) glass and rose quartz 200°C-600cycle, (i-j) glass and rose quartz 150°C-800cycle, (k-l) glass and rose quartz 200°C-800cycle.

Figure 3 shows binding energy of O 1s on the film surface: 530.72-eV peak corresponds to the Al-O of AlO(OH), 531.8-eV peak corresponds to the C=O, 532.5-eV peak corresponds to the Al-O-C, 533.6-eV peak corresponds to the C-O- [12,13] and 535.1 eV peak corresponds to the H_2O [14].



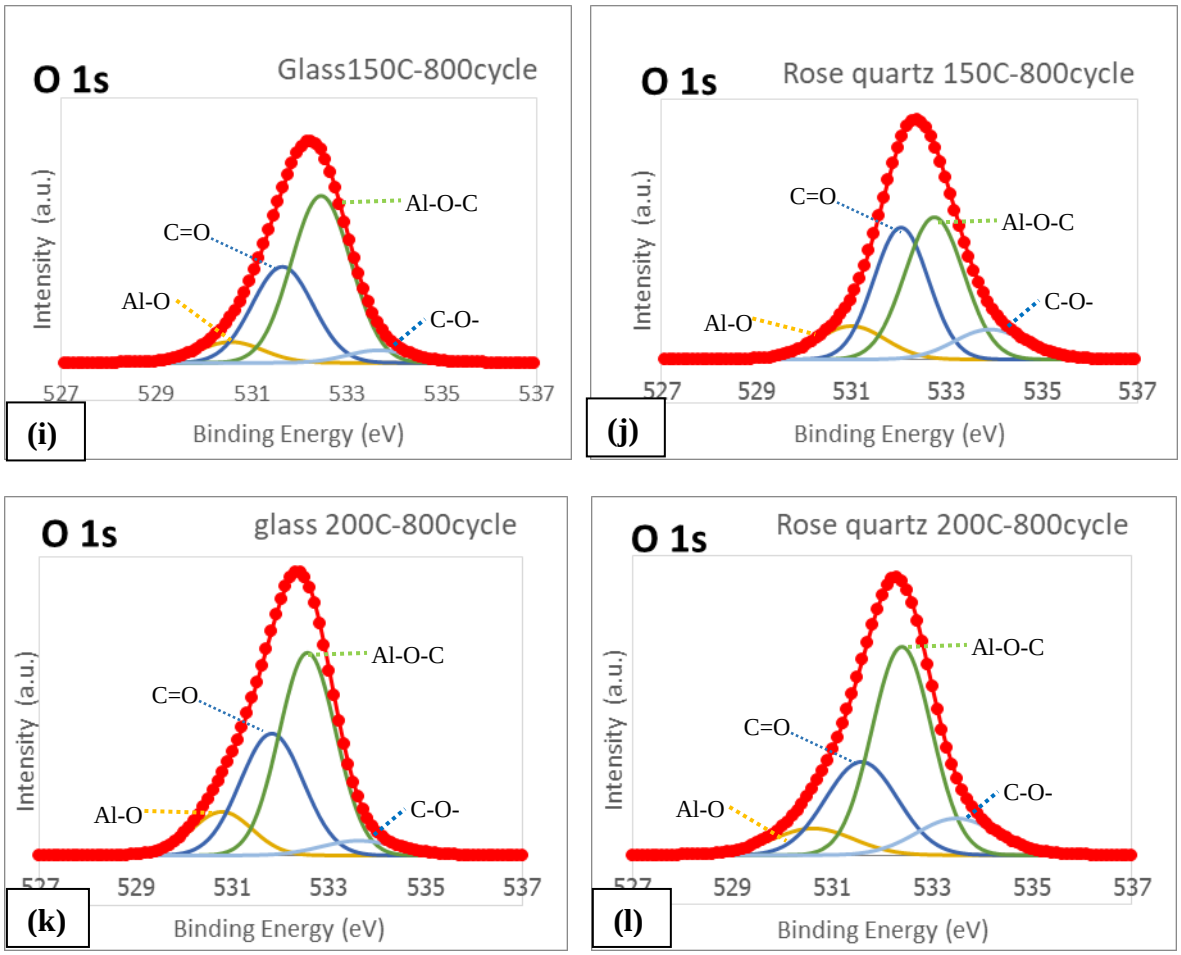
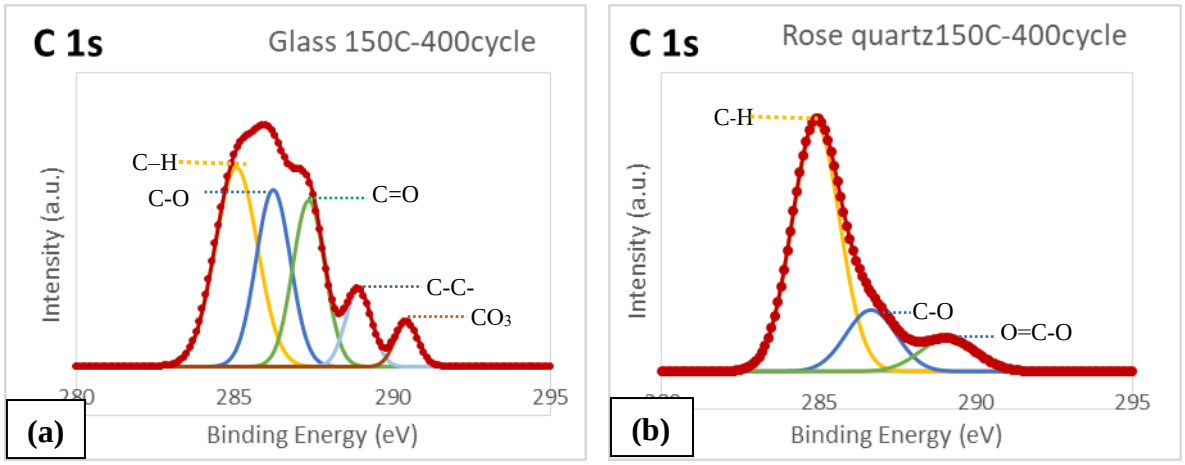
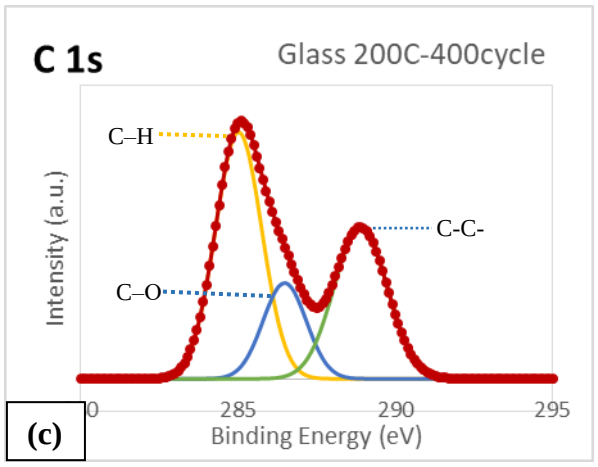
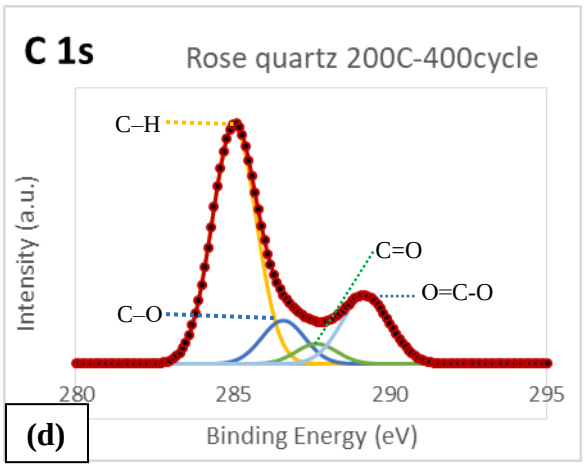


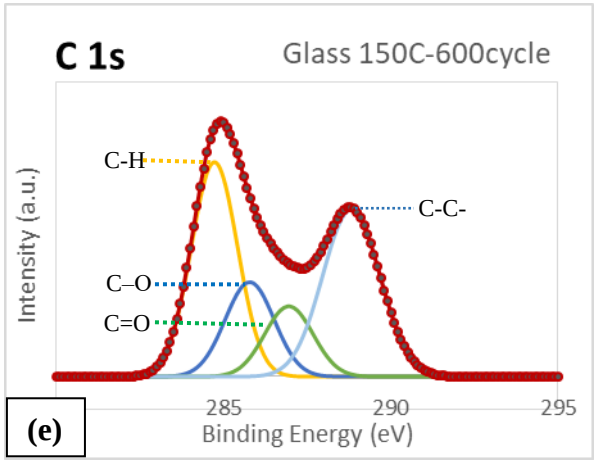
Figure. 3 XPS spectra of O 1s peaks for (a-b) glass and rose quartz150°C-400cycle, (c-d) glass and rose quartz 200°C-400cycle, (e-f) glass and rose quartz 150°C-600cycle, (g-h) glass and rose quartz 200°C-600cycle, (i-j) glass and rose quartz 150°C-800cycle, (k-l) glass and rose quartz 200°C-800cycle.

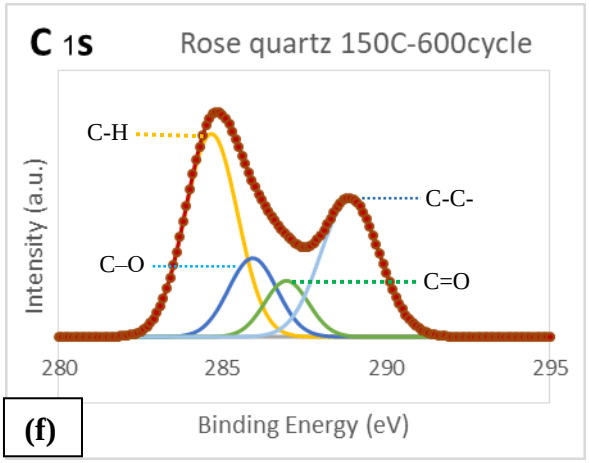
Figure 4 shows binding energy of C 1s on the film surface: 284.7 eV peak corresponds to the C-C and C-H bonds (carbon atoms in phenyl ring), 286.6-eV peak corresponds to the C-O bonds, 287.7-eV peak corresponds to the C=O and carboxylic group (-COOH), 288.8-eV peak corresponds to the -C-C-, 289-eV peak corresponds to the O=C-O [12,13] and 290 eV peak corresponds to the CO_3 [15]. The carbons appearing on the alumina film is probably occurred after TMA:$Al(CH_3)_3$ cycle which is the carbon source and the remaining carbons is attached to -OH from O_2 plasma, the second substrate [16].

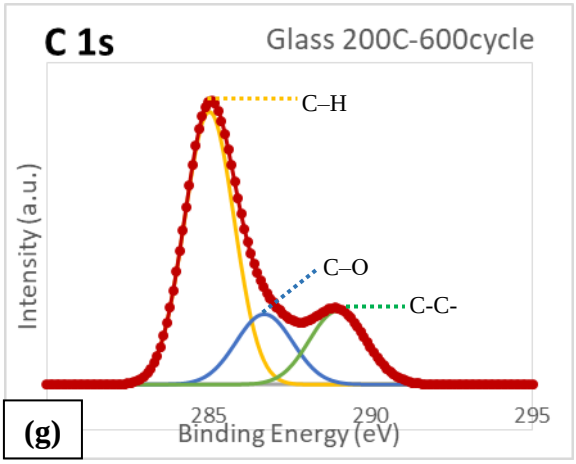


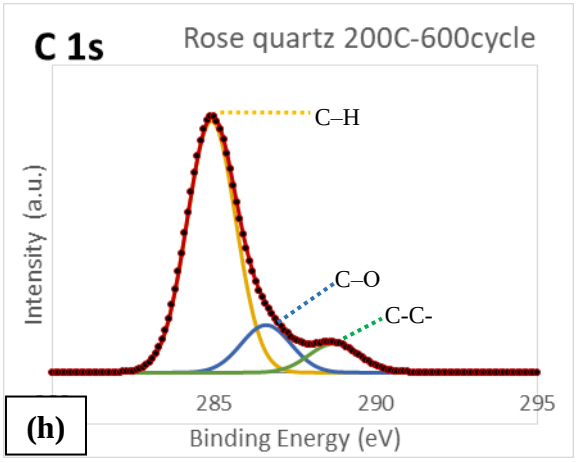












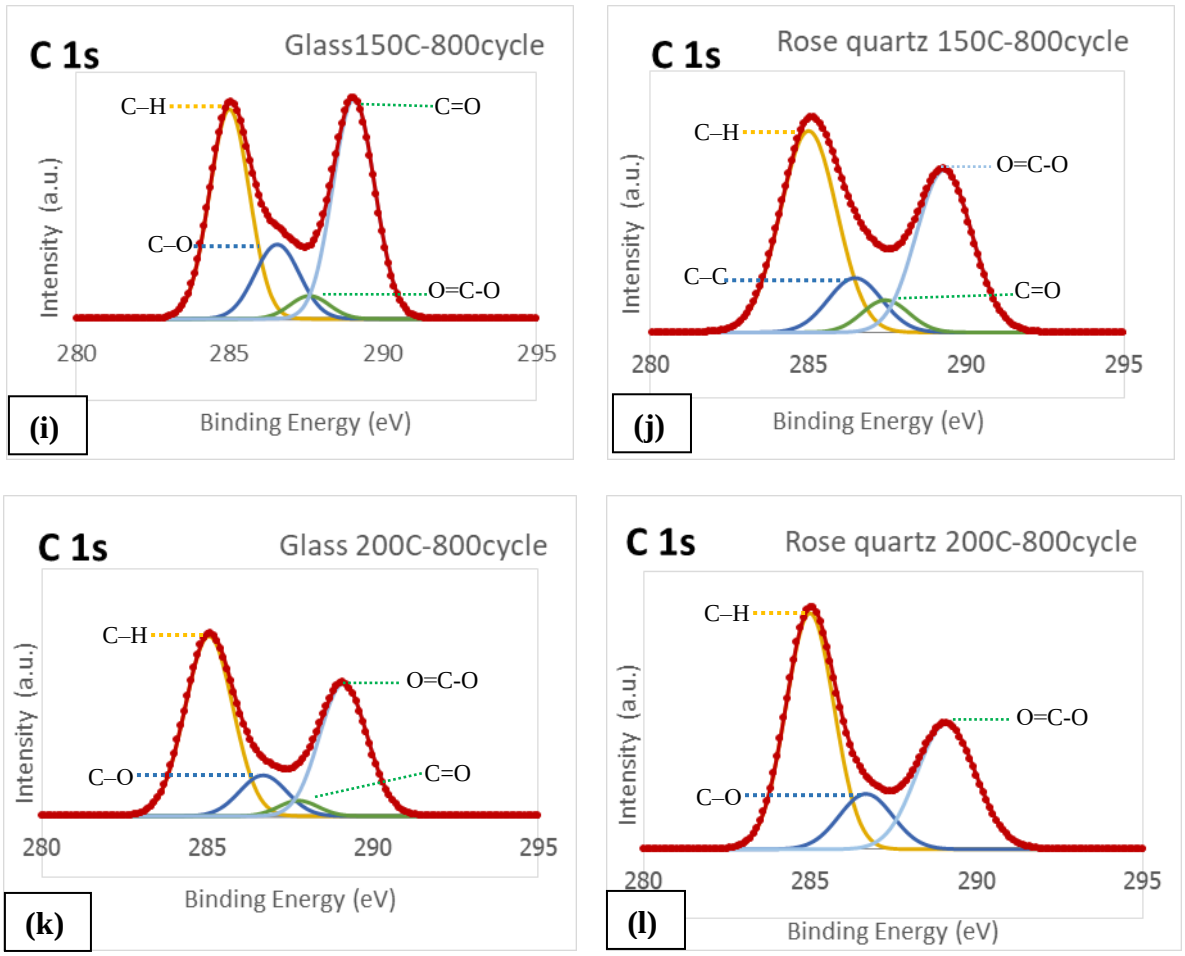


Figure. 4 XPS spectra of O 1s peaks for (a-b) glass and rose quartz150^{o}C-400cycle, (c-d) glass and rose quartz 200^{o}C-400cycle, (e-f) glass and rose quartz 150^{o}C-600cycle, (g-h) glass and rose quartz 200^{o}C-600cycle, (i-j) glass and rose quartz 150^{o}C-800cycle, (k-l) glass and rose quartz 200^{o}C-800cycle.

Chemical compositions found on the film surface represented the remaining carbons in thin film alumina. The result from XPS technique verified the 284.7-eV peak, which corresponds to the C-C and C-H bonds, came from the reaction between TMA : $Al(CH_3)_3$ and Oxygen plasma. Results from comparison of mass content (%) from XPS technique of thin film alumina in the conditions shown in figure 5 found the presence of carbon content in control slides (before coating), while the small amount of carbon content was found, and aluminium content was absent in the slides with 400 cycles of coating at 150 degrees celsius condition. The carbon and aluminium content in the slides with 800 cycles of coating at 200 degrees celsius condition were found more than any other conditions.

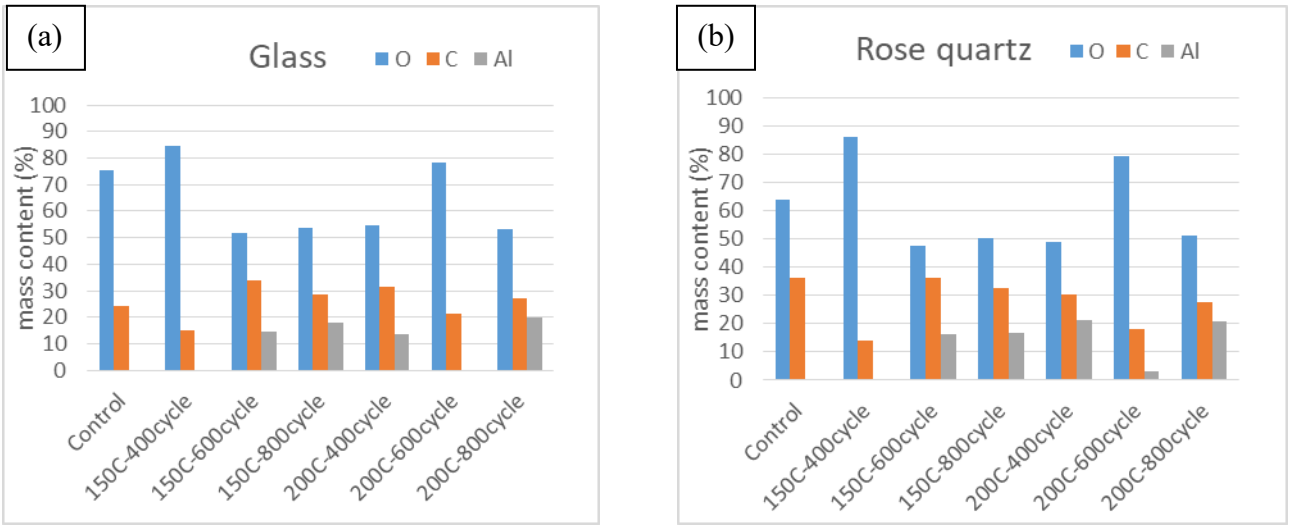


Figure 5: Relative elemental contents of thin film alumina; composed of oxygen (O), carbon (C), and aluminium (Al).

3.2 Contact angle of the deposited Al_2O_3 thin film

Because the alumina thin film coated on the glass slides and rose quartz was synthesised from the reaction of trimethylaluminium (TMA) and oxygen plasma which contains hydroxyl group(-OH), thus, the film surface is hydrophobic. Contact angle of water droplet is one of the important methods to determine changing of condition of the slides' surface. Figure 6 shows the contact angle of water droplet before coating (control sets) and after coating from day 1-7. The diagram shows the longer the day, the more the contact angle which represents the hydrophobicity of the film [17].

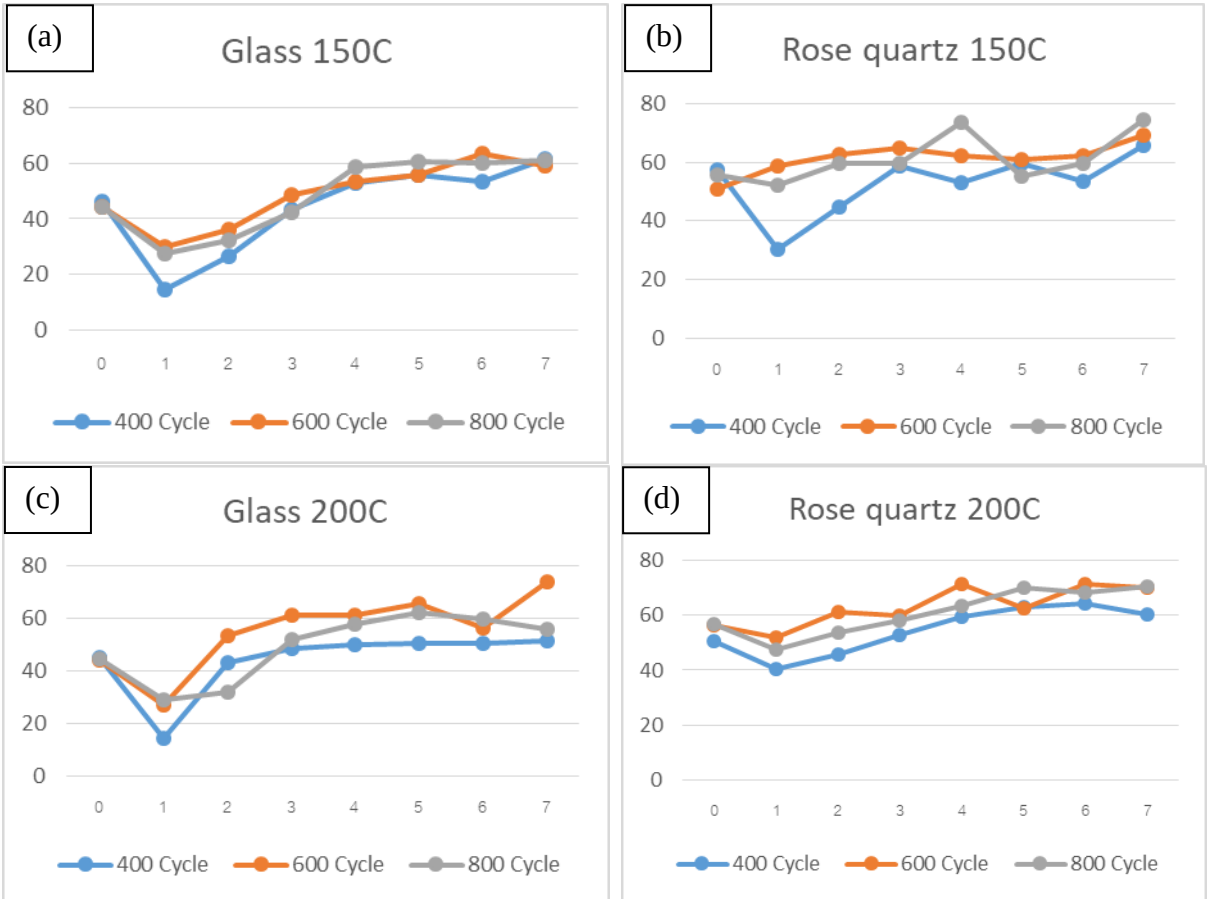


Figure. 6 The water contact angle. (a) glass slides at 150 ºC, (b) rose quartz at 150ºC, (c) glass slides at 200 ºC and (d) rose quartz at 200ºC.

3.3 Determining Hardness (Hardness Property)

Determining hardness of the slides and rose quartz after coating by micro vickers hardness machine. The determining of harness in microscale, the pressure used is 0.98 N. The results from the test are shown in figure 7 . Alumina thin film coated on the slides and rose quartz has more hardness [18,19].

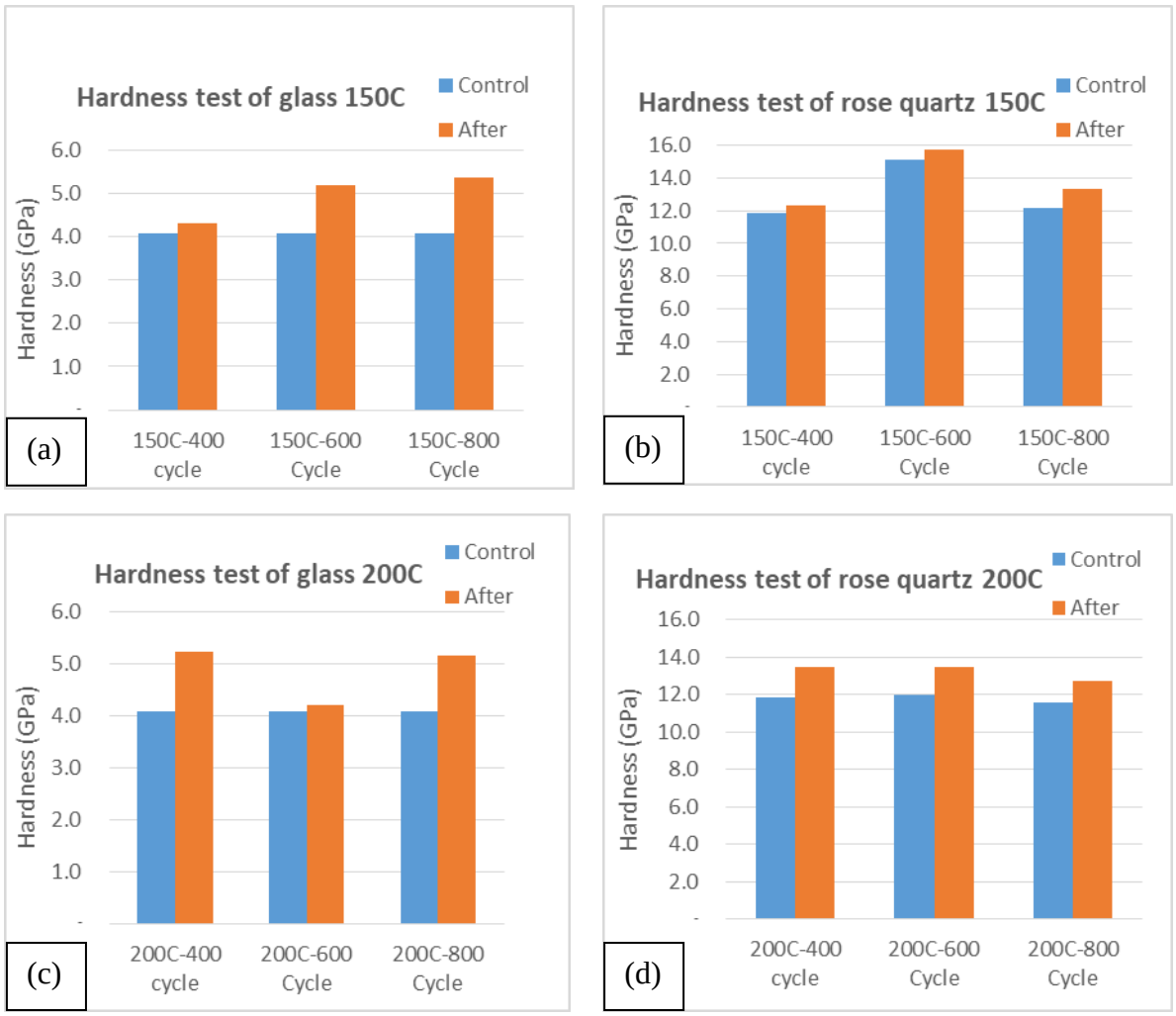


Figure. 7 The plots of hardness test of alumina thin film (a) glass slides at 150 ºC, (b) rose quartz at 150ºC, (c) glass slides at 200 ºC and (d) rose quartz at 200ºC.

3.4 Optical Properties

Optical properties determination of alumina thin film after coated on the glass slides and rose quartz with 400, 600, and 800 cycles of coating process at 150 and 200 degrees celsius was analysed by spectrophotometric method using UV-VIS NIR Spectrophotometer analyse the absorbance at 200 – 1100 nm of wavelength. Because of the thin film is transparent [20], the coating must not change the colour of the glass slides. Collect photos of the glass slides and rose quartz both before and after coating and analyse. The result showed no difference of colour when detect with naked eyes. After analysed with UV-VIS NIR Spectrophotometer, the result showed no difference of colour in the slides coated with the thin film, but the colour changed for a little in the rose quartz coated with the thin film, as shown in figure 8-9.

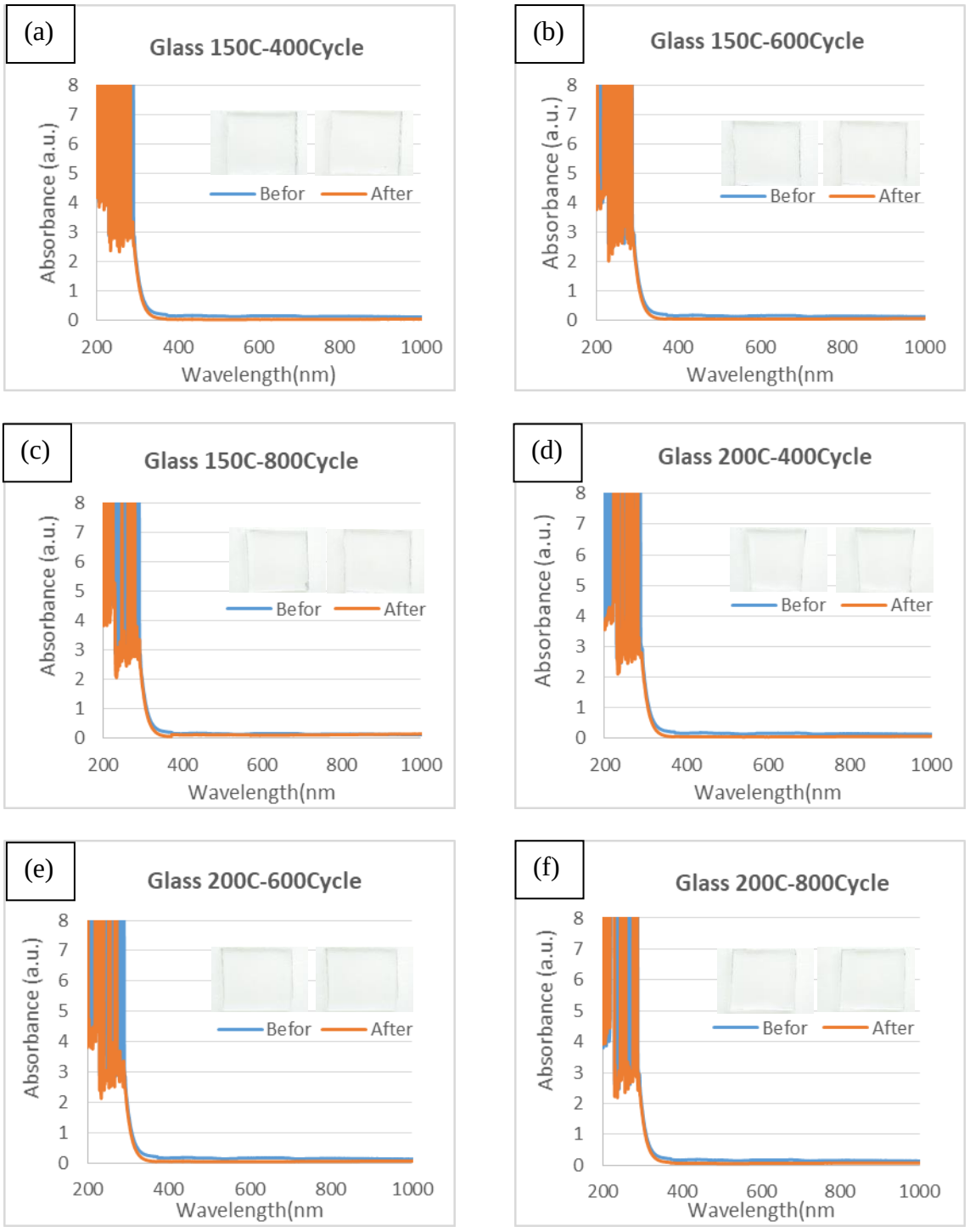


Figure. 8 Optical properties of Al_2O_3 thin films and collect photos. (a-c) glass of coating process at 150ºC and (d-f) glass of coating process at 200ºC.

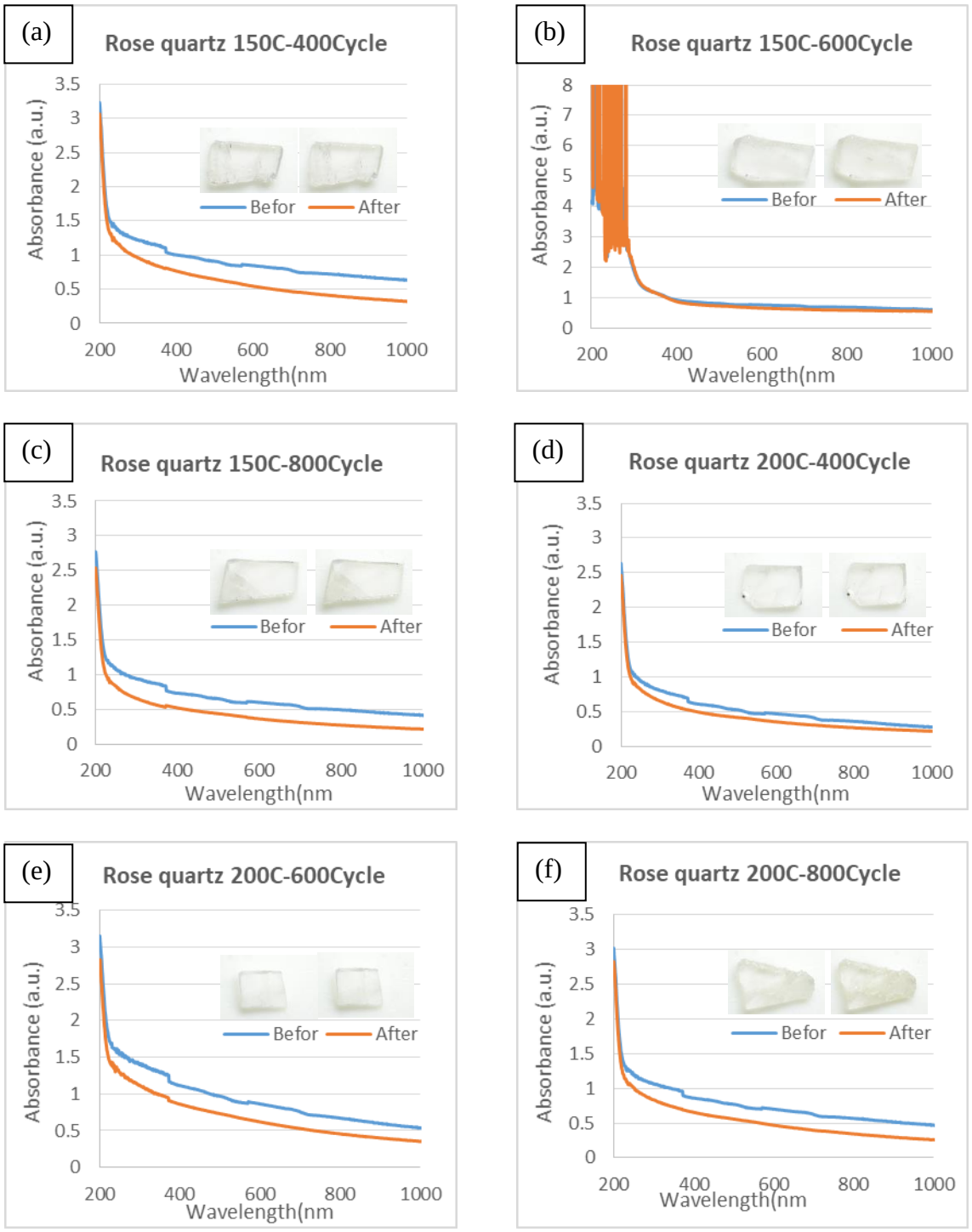


Figure. 9 Optical properties of Al_2O_3 thin films and collect photos. (a-c) rose quartz of coating process at 150°C and (d-f) rose quartz of coating process at 200°C.

Conclusion

Coating thin film alumina on rose quartz (or semi-precious stones) with plasma enhanced atomic layer deposition (PE-ALD) was qualified the chemical composition and the result showed that the thin film alumina had remaining carbon from the reaction between TMA : $Al(CH_3)_3$ and oxygen plasma which was not affect the hardness and optical properties. Rose quartz had greater number of hardness after coating with thin film alumina and the colour of rose quartz are changed for a bit. The increase of contact angle of water droplet showed the hydrophobicity of the slides which was proper

with the film's property – hydrophobicity of the film occurred from the effect of hydroxyl group (-OH).

Acknowledgments

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THE DESIGN ENVIRONMENT TO RESPOND TO APPLICATIONS FOR BABY APHASIA CASE STUDY: BABIES APHASIA AND INTELLIGENCE. "NONTAWITH HOME LANDSCAPE," PAK KRET DISTRICT SOME MARKETS. NONTHABURI

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Keywords: Design environment, Baby aphasia, Babies aphasia and intelligence.

Introduction

With an average rate increase of 1 million people per year, most disabled people with health problems and a higher risk of health problems than the general population. A key element of the problem is that people with disabilities have limited health care. Including the ability to take care of themselves than people who have normal body. There are certain types of people with disabilities who have the disorder than the general disability. Need to be taken care of than normal. The cause and the problem. The government has set up an agency or shelter. Care to assist those with disabilities. Agencies are spread out geographically in order to assist and care for the disabled, these thoroughly. To be able to care for and help themselves. Improves quality of life and care as a fundamental right which should be given.

Babies aphasia and intelligence. "Nontawith home landscape," Pak Kret district some markets. Nonthaburi Has opened a service and support for a long period and infant aphasia. Use a lot of The current state of disrepair The area should be designed and updated as appropriate. This will allow service providers infant aphasia. Quality of life improved Education about the need for space applications is an important issue. Spatial needs to be aligned to real world applications. This will entail improving the quality of life in Babies aphasia and intelligence. Nonthaburi

In this study, Oriented education to fix problems in the design environment to respond to applications for Babies aphasia and intelligence. Nonthaburi researchers used data collection methods used by the target group. Focus on the involvement of people living in the area. By the authorities and local residents to participate in all activities in the research.

Literature References

Researchers have studied the concepts and theories related to research and research methodologies. The story is divided into four definitions of disability. The type of disability and welfare. The participatory design and design institutions and design standards thoroughfare for people with disabilities.

Definition of disability

Patip Assawaphom (2013) argue that the disabled population is important to the nation in many ways, but the well-being of people with disabilities is often neglected by the society. The environment is not easy to live. Attitude of people in society toward the disabled. Understanding disability is essential. As a result, the society recognizes the importance of such matters. This will lead to help and support to enable people with disabilities to live like people.

Act for Empowerment of Persons with Disabilities 2550 under Article 4 provides that the definition of disability. "People who have limitations in performing everyday activities. Or participated in social activities. Due to impaired sight, hearing, mobility, communication, behavioral, mental, emotional intelligence, learning disabilities, or any other. The barriers in areas with special needs to receive help one area to be able to practice. In everyday life or social involvement with guests ".

From the above definition The medical definition of disability in terms of looking at the problems and difficulties of the life of ordinary people. The attitudes about people with disabilities as people who have been helping care. But the definition of disability in the social dimension. That disabled people have the same rights to everyone. It is the duty of society to encourage people with disabilities to participate in these activities as individuals.

The type of disability and welfare

Currently, there are many types of disabilities. Each type of defect are different away. The aid scheme is different. Sorting disabled by the Ministry of Social Development and Human Security disability guidelines on the type and No. 2, 2555 were categorized into 7 types of disabilities, including the visually impaired. Hearing disability or meaningful. Disability or physical movement. Disability, mental disability or behavioral intelligence. Learning Disabilities Disabilities and autism. (Ministry of Social Development and Human Security, 2555).

Babies aphasia and intelligence. Nonthaburi set up with the purpose of restoring health. Mental health advocacy and mentally. Neglected and abandoned by their families and society. The optimum age for dependents aged 60 years and over who have contagious diseases. And people with physical disabilities or brain, and can help them in their daily lives. homeless Can not live with the family The orphanage will assist with the development and rehabilitation in areas they can help themselves. The purpose of this educational institution. Is another way to help designers understand the special nature and needs of different people. This will be used to guide the design.

Design involved

Design participatory process that encourages stakeholders to exchange ideas. Offer solutions and create an understanding of the design work together. This will lead to the creation of partnerships for all parties. The decision to participate in the design process Information must come from those who actually use the building. This will create a sense of ownership. It also provides an opportunity to use the space to display their own needs. This approach brings to the design and the solutions to the problems which have come from the real needs (Nuntiya Hatanuwat and Narong Hutanuwat,2004).

Designed to foster and design standards for the disabled

Babies aphasia and intelligence. Nonthaburi A key element to take into account the 4: 1) the composition of the primary users and secondary users such as service providers and service recipients, 2) component activities include the type of activity. Patterns of user behavior and characteristics in building support for activities 3) the location and the surrounding environment. Access to the building The social, cultural, and 4) economic factors include the budget to invest in building new or remodeling. Sources of funding The design may be more specific to different environmental conditions conducive to use. And facilities

Guide "recommendations designed facilities for all" has been identified as a thoroughfare that allows disabled people who can use it easily. To focus on two issues, namely the width of the

path and the slope of the thoroughfare. The proper width will range between 0.90 to 1.50 meters and a slope of at least 1:12 if the ramp is longer than 2.50 meters must have handrails on both sides. If the length of the ramp-up period of 6.00 meters to a landing ramp has a width of 1.50 m, the surface of the ramp must not slip material is suitable for use. (Association of Siamese Architects under Royal Patronage, 2015).

Method

In the process of data collection The researchers conducted a survey of the physical Babies aphasia and intelligence. Nonthaburi The interviews are the primary means of storing data with the stored image and to create an environment within the actual project. The research was conducted into space three times. The physical storage conditions and issues twice. Co-designed with participation once again.

The first survey was held on December 7, 2018 with the objective to explore and visit. The Babies aphasia and intelligence. Nonthaburi accommodation Executive agencies Procurement Officer Nurses Mentors, as well as provide more frequent. To get information about the place and the overall issues in general. The information is used to guide the research and plans are preliminary. Later on January 21, 2018, the researcher has studied the area again to collect insights. By means of interviews and participatory observation in detail. To understand the current conditions. Joint analysis of the problems and the needs of the staff interviewed in all sectors. The data were analyzed in order to design an environment for young children in primary aphasia to be used in preparing the detailed design. Plan to join the staff of the Social Welfare Development Center for the Elderly in the final stag

The sample consisted of interviews, the researchers selected a group of nurses, nurse aides, office staff and maintenance technicians within Babies aphasia and intelligence. Nonthaburi because groups to take place in practice. Information can be clearly Unlike patients who are handicapped and disabled. These groups, which are limited in their ability to provide information on the spatial applications. The researchers relied on data from the first sample-based.

On the 3rd day of March 27, 2018 were prepared and used in the design of the important issues that are involved. Using the information from the interview. Observations used as a guide to create the drawing. Environment Design of New Babies aphasia and intelligence. Nonthaburi and take such an approach to be presented with the information from the various departments. The audience follows: An executive agency of the first group of 12 providers and patients or those with disabilities who can communicate for 3 people. All participants can provide feedback and share ideas and make suggestions. To be used in the design environment. The layout of the building The new system, roaming the area with investigators. To make sure that all the parties. The draft development plan for the project can be used to cause a real interest in the work. It also can be used as documentation for presentation development budget Babies aphasia and intelligence. Nonthaburi province to the executive decision to go.

Case study

Babies aphasia and intelligence. Nonthaburi With a total area of 54 acres with 14 buildings, including building a building, service building and seven other buildings of 7 buildings with a single-storey building. All the information in Dalmatia Derived from a joint survey and interview with nurse mentors and service providers in Babies aphasia and intelligence. Nonthaburi

Results Conclusions

Barriers that result in inconvenience and delay in providing and receiving services today can be split into two major areas: the problems and difficulties of the route within the area of the building.

Obstacles caused by road traffic.

The main obstacle occurs within the area. To modify applications that change based on actual usage in the area. The use of the building, according to the circumstances of each activity such as the increase of residential buildings infant aphasia showed that the number of disabled people more. Issue of a thoroughfare for vehicles and pedestrians occur immediately. The main route for commuters currently used mainly by vehicles. Nature trails current bridge is narrow and steep. As a result, access to Babies aphasia and intelligence. Nonthaburi continued inconvenience. The road project is currently not linked to each other where possible. Make car travel Not accessible in all areas within the project. The land is still at large. Roads within the current size of just 4 meters, resulting in the car can run only one lane. It is impossible to access the building thoroughly. If there is an emergency such as a fire. It may be that the fire will not reach the scene within a timely manner.

The pedestrian route traffic within the area is currently not designed to respond to the truly active, such as the link between building design is not contiguous. Both those with disabilities and service providers need to walk down the street with the car at some point. Although the wide walkways are wide enough for the use of disabled people, especially disabled people who use wheelchairs. The areas covered. Nevertheless, the slope of the ramp does not meet the standards for the use of disabled people in general. Some of the slopes are steep, the proportion of 1: 6, which is steeper than that disabled people are able to move up and down by themselves. Many point to rail Route traffic across multiple paths to serve as general entrance buildings 1 and 2 will be used together with the transfer of food. Or disabled access to buildings, hospitals need to walk down the road to get access to services and so on.

The tower is not appropriate

Located in the main building, in the improper access by Center staff and kitchen staff as the food can lead to the building. Building nurse disabled should be easily accessible and safe, but it is far greater than the disabled, remember to arrive in time. If there is an emergency Access the ambulance was not very convenient.

The research showed that the main problem of Babies aphasia and intelligence. The jobs issue is the placement of buildings and road projects. This issue affects the providers and recipients of services within the area. The research focus is on the design of the project is to improve the layout. To determine the distance between buildings. Should put an end to the new building. By requiring them to be in the proper position. Taking into account the needs of each service provider and the recipient. Routing and roaming through the various trails in the area. Traffic routes should have continuous access to various points of Babies aphasia and intelligence. Nonthaburi is easy Not interfere with each other and are safe if there is an emergency.

Results Conclusions

Data from the surveys and interviews, physical involvement with the informant. The research data were analyzed and the draft Plan. The placement of the building System traffic Design environment for the handicapped and disabled. The design approach can be summarized as follows environments.

1) The position of the hospital building - physiotherapy. Buildings and facilities such as the kitchen, office buildings and activities.

2) Route traffic within the Social Welfare Development elderly home Khae. Must be linked together and can shorten the travel time from the overall layout of the original. Either in the form of vehicular traffic and on foot. The width of the thoroughfare for vehicles to facilitate access for large vehicles. For quick service and assistance at the time.

The Rail Master Plan and design a new layout. Representing all sectors of Babies aphasia and intelligence. Nonthaburi province has offered a detailed layout of a building using segmented by type of building applications. To make it easier to understand Connect and respond to the needs of service providers, all within easy reach. Can be divided into zones as follows.

1.) The building's accessibility. Which classify disabilities are 2 types of people with disabilities and disability. To facilitate the allocation is appropriate to the nature of their disability. Each building will be classified according to specific characteristics such as disability disabled handicapped seat next to the bed with a wheelchair.

2.) Office building The staff work department. Both the Administration Procurement and Maintenance. In addition, the area is welcome to visit the project.

3.) Building nursing and physiotherapy. Placement near a residential building of the handicapped and disabled. Also connected to each other.

4.) The kitchen and dining area. Placed in the area to cater for services in various parts of the hotel.

5.) Auditorium and recreational buildings The area in front of the project It can accommodate a group of visitors in a group then. It is also an area for the joint activities of the disabled and those who visit them.

6.) The shelter's staff and the service provider is separate from the service. To ensure the privacy of its duties.

7.) Size is 2 lane roads surrounding the project. To facilitate And improve the trails for the project to be constantly connected.

The detailed requirements for each of the sub-group of buildings. Need to be designed to contribute more. Since each building is a form of active and functional requirements specific to different away. However, a draft of the Master Plan for Babies aphasia and intelligence. Nonthaburi Is the starting point for the development of the quality of life of those involved in the area. This will lead to the development of future projects.

Acknowledgment

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BIOELECTRICITY PRODUCTION FROM RICE NOODLE WASTEWATER USING PLANT MICROBIAL FUEL CELL (PMFC)

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Keywords: Wastewater treatment, Electricity generation, Microbial fuel cell

Abstract : The environmental pollution and energy depletion caused by an increasing of human demands and consumptions required the need for new eco-friendly, sustainable and cost effective energy sources. Microbial fuel cell (MFC) has been investigated for bioelectricity production through organic degradation of wastewater by microbial consortium. Many modifications of MFC have been developed, including plant microbial fuel cell (PMFC) which has gained a lot of interests recently. Due to practical limitations, however, PMFCs are still unsuitable for high energy demands which need more studies. In this study, PMFC using 3 plant species; *Canna indica* L. ($PMFC_1$), *sagittaria latifolia* L.($PMFC_2$) and *Barleria lupulina* Lindl ($PMFC_3$) were conducted for rice noodle wastewater treatment and bioenergy production. Lab-scale PMFC reactors were constructed with 242 cm^2 of aluminium sheets as the electrodes. It was found that the internal resistance of $PMFC_1$, $PMFC_2$ and $PMFC_3$ were 264.22, 339.36 and 365.87 ohms, respectively. Power generation from rice noodle wastewater using *Canna indica* L. showed the maximum power density and current density of 45.82 mW/m^2 and 1.37 mA/m^2, with the highest COD removal efficiency of 66.4%. The electrical energy production from wastewater using PMFC could offer an economical solution for the environmental problems and energy crisis in the near future.

Introduction

The energy demand around the world has been increasing every year as a consequence of the growing population and higher living standards. More than half of energy used comes from fossil fuels and increasing in fossil fuels needs raises serious environmental concerns. The rapidly increasing consumption of energy and fossil fuel dominated energy structure have caused great pressure on energy security and carbon reduction policies in global, and the global has attempted to substitute fossil with non-fossil energy[1]. More than 100 cities now mostly powered by renewable energy and at least 70% of their electricity come from renewable sources such as hydro, geothermal, solar energy, wind energy and bio-energy[2]. This has an influence to cities around the world to switch from fossil fuels to renewable sources. As a consequence, upgrading technologies

and discovering a new renewable energy source with high potential, scaled up and being environmental friendly are still required.

One of the emerging technologies that has gained a lot of interests is the Microbial Fuel Cell (MFC) which generates electricity from organisms [3]. MFC is a device that directly converts chemical stored in substrates into electricity by the catalytic activity of microbes . The MFC system consists of anode and cathode compartments separated by a cation specific membrane. In the anode, organic matter is oxidized by microorganisms to release electrons and protons. Electrons are transferred to the cathode compartment through an external circuit, generate electricity, while protons are transferred to the cathode compartment through the membrane. Water is also produced by the combination of electrons and protons with oxygen, on the cathode [4]. MFC technology can be used as a treatment system to treat both domestic and organic industrial wastewater by converting organic matter in wastewater into electricity using the bacteria [5]. MFC is considered to be a promising sustainable technology to meet increasing energy needs. This is due to MFC can generate electricity and accomplish wastewater treatment by utilizing wastewater as substrates to generate energy simultaneously which may offset the operational costs of wastewater treatment plant . However, MFC still has the disadvantages that make it difficult to upscale and high cost of membrane.

Recently, a new concept of plant microbial fuel cell (P-MFC) has been developed to generate electricity from living plants[3] . The plants use the solar energy to produce carbohydrates from atmospheric CO_2 via the photosynthetic processes. A part of the produced carbohydrates and other organic substances is excreted by the plant roots and can be utilized by the microorganisms occupying the rhizosphere for their own growth and development. The electrochemically active bacteria in the anode oxidized and transferred extracellular electrons through plant roots who act as the intermediaries for bioelectricity generation, while wastewater is treated [6] .A variety of wastewaters, including synthetic wastewater [7], beer brewery processing wastewater [8], food processing wastewater [9]. Landfill leachates [10], Municipal or domestic wastewater [11] and agricultural wastewater [12], have been used as substrates in MFCs for electricity production.

However, electricity generation efficiency of the plant microbial fuel cell (PMFC) depends on the type of electrodes [4], the surface of area electrodes [13], the distance between the electrodes [3], as well as the types of plants used,. Each type of plant roots has different branching and lengths that can affect to the oxidation ability of microorganisms in rhizosphere zone and electricity generation [14]. There are different types of plant species such as *Cyperus involucratus* R.[13], Rice (Oryza sativa L.) [15], *Lemma* valdiviana [16], *Canna indica*. [17], *Brassica juncea, Trigonella foenum-graecum, Canna Stuttgart* [6], *Spartina anglica, Arundinella anomala* and *Arundo donax* have been applied in the PMFC systems for electricity generation [18].

Apart from energy crisis, Thailand, where having wide varieties of plants, has problems of high amount of various types of agro industrial wastewater that still needed to be solved. The current research and studies on MFC in Thailand still have not received much attention. This research involved using plants in working with the MFC, so called PMFC to treat wastewater and produce electricity used for the local community. In this work, electricity generation and wastewater treatment efficiencies of PMFC between three plant species; *Canna indica* L., *sagittaria latifolia L.* and *Barleria lupulina* Lindl. was compared and evaluated. The results of this study are expected to develop renewable energy from wastewater as well as environmental pollution treatment for sustainable local community.

Materials and methods

PMFC Design and set up

The PMFC was constructed using a plastic cylinder container (19 cm inner diameter and 25 cm height). The PMFC system (Fig. 1) consisted of 3 kg of soil and 2 L of rice noodle wastewater with the same initial COD concentration of 500 mg/L. Three plants species; *Canna indica L.*, *Sagittaria latifolia L.* and *Barleria lupulina L.* selected from Areya and co-workers were used in this work[]. Both electrodes were made of aluminium sheets (0.5 mm thickness) with the surface area of 242 cm^2 and 360 cm^2 for anode and cathode, respectively. The anode was set approximately 5 cm. below the bottom container where the root-plants have been attached, while the cathode was wrapped around the stem. The distance between both electrodes was set at 15 cm in each experiment. In this study, four experimental treatments were conducted as shown in Table 1. PMFCs were operated at room temperature (~ 30 ºC) for 7 days. The electricity production was measured every day. The influent and effluent were collected for physical and chemical analysis. Soil bacteria living in the rhizosphere before and after treatment were determined using pour plate's method.

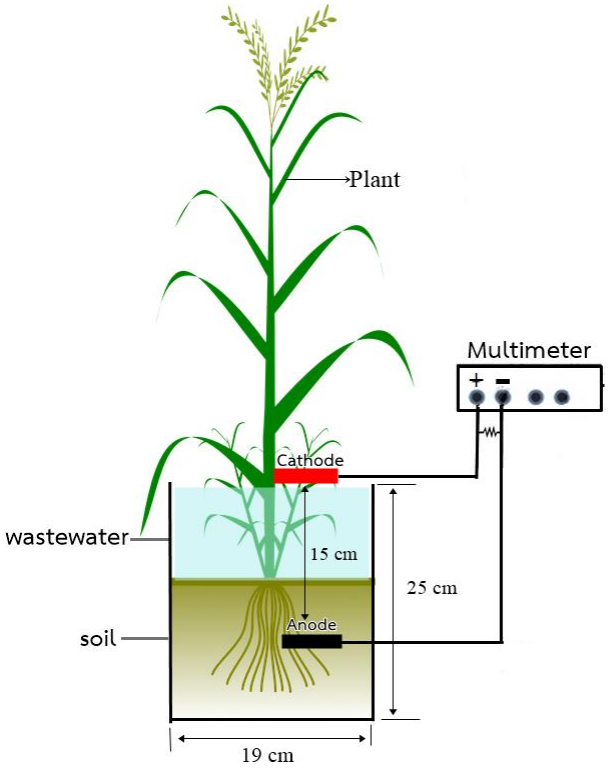


Fig. 1 PMFC design

Table 1

Experimental treatment

Treatment	Condition
PMFC1	*Canna indica L.* + Soil + wastewater
$PMFC_2$	*Sagittaria latifolia L.* + Soil + wastewater
$PMFC_3$	*Barleria lupulina L.* + Soil + wastewater
control	Wastewater

Polarization studies

The voltage and the current were measured using a digital multimeter (BLU YH-1230, China). The polarization curve was obtained by varying the external resistance from 10 to 15000 Ω, while R_{ext} was adjusted every 10 min. Polarization curves were plotted graph between the current density (mA/m^2) and power density (mW/m^2), the slope of the graph was equaled to the internal resistance of the PMFC.

Calculations

The current (I) was calculated using Ohm's law, I = V/R, where V is the voltage (mV), R is the external resistance (Ω). The current density (*i*) was calculated using *i* = I/A, where A is the surface area of electrode (cm^2). Power density (P) was calculated using P = IV/A, where I, V and A are the same as previously described [19].

Wastewater sampling and characteristics

PMFC technology was deemed useful for wastewater treatment. Wastewater used in the experiment obtained from the rice noodle processing at Huainamrin village, Keelek, Mae Rim district, Chiang Mai. Physical and chemicals characteristics of wastewater and the effluent after treated by PMFC were identified according to Table 2 .

Table 2

Methods for analysis of parameters

Parameters	Methods
COD	Closed reflux titrimetric method
pH	pH meter (pHTestr® 35, Eutech Instruments Pte Ltd.)
Conductivity (EC)	pH meter (pHTestr® 35, Eutech Instruments Pte Ltd.)
Temperature	Thermometer
DO	DO meter (HI9147, HANNA instruments, USA)
Nitrate (NO_3^-)	Dimethylphenol (DR6000^{TM} UV Vis Spectrophotometer, HACH, USA)
Phosphate (PO_4^{3-})	PhosVer3 (DR6000^{TM} UV Vis Spectrophotometer, HACH, USA)

Results and discussion

Electricity generation

This study compared the potential of three plant species; *Canna indica* L. ($PMFC_1$), *sagittaria latifolia* L.($PMFC_2$) and *Barleria lupulina* L. ($PMFC_3$) for electricity generation using PMFC. Experimental results showed that the PMFC could generate electricity using rice noodle wastewater as substrate. *Canna indica* L. exhibited the highest power density of 45.82 mW/m^2, compared to *sagittaria latifolia* L. (13.09 mW/m^2) and *Barleria lupulina* L. (21.48 mW/m^2) (as seen in Fig. 2 and Table 3). As shown in Table 4; It was reported total bacteria counts in wastewater and soil of the rhizosphere after treatment. The high power density may be attributed to total bacteria counts in systems of PMFCs which are degradable by microorganisms and responsible for electron donation [20].

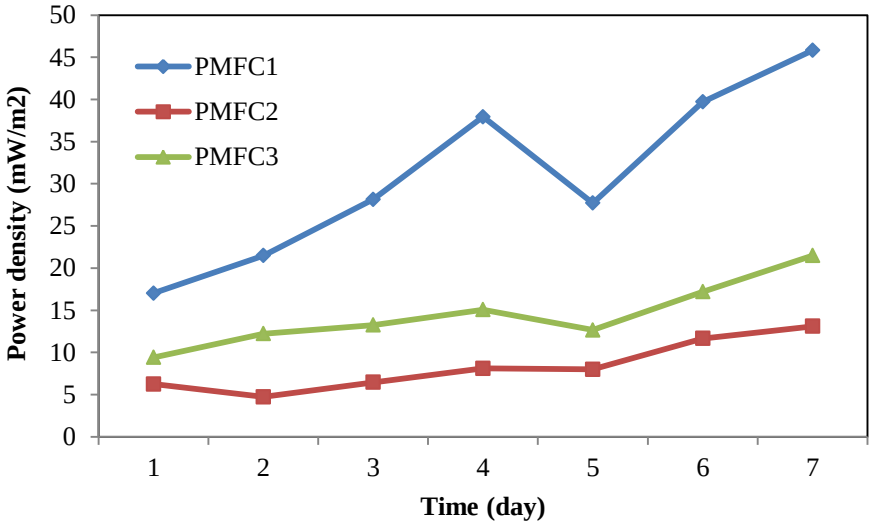


Fig. 2 Power density production from each PMFC reactor at 1000 Ω of the external resistance

Table 3

Comparison of PMFC performance between three plant species

PMFC	R_{int} (Ω)	Voltage (mV)	Power density (mW/m^2)	Current density (mA/m^2)	Efficiency (%)
Canna indica L.	264.22	33.3	45.82	1.37	0.25
Sagittaria latifolia L.	339.36	17.8	13.09	0.73	0.18
Barleria lupulina L.	365.87	22.8	21.48	0.94	0.21

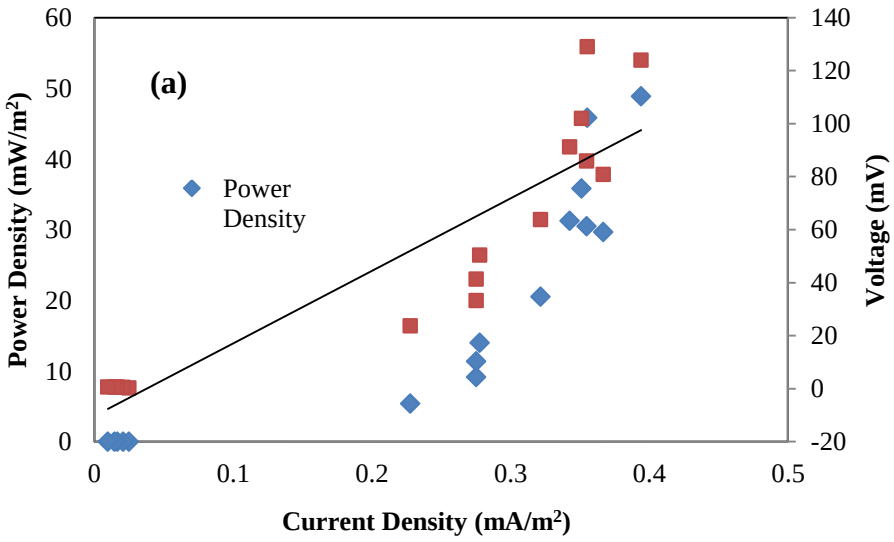
Table 4

Total bacteria counts of effluent and slurry on seven days

Treatment	Total bacteria counts (CFU/g)	
	Effluent	Soil
Canna indica L. + wastewater	2.34×10^5	9.35×10^6
Sagittaria latifolia L. + wastewater	3.75×10^5	7.60×10^6
Barleria lupulina L. + wastewater	2.15×10^4	8.90×10^6
Canna indica L. + water supply	2.24×10^5	8.90×10^6
Sagittaria latifolia L. + water supply	1.17×10^4	6.50×10^6
Barleria lupulina L. + water supply	4.80×10^6	4.8×10^6

Polarization curve

The polarization curve was obtained by recording the voltage via varying the external resistance from 10 to 15000 Ω. The current density and power density were calculated using Ohm's law. A curve of voltage as a function of current density was established by varying external resistance (Fig. 3), and the slopes of plots represented internal resistances of PMFC[21]. It was found that the internal resistance of $PMFC_1$, $PMFC_2$ and $PMFC_3$ were 264.22, 339.36 and 365.87 ohms, respectively. The analysis of relationship between the internal resistance and power density; It was found that low internal resistance can be produced the current better than high internal resistance; because the high internal resistance have given resistance the flow of electrons in circuit [13]. M. Helder et al. reported that the internal resistance of P-MFC's using *S.anglica* and *A.anomala* were 270 and 100 Ω [18].



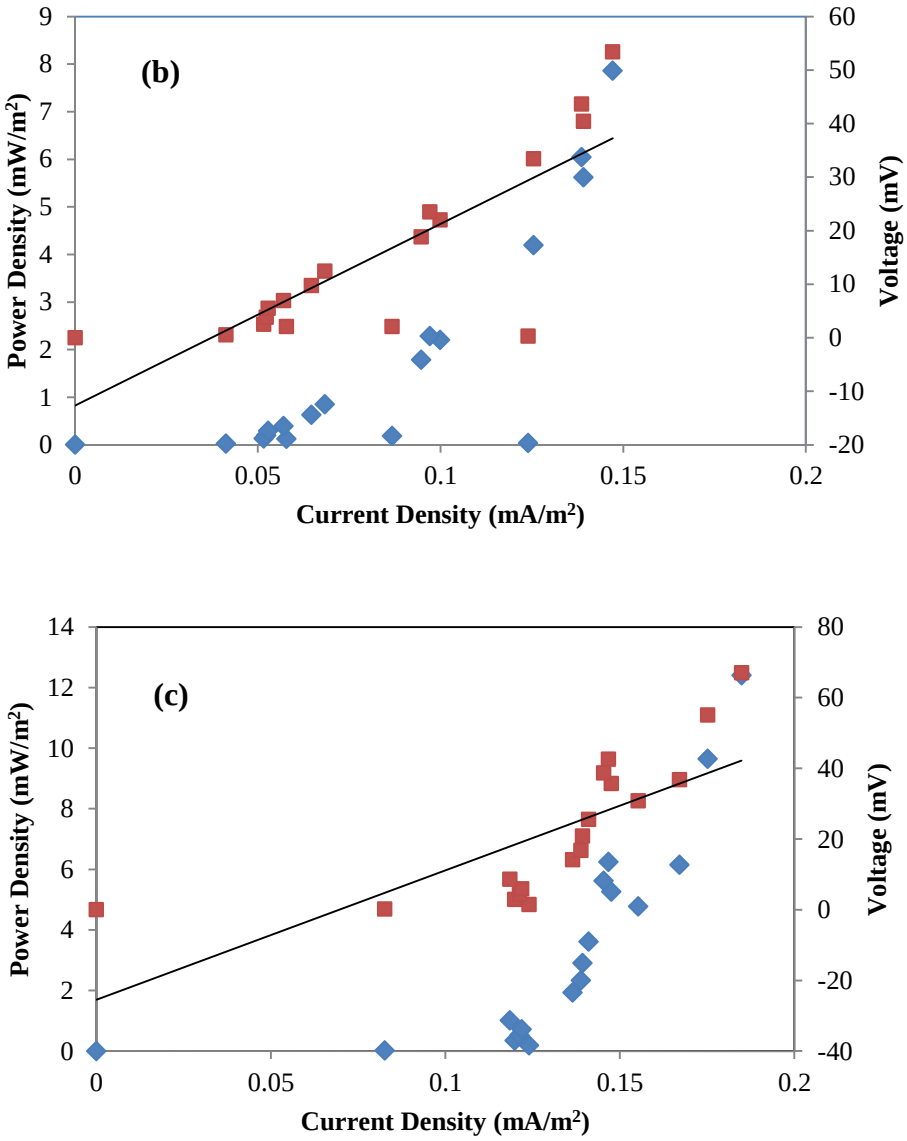


Fig. 3 Polarization curve of the $PMFC_1$ (a), $PMFC_2$ (b) and $PMFC_3$ (c)

Rice noodle wastewater treatment efficiencies

The PMFC system developed in this study was able to accomplish continuous electricity generation while wastewater has been treated. Wastewater in the experiment from the rice noodle processing. The characteristic of rice noodle wastewater used in this study was shown in Table 4.

Table 4

Characteristics of the rice noodle wastewater

Parameters	pH	DO (ppm)	EC (µs/cm)	PO_4^{3-} (mg/L)	NO_3^- (mg/L)	COD (mg/L)
Value	3.70	1.2	235	1.38	28.5	2150

As shown in Fig. 4, the effluent COD concentrations after 7 days were 160, 248, 224 mg/L for $PMFC_1$, $PMFC_2$ and $PMFC_3$, respectively and COD removal efficiencies of each PMFC reactor were 66.4, 50.5 and 55.2% for $PMFC_1$, $PMFC_2$ and $PMFC_3$, where *Canna indica* L. has been applied showed the highest COD removal efficiency of 66.4% in 7 days. This support the results of electricity generation mentioned earlier. The quality of the wastewater after treated by PMFC were presented in Table 5 $PMFC_1$ were observed to show the maximum power density and current density with the highest COD removal efficiency of 66.4%.

Normally, starch processing wastewater contains a relatively high content of carbohydrates (2300-3500 mg/L), sugars (0.65-1.18%), protein (0.12-0.15%) and starch (1500-2600 mg/L), representing an important energy-rich resource and suitable for electricity in MFC system. Zhang YF and co workers reported that the maximum current obtained from MFC treating starch wastewater was 0.2 mA after 30 days and the system could reduce COD from over 1700 mg/L to 50 mg/L [22]. The dissolved oxygen (DO) concentration suggesting effective O_2 reduction reaction on the cathode compartment [17]. Nitrate (NO_3^-) and phosphate (PO_4^{3-}) are another important parameter of plant growth. Nitrate (NO_3^-) and phosphate (PO_4^{3-}) increasing reflects a process carried out by nitrifying bacteria, transforms soil ammonia into nitrates (NO_3^-), which plants can incorporate into their own tissues [23].

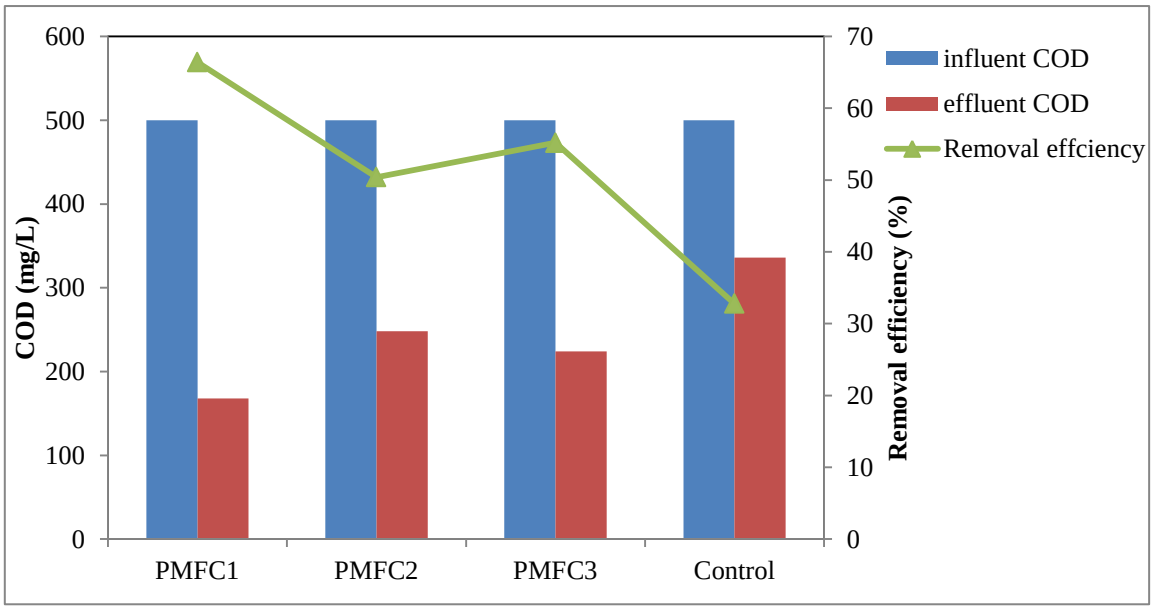


Fig. 4 COD removal efficiency of four experiments.

Table 5

The quality of the wastewater after treated by PMFC

Parameters	pH	DO (ppm)	EC (µs/cm)	PO_4^{3-} (mg/L)	NO_3^- (mg/L)	COD (mg/L)
$PMFC_1$	8.02	6.4	537	1.66	3.8	168
$PMFC_2$	8.00	5.7	501	0.73	3.2	248
$PMFC_3$	7.95	6.0	452	1.81	4.7	224
Control	7.53	2.0	310	0.27	1.7	336

Conclusions

In this study, bioelectricity generation from PMFCs for rice noodle wastewater treatment and bioenergy production by using three difference plant namely, *Canna indica* L., *Sagittaria latifolia* L. and *Barleria lupulina* L.. Among the systems studied, *Canna indica* L. were observed to show the maximum power density and current density with the highest COD removal efficiency of 66.4%. The high power density may be attributed to total bacteria counts in systems of PMFCs which are degradable by microorganisms and responsible for electron donation. The study concludes that plant systems can be a viable alternative bioelectricity generation and wastewater treatment.

Acknowledgement

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EFFECTS OF INITIAL MOISTURE CONTENT, INFRARED TEMPERATURE AND PUFFING TIME ON QUALITIES OF PUFFED PORK RINDS IN A CONTINUOUS INFRARED-MICROWAVE OVEN

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Keywords: Puffing, Pork rinds, Infrared, Microwave, Quality

Abstract. Nowadays, traditional deep fat frying is a popular method to puff pork. However, amount of oil is increased to 1/3 of the total food product by weight which causes many problems. A new method to puff the product that can reduce oil content is important. This research combined microwave and infrared radiation heating to increase the expansion volume and quality of pork rinds. The objective of this study was to characterize the effects of initial moisture content, infrared temperature and puffing time on final moisture content, expansion volume, water activity and texture of puffed pork rinds. In this experiment, 4 levels of initial moisture content (11.46, 10.06, 9.95 and 9.49% wet basis), 3 levels of infrared temperature (170°C, 190°C and 210°C) and 2 levels of puffing time (80 and 135 seconds) were studied. The results showed that initial moisture content, infrared temperature and the puffing time had significant effects on qualities of pork rinds. The optimum condition for puffing was 9.95% wet basis of moisture content, 190°C of infrared radiation temperature and 135 seconds of puffing time. This knowledge can be applied in the commercial production.

Introduction

Puffed pork rind is produced from the pig skin by removing the hairs, cleaning, boiling and seasoning before it was puffed by deep fat frying method to create the crispy and "pop up" texture on the pork skin (Khanh, 2014). Pork rind is very popular in Thailand. Thai people always eat pork rinds with rice noodles and other dishes. Pork rind is also eaten as snacks. Moreover, pork rind is also known as *chicharrÓn*, is a popular crunchy salty snack in the southern USA, Spain and Latin American countries (Martínez *et al.*, 2003). Nowadays, traditional deep fat frying method is a popular method for puffed products due to deep fat frying method creates a good texture and high expansion volume on the puffed products (Khanh, 2014). However, the high amount of oil is absorbed in the pork rinds which generates such the obesity and heart disease problem and rancidity problem (Mellema, 2003). For these reasons, the industry is in search of the new method to puff the pork rind product that does not use oil. Microwave combined with infrared heating (IR) can effectively puff the pork rinds without oil. This new technology can solve the various quality problems in microwave method such as tough texture and low volume of products (Sumnu, 2001) while addition of IR heating is saving time advantage of microwave heating with the browning and crispness (Sumnu *et al.*, 2004). Moisture content of dried pork skins is a critical factor in puffing products that influences volume expansion and texture (Truong *et al*., 2014) during microwave puffing while infrared temperature has a significant effect on heat and mass transfer and the puffing ability of pork rinds and moisture removal from the surface of foods (Sumnu *et al.*, 2004). Moreover, puffing time also affects the puffing volume and qualities of puffed pork rinds due to the generation of vapour and appropriate pressure levels (Nguyen *et al*., 2013).

The objective of this study was to characterize the effects of initial moisture content, infrared temperature and puffing time on final moisture content, expansion ratio, water activity and texture of the puffed pork rinds.

Materials and methods

1. Sample preparation

The pork rinds was bought from the Amornphan market, Bangkok, Thailand. The hairs and fat were removed before cleaning. Then, pork rinds were boiled in boiling water (100°C) for 20 minutes before cutting into small pieces of 1 cm x 5 cm. After boiling, the samples were dried at 90°C in the tray dryer (Kan Seng Lee Machinery, Thailand) for 6, 7, 8 and 9 hours for achieving different moisture contents before puffing. The palm oil used in the frying process was bought from the Morakot Industry Company, Thailand.

2. Puffing method

The dry pork rinds were puffed by the microwave combined with infrared oven in a continuous scale which was developed by Asst. Prof. Sirichai Songsermpong, Department of Food Science and Technology, Kasetsart University and Asst. Prof. Chokchai Sangdao, Department of Telecommunications Engineering, Mahanakorn University of Technology. Microwave power at 850 Watts 2,450 MHz. infrared temperatures namely 170, 190 and 210°C at 80 and 135 seconds of puffing time were studied. The screened teflon conveyor belt conveyed the dry pig skin pieces to the oven to puff the pork rinds and conveyed them out of the oven continuously. The speed of the belt was controlled by the variable motor which will control the puffing time. The puffed pork rinds were stored in aluminum foil bags for analysis.

3. Determination of qualities of puffed pork rinds

Measurements of final moisture content, expansion ratio, water activities (a_w) and texture of puffed pork rinds were determined in replication. Final moisture content of the pork rinds was determined by the hot air oven method (Association of Official Analytical Chemists, 2000). Two grams of each sample were blended by a blender (Model AY 46, Moulinex, Bangkok, Thailand) and spread out in aluminum cans before drying at 105 °C 24 hours.

Expansion ratio of the puffed pork rinds was determined by the seed displacement method (Segnini *et al*., 2004). The known density of black sesame seed was placed in a beaker of known volume and the volume of sample was calculated from change in the volume of sesame displacement.

Water activities was determined by the water activity meter (4TE; Aqua lab, USA)

A TA-XT.Plus Texture Analyzer (Stable Micro Systems; Godalming, UK) was used to measure the hardness of the fried and puffed pork rinds. The testing conditions were modified from Khanh *et al*. (2014). The texture analyzer was set up with a Warner-Bratzler blade corresponding with a heavy duty platform (HDP/90) and a force/displacement measurement of a 25 kg load cell. The pre-test speed and post-test speed were determined at 1 mm.s-1 and 10 mm.s-1, respectively. Puffed pork rind samples were tested under the conditions of a 20 g trigger force and 30 mm travel distance of the blade. The peak (maximum force) was recorded and was used to represent the hardness. The number of peaks was representation of crispness.

Results and Discussion

1. Effect of initial moisture content, infrared temperature and puffing time on expansion ratio of puffed pork rinds

Effects of infrared temperature, initial moisture content and puffing time on expansion ratio are shown in Fig. 1., Fig. 2. and Table 1. Increasing IR temperature

increased expansion ratio while decreasing initial moisture contents increased expansion ratio until at very low initial moisture content, the expansion ratio was less than the optimum moisture content. Moreover, increasing puffing time from 80 to 135 s also increased expansion ratio. Normally, when water inside pork skins received MW and IR radiation, water became vapor and cumulated to have high vapor pressure. Then the temperature of samples was higher than glass transition temperature of pork skin, this vapor pressure made pork skins expansion easily. The pork skin had a thick layer of gelatin which can accommodate vapor and expand more. Cumulative vapor pressure was higher and made higher expansion ratio of pork skins. But initial moisture content also affected on expansion ratio. Less initial moisture contents limited the vapor generation and less expansion ratio. Optimum initial moisture content generated the highest expansion ratio. For high initial moisture content, it decreased expansion ratio. This result could be explained that at high initial moisture content, water inside pork skins had lower evaporation because more moisture inside pork skins didn't receive enough energy to become vapor due to high amount of water while receiving the same energy. The more puffing time, the more water became more steam and then made the bigger pork skins expansion. The more time of puffing also increased the expansion ratio due to more vapor generation.

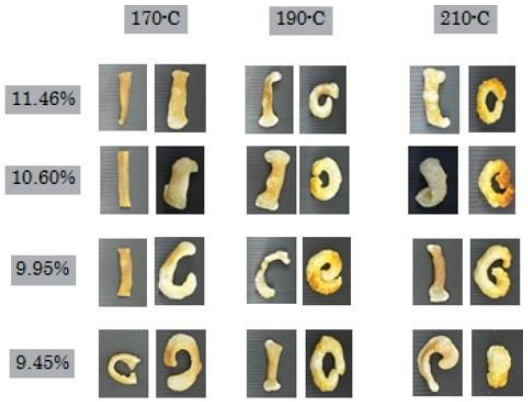

Fig.1: Expansion of pork rinds at 80 and 135 s

Table 1. Effects of initial moisture content, infrared temperature, and puffing time on expansion ratio

Intial moisture content [%wet basis]	Infrared temperature [°C]	Puffing time [sec]	
		80	135
11.46	170	0.67±0.36	3.04±0.70
	190	2.53±0.70	4.49±0.77
	210	2.63±0.13	6.45±0.36
10.60	170	0.83±0.62	4.02±0.00
	190	2.84±0.52	6.76±0.62
	210	6.97±0.13	7.12±0.25
9.95	170	0.93±0.55	5.88±0.33
	190	1.00±0.52	6.76±0.62
	210	4.33±1.24	9.91±0.38
9.45	170	2.01±0.79	4.80±0.33
	190	2.68±0.41	10.94±0.44
	210	1.00±0.73	8.00±0.70

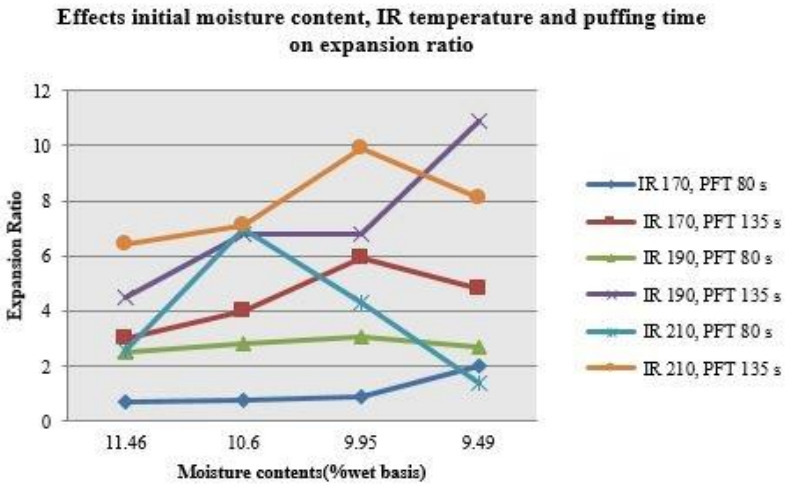

Fig.2: Effects of infrared temperature, initial moisture content and puffing time on expansion ratio

2. Effect of initial moisture content, infrared temperature and puffing time on final moisture content and water activity of puffed pork rinds

The effects of infrared temperature, initial moisture content and puffing time on final moisture content and water activity were shown in Fig. 3., Fig. 4. Table 2. Trends of final moisture contents were the same with water activities. Increasing IR temperature, initial moisture content and puffing time decreased final moisture content and water activity because increasing IR temperature increased surface temperatures of pork skins to be dry, which increased the evaporation of water inside the sample. While decreasing initial moisture contents decreased final moisture contents and water activities due to higher initial moisture contents had higher water in pork skins and this water was evaporated while puffing. So, pork skins which had high amount of water remained high final moisture contents and high free water. Considering at some condition of low initial moisture contents gave high final moisture contents and high water activities due to low expansion ratio at lower rate of evaporation of water, so free water still remained in final products. Moreover, at the same condition, increasing time to puff pork skins decreased final moisture contents and water activities of pork rinds because increase of puffing time was the increase of the time that pork skins were contacted with MW and IR radiation that affected on water evaporation.

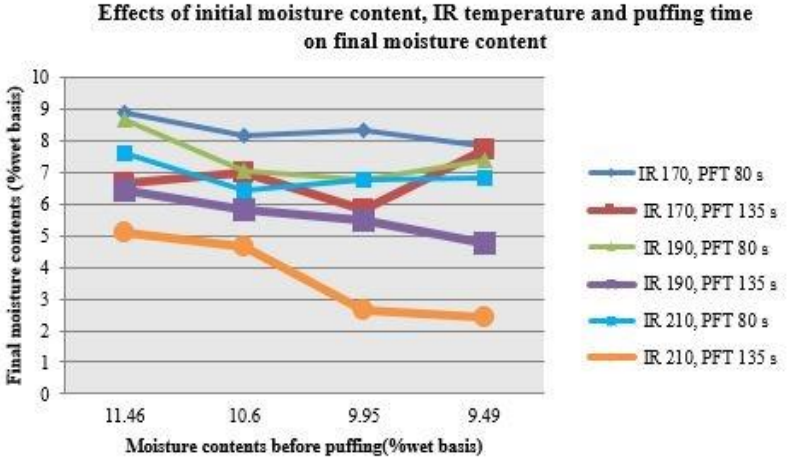

Fig.3: Effects of infrared temperature, initial moisture content and puffing time on final moisture content

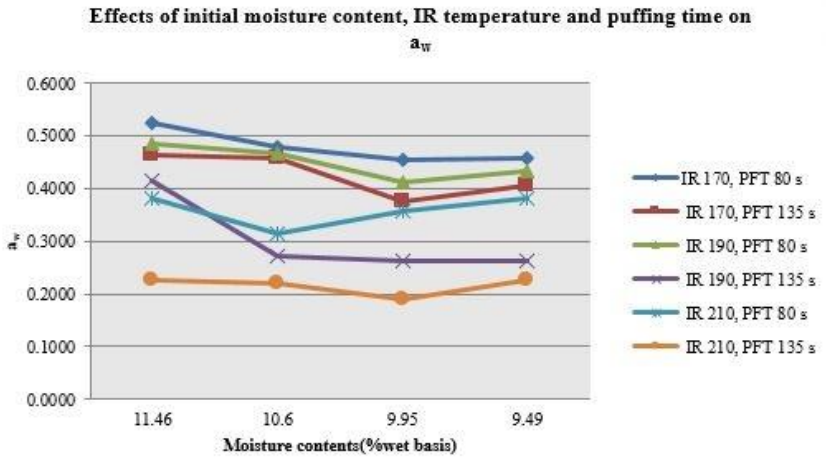

Fig.4: Effects of infrared temperature, initial moisture content and puffing time on a_w

Table 2. Effects of initial moisture content, infrared temperature, and puffing time on final moisture content and water activities

Intial moisture content [%wet basis]	Infrared temperature [°C]	Final moisture content [%wet basis]		Water activities	
		Puffing time [sec]			
		80	135	80	135
11.46	170	10.54±0.04	8.54±0.02	0.46±0.03	0.05±0.03
	190	10.50±0.17	8.34±0.11	0.42±0.03	0.48±0.03
	210	9.47±0.08	6.94±0.13	0.23±0.08	0.38±0.10
10.60	170	9.88±0.09	8.97±0.07	0.46±0.01	0.48±0.01
	190	9.00±0.11	8.16±0.46	0.27±0.10	0.47±0.10
	210	8.31±0.06	6.61±0.19	0.22±0.05	0.31±0.05
9.95	170	9.93±0.07	8.64±0.11	0.37±0.04	0.45±0.04
	190	8.94±0.05	8.42±0.18	0.27±0.07	0.41±0.07
	210	8.66±0.13	4.47±0.17	0.19±0.08	0.36±0.09
9.45	170	9.57±0.11	9.33±0.11	0.46±0.03	0.46±0.03
	190	9.12±0.09	6.66±0.11	0.37±0.03	0.26±0.07
	210	8.60±0.11	4.34±0.02	0.23±0.08	0.38±0.10

3. Effect of initial moisture content, infrared temperature and puffing time on texture of puffed pork rinds

Effects of infrared temperature, initial moisture content and puffing time on hardness and crispness are shown in Table 3., Fig. 5. and Fig. 6. The results indicated that the hardness and crispness was dependent on infrared radiation temperature. Increasing infrared radiation temperature decreased hardness while increased crispness. For hardness, high infrared radiation temperature created hard surface of pork skins and affected on evaporated vapor inside pork skins. Harder surface of pork skins occurred higher vapor pressure inside pork skins. When pork skins were puffed, many big porous structures inside pork rinds were created that affected to lower hardness while higher crispness. Moreover, at high infrared radiation temperature in this case was at 190 and 210 °C. Crispness was not significantly different at low initial moisture content. Initial moisture content affected on the texture of puffed pork rinds. Increasing initial moisture content decreased hardness for some

conditions and increased hardness for other conditions and increased crispness due to higher initial moisture content. The higher amount of water in pork skins affected on vapor pressure and expansion ratio of pork rinds. Products had higher expansion, higher crispness while lower hardness. Increasing puffing time decreased hardness and increased crispness of pork skin due to higher expansion.

Table 3. Effects of initial moisture content, infrared temperature, and puffing time on crispness and hardness

Intial moisture content [%wet basis]	Infrared temperature [°C]	Crispness [N]		Hardness [N]	
		Puffing time [sec]			
		80	135	80	135
11.46	170	10.06±0.03	6.84±2.57	122.71±0.02	84.89±1.89
	190	5.11±1.03	6.57±4.32	69.57±1.02	78.36±4.53
	210	12.43±1.02	6.01±0.35	142.32±1.03	78.40±0.24
10.60	170	9.49±0.04	6.59±0.98	130.18±0.04	59.11±0.78
	190	9.09±1.01	14.28±1.45	97.75±0.98	33.55±1.32
	210	12.89±3.04	13.51±0.12	29.85±2.98	25.88±0.20
9.95	170	9.74±0.32	12.71±2.45	147.57±0.22	27.14±2.05
	190	10.02±3.42	14.14±1.06	147.91±3.30	22.32±1.14
	210	14.82±2.45	14.62±0.18	73.48±2.54	12.22±0.14
9.45	170	8.72±0.50	6.74±2.33	95.33±0.56	73.51±2.54
	190	8.84±2.24	14.21±0.45	107.96±2.45	16.69±0.32
	210	11.89±4.12	13.92±0.12	53.38±4.11	15.06±0.14

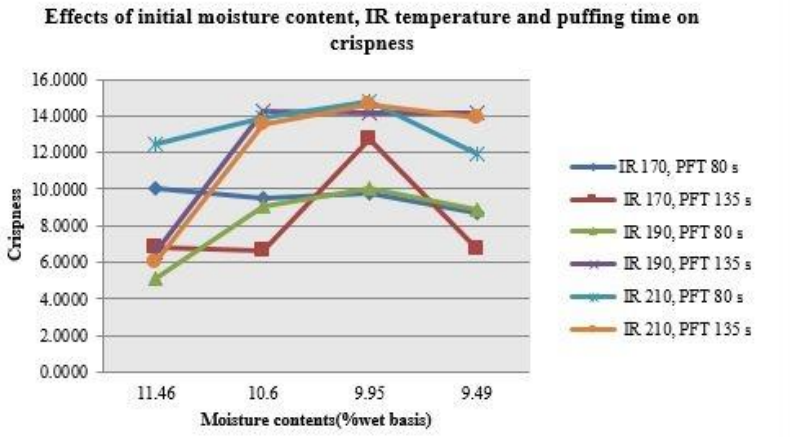

Fig.5: Effects of infrared temperature, initial moisture content and puffing time on crispness

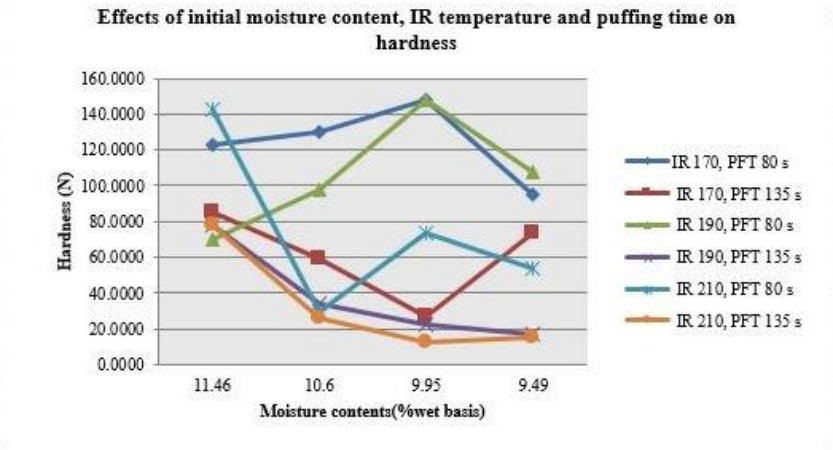

Fig.6: Effects of infrared temperature, initial moisture content and puffing time on hardness

Conclusion

Initial moisture content, infrared temperature, and puffing time had effects on final moisture content, expansion ratio, water activity and texture of pork rinds due to infrared temperatures created hard texture on pork skins while initial moisture content affected on amount of initial water inside pork skins. Both of these factors affected on the generation of vapor inside the pork skins. Moreover, longer puffing time showed a bigger expansion ratio. Therefore, all of these factors were important to optimize the puffing process of pork rinds by using microwave-infrared heating. Moisture content of 9.95% wet basis, temperature of infrared radiation of 190°C and puffing time of 135 s are the optimum condition for this study.

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THE STUDY AND DESIGN OF THE PHYSICAL ENVIRONMENT IN RESPONSE TO APPLICATIONS FOR DISABLED CHILDREN IN EDUCATION: IMPROVING THE ENVIRONMENT OF THE ORPHANAGE FOR DISABLED CHILDREN IN PAK KRET. NONTHABURI

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Keywords: Design environment, Baby aphasia, Disabled children, foster children Pak.

Introduction

With an average rate increase of 1 million people per year, most disabled people with health problems and a higher risk of health problems than the general population. A key element of the problem is that people with disabilities have limited health care. Including the ability to take care of themselves than people who have normal body. There are certain types of people with disabilities who have the disorder than the general disability. Need to be taken care of than normal. The cause and the problem. The government has set up an agency or shelter. Care to assist those with disabilities. Agencies are spread out geographically in order to assist and care for the disabled, these thoroughly. To be able to care for and help themselves. Improves quality of life and care as a fundamental right which should be given.

Children with disabilities Pak Jobs are available and help a long time and have children with disabilities. Use a lot of The current state of disrepair The area should be designed and updated as appropriate. This will allow service providers. Disabled children have a better life. Education about the need for space applications is an important issue. Spatial needs to be aligned to real world applications. This will entail improving the quality of life in the orphanage for disabled children in Pak Kret. Nonthaburi

In this study, Oriented education to fix problems in the design environment to respond to applications for children with disabilities. Children with disabilities in Pak Nonthaburi researchers used data collection methods used by the target group. Focus on the involvement of people living in the area. By the authorities and local residents to participate in all activities in the research.

Literature References

Researchers have studied the concepts and theories related to research and research methodologies. The story is divided into four definitions of disability. The type of disability and welfare. The participatory design and design institutions and design standards thoroughfare for people with disabilities.

Definition of disability

Patip Assawaphom (2014) Said that disabled people are vital to the nation in many ways, but the well-being of people with disabilities are often socially omissions. Whether the environment is no easy life. The attitude of the society towards the disabled. Understanding about disability is essential. The society recognizes the importance of the matter. This will lead to the help and support so that people with disabilities can live like normal people.

Act for Empowerment of Persons with Disabilities 2550 under Article 4 provides that the definition of disability. "People who have limitations in performing everyday activities. Or participated in social activities. Due to impaired sight, hearing, mobility, communication, behavioral, mental, emotional intelligence, learning disabilities, or any other. The barriers in areas with special needs to receive help one area to be able to practice. In everyday life or social involvement with guests ".

From the above definition The medical definition of disability in terms of looking at the problems and difficulties of the life of ordinary people. The attitudes about people with disabilities as people who have been helping care. But the definition of disability in the social dimension. That disabled people have the same rights to everyone. It is the duty of society to encourage people with disabilities to participate in these activities as individuals.

The type of disability and welfare

Currently, there are many types of disabilities. Each type of defect are different away. The aid scheme is different. Sorting disabled by the Ministry of Social Development and Human Security disability guidelines on the type and No. 2, 2555 were categorized into 7 types of disabilities, including the visually impaired. Hearing disability or meaningful. Disability or physical movement. Disability, mental disability or behavioral intelligence. Learning Disabilities Disabilities and autism. (Ministry of Social Development and Human Security, 2013).

Children with disabilities Pak Nonthaburi set up with the purpose of restoring health. Mental health and rights of children with disabilities. Neglected and abandoned by their families and society. The optimum age for dependents aged 60 years and over who have contagious diseases. And people with physical disabilities or brain, and can help them in their daily lives. homeless Can not live with the family The orphanage will assist with the development and rehabilitation in areas they can help themselves. The purpose of this educational institution. Is another way to help designers understand the special nature and needs of different people. This will be used to guide the design. Improve the environment as well as allowing service providers to prioritize applications, which can increase the performance and speed of access to the service appropriately fast.

Design involved

Design participatory process that encourages stakeholders to exchange ideas. Offer solutions and create an understanding of the design work together. This will lead to the creation of partnerships for all parties. The decision to participate in the design process Information must come from those who actually use the building. This will create a sense of ownership. It also provides an opportunity to use the space to display their own needs. This approach brings to the design and to solve problems which come from the real needs are.

Designed to foster and design standards for the disabled

Children with disabilities Pak Nonthaburi important element to take into account the 4: 1) the composition of the primary users and secondary users such as service providers and service recipients, 2) component activities include the type of activity. Patterns of user behavior and characteristics in building support for activities 3) the location and the surrounding environment. Access to the building The social, cultural, and 4) economic factors include the budget to invest in building new or remodeling. Sources of funding The design may be more specific to different environmental conditions conducive to use. And facilities

Guide "recommendations designed facilities for all" has been identified as a thoroughfare that allows disabled people who can use it easily. To focus on two issues, namely the width of the

path and the slope of the thoroughfare. The proper width will range between 0.90 to 1.50 meters and a slope of at least 1:12 if the ramp is longer than 2.50 meters must have handrails on both sides. If the length of the ramp-up period of 6.00 meters to a landing ramp has a width of 1.50 m, the surface of the ramp must not slip material is suitable for use. (Association of Siamese Architects under Royal Patronage, 2015).

Method

In the process of data collection The researchers collected survey data on the physical side of the foster children with disabilities Pak. Nonthaburi using the interview as the primary means of storing data with the stored image and to create an environment within the actual project. The research was conducted into space three times. The physical storage conditions and issues twice. Co-designed with participation once again.

The first survey on December 9th, 2017, aims to explore the place and met. Children with disabilities Pak Nonthaburi accommodation Executive agencies Procurement Officer Nurses Mentors, as well as provide more frequent. To get information about the place and the overall issues in general. The information is used to guide the research and plans are preliminary. On January 4, 2019 that the researcher has studied the area again to collect insights. By means of interviews and participatory observation in detail. To understand the current conditions. Joint analysis of the problems and the needs of the staff interviewed in all sectors. The data obtained were analyzed for use in the design environment for children with disabilities. In the preliminary stage, to be used in preparing the detailed design. Plan to join the staff of the orphanage for disabled children in Pak Kret. In the final stage

The sample consisted of interviews, the researchers selected a group of nurses, nurse aides, office staff and maintenance technicians within the orphanage for disabled children in Pak Kret. Nonthaburi because groups to take place in practice. Information can be clearly Unlike patients who are handicapped and disabled. These groups, which are limited in their ability to provide information on the spatial applications. The researchers relied on data from the first sample-based.

On the 3rd day of March 12, 2018 were prepared and used in the design of the important issues that are involved. Using the information from the interview. Observations used as a guide to create the drawing. Environment Design of workhouse children Pak. Nonthaburi and take such an approach to be presented with the information from the various departments. The audience follows: Executive Agency Number 1 Provider Group of 12 and Group of the clients or those with disabilities who can communicate for 3 people, all participants can provide feedback and share ideas and make suggestions. To be used in the design environment. The layout of the building The new system, roaming the area with investigators. To make sure that all the parties. The draft development plan for the project can be used to cause a real interest in the work. It also can be used as documentation for presentation development budget orphanage for disabled children in Pak Kret. Nonthaburi The executive decision to go.

Case study

Children with disabilities Pak Nonthaburi With a total area of 12 acres with buildings for a total of 11 buildings divided into five buildings, service buildings and other buildings with a total of 6 buildings, one-storey building. All the information in Dalmatia Derived from a joint survey and interview with nurse mentors and service providers in the orphanage for disabled children in Pak Kret. Nonthaburi

Results Conclusions

Barriers that result in inconvenience and delay in providing and receiving services today can be split into two major areas: the problems and difficulties of the route within the area of the building.

Obstacles caused by road traffic.

The main obstacle occurs within the area. To modify applications that change based on actual usage in the area. The use of the building, according to the circumstances of each activity such as the increase of residential buildings for disabled children. It was found that there were more people with disabilities. Issue of a thoroughfare for vehicles and pedestrians occur immediately. The main route for commuters currently used mainly by vehicles. Nature trails current bridge is narrow and steep. As a result, access to the orphanage for disabled children in Pak Kret. Nonthaburi Continued inconvenience The road project is currently not linked to each other where possible. Make car travel Not accessible in all areas within the project. The land is still at large. Roads within the current size of just 4 meters, resulting in the car can run only one lane. It is impossible to access the building thoroughly. If there is an emergency such as a fire.

The pedestrian route traffic within the area is currently not designed to respond to the truly active, such as the link between building design is not contiguous. Both those with disabilities and service providers need to walk down the street with the car at some point. Although the wide walkways are wide enough for the use of disabled people, especially disabled people who use wheelchairs. The areas covered. Nevertheless, the slope of the ramp does not meet the standards for the use of disabled people in general. Some of the slopes are steep, the proportion of 1: 6, which is steeper than that disabled people are able to move up and down by themselves. Many point to rail Route traffic across multiple paths to serve as general entrance buildings 1 and 2 will be used together with the transfer of food. Or disabled access to buildings, hospitals need to walk down the road to get access to services and so on.

The tower is not appropriate

Located in the main building, in the improper access by Center staff and kitchen staff as the food can lead to the building. Building nurse disabled should be easily accessible and safe, but it is far greater than the disabled, remember to arrive in time. If there is an emergency Access the ambulance was not very convenient.

Based on the information received and state issues. The researchers found that the primary focus of the Center for Social Welfare Development elderly home Khae. Nonthaburi problem is the placement of buildings and road projects. This issue affects the providers and recipients of services within the area. The research focus is on the design of the project is to improve the layout. To determine the distance between buildings. Should put an end to the new building. By requiring them to be in the proper position. Taking into account the needs of each service provider and the recipient. Routing and roaming through the various trails in the area. Traffic routes should have continuous access to the center of Ban Bang Khae Social Welfare Development elderly friendly. Not interfere with each other and are safe if there is an emergency.

Results Conclusions

Data from the surveys and interviews, physical involvement with the informant. The research data were analyzed and the draft Plan. The placement of the building System traffic Design environment for the handicapped and disabled. The design approach can be summarized as follows environments.

1) The position of the hospital building - physiotherapy. Buildings and facilities such as the kitchen, office buildings and activities.

2) Route traffic within the Social Welfare Development elderly home Khae. Must be linked together and can shorten the travel time from the overall layout of the original. Either in the form of vehicular traffic and on foot. The width of the thoroughfare for vehicles to facilitate access for large vehicles. For quick service and assistance at the time.

The Rail Master Plan and design a new layout. Representing all sectors of the orphanage for disabled children in Pak Kret. Nonthaburi It offers a detailed layout of a building using segmented by type of building applications. To make it easier to understand Connect and respond to the needs of service providers, all within easy reach. Can be divided into zones as follows.

1.) The building's accessibility. Which classify disabilities are 2 types of people with disabilities and disability. To facilitate the allocation is appropriate to the nature of their disability. Each building will be classified according to specific characteristics such as disability disabled handicapped seat next to the bed with a wheelchair.

2.) Office building The staff work department. Both the Administration Procurement and Maintenance. In addition, the area is welcome to visit the project.

3.) Building nursing and physiotherapy. Placement near a residential building of the handicapped and disabled. Also connected to each other.

4.) The kitchen and dining area. Placed in the area to cater for services in various parts of the hotel.

5.) Auditorium and recreational buildings The area in front of the project It can accommodate a group of visitors in a group then. It is also an area for the joint activities of the disabled and those who visit them.

6.) The shelter's staff and the service provider is separate from the service. To ensure the privacy of its duties.

7.) Size is 2 lane roads surrounding the project. To facilitate And improve the trails for the project to be constantly connected.

The detailed requirements for each of the sub-group of buildings. Need to be designed to contribute more. Since each building is a form of active and functional requirements specific to different away. However, a draft of the Master Plan for Children with Disabilities Pak. Nonthaburi Is the starting point for the development of the quality of life of those involved in the area. This will lead to the development of future projects.

Acknowledgment

Thanks to the staff as well as clients in the orphanage for disabled children in Pak Kret. Nonthaburi province every courtesy, informative and educational activities. To help guide this review article. Which allows participation occurs in almost all stages of education. And encourage studies of this success well.

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NEAR INFRARED SPECTROSCOPY ANALYSIS OF MIXED RAW AND PARBOILED RICE BRAN

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Keywords: Near-infrared spectroscopy (NIRS), rice bran, parboiled rice bran

Abstract. The aim of this study was to employ NIRS for the prediction of mixed rice bran properties. NIR reflectance spectra in the range of 3,600-12,500 cm^{-1} were recorded. Partial least square (PLS) regression was used to develop a calibration equation which was tested with a validation set. The determination coefficient (R^2) for calibration model for moisture, protein, lipid, fiber, ash, carbohydrate, phytic acid, acid value, bulk density and whiteness index was 0.95, 0.96, 0.96, 0.82, 0.89, 0.93, 0.97, 0.96, 0.96, and 0.98, respectively. Root mean square error calibration (RMSEC) was 0.24, 0.19, 0.94, 0.67, 0.30, 1.76, 0.10, 7.63, 0.01, and 0.92, respectively. In addition, the internal validation showed that NIR could be successfully used to predict moisture, protein, lipid, fiber, ash, carbohydrate, phytic acid, acid value, bulk density and whiteness index of mixed rice bran.

Introduction

Near-infrared spectroscopy (NIRS) is a non-destructive fast technique that is capable of analyzing organic substances in a reliable way. NIRS has been applied in authentication processes so as to estimate whether the product is strictly according to the label described or if it complies with the current legislation [1, 2]. This analytical method has presented an important impact in the agriculture and food industry. A large number of analytical methods depend on NIRS have already demonstrated the potentiality of such technique in rapidly and dealing safely with diverse problems such as determining protein, moisture, carbohydrate and fat content in various types of food [3]. The determination methods using NIRS technique provide precise and quick results, with minimal sample preparation and waste generation [4, 5, 6].

Rice bran is the pericarp and germ of *Oryza sativa* L. seeds and compound about 10% of rough rice grain [7]. It consists of three fused layers –pericarp, seed coat, nucellus and aleurone layer. It is a by-product in the milling process and has been used as a raw material for oil source and food ingredient. As Rice bran is the most nutritious part of rice grain, both raw rice bran and its stabilized form can be used for value added product development [8]. The function of rice bran in final products depends greatly on its composition and stabilization. Therefore, the objectives of this experiment were to determine compositions of raw and parboiled, or stabilized, rice brans as well as the mixed samples and used NIRS technique to develop relationship between NIR response and compositions of rice bran samples for the prediction of the samples' properties.

Materials and methods

Samples

A total of 6 rice bran samples; 3 parboiled and 3 raw rice bran, were obtained from 6 mills in Nonthaburi and Nakhon Pathom area.

Samples preparation

The obtained rice bran samples were first strained through a 20-mesh strainer. Then, vacuum packed in an aluminum foil bags and kept in a freezer until further use. To prepare mixed rice samples for the analyses, raw and parboiled rice bran samples were mixed to obtain 6 different proportions from 0:10 to 10:0 (raw rice bran : parboiled rice bran). The samples were prepared in two replications.

Chemical analysis of the sample

Proximate composition of the samples were determined by AOAC (2012) [9]. Hexane was used for crude oil extraction from rice bran samples. Acid value was determined by AOCS. (2003) [10]. Phytic acid was analyzed as per K-PHYT (11/15, Megazyme , Ireland). Whiteness index was analyzed as per Color Chroma Meter (Minolta CR-300 series, Japan) Hunter Color System (L* a* and b*) and Bulk density was determined by AOAC (2005) [11].

Near-infrared analysis

The samples were analyzed using an FT-NIR (MPA, Bruker, German) in reflectance mode. The region measured is between 12,500 to 3,600 cm^{-1} with 16 cm^{-1} of resolution and 32 number of sample scans. Forty (40) g sample was filled in a quartz sample holder and scanned at 25 °C. Six (6) spectra were collected on each sample. The spectra were then averaged to produce a single spectrum for each sample.

Chemometric analyses

The calibration was accomplished by partial least square (PLS) regression and 10 chemical and physical properties data from fresh rice bran samples was carried out using the Unscrambler- ® X version 10.3 software package (CAMO, Norway) with full-spectrum analysis methods.

Rice bran samples were separated into 2 groups, data from 27 samples were used for the development of the calibration model and those from 9 samples were used for the internal validation. The spectra were preprocessed by the combination of several mathematic treatment and all data were mean centered before the calibration, for which was used the PLS regression.

The quality of the models was checked by calculation of the determination coefficient (R^2), root mean square error of calibration (RMSEC), root mean square error of prediction (RMSEP). Values closer to one for R^2 and low value for RMSE indicate the good performance of the model for the prediction of the quality parameters of rice bran samples.

Results and discussion

Composition analysis in mix rice bran

The results obtained in the chemical analysis of the moisture content, crude protein, crude lipid, crude fiber, acid value, phytic acid, bulk density and whiteness index that were used to predict and validate the model are presented in Table 1.

Table 1 Chemical compositions and physical properties of rice bran samples.

Parameter	Range	Mean	SD
Moisture content (%wb)	6.0-10.5	8.2	1.1
Protein (%db)	12.4-16.2	15.3	0.9
Lipid (%db)	14.3-32.0	24.6	4.6
Fiber (%db)	9.5-14.0	11.9	1.6
Ash (%db)	7.8-12.0	9.6	0.8
Carbohydrate (%db)	28.9-53.2	38.7	6.5
Acid value (mg KOH/g oil)	4.0-146.6	48.6	38.3
Phytic acid (g/100g bran)	5.4-7.5	6.2	0.6
Bulk density (g/ml)	0.26-0.42	0.35	0.05
Whiteness index	51.1-74.0	60.7	7.6

SD = standard deviation

Rice bran has the highest carbohydrate content, which lies between 28.9-53.2%db, followed by lipid content, crude protein, crude fiber moisture content and ash content, respectively. The range of compositions, such as lipid, protein, ash, and fiber, found in our study is within close proximity of the value reported by other researchers (Azizah & Luan, 2000) [12]. By analyzing the value of the mean and standard deviation. A huge variability among the samples, especially in the amount of crude lipid and acid value, was observed. This is due to the variation in the samples in this study, that included both raw and stabilized rice bran which were obtained from different rice mills.

Development of calibration models and validation

Fig.1 presents sample untreated spectra obtained from 36 rice bran samples, in the range of 3,600 to 12,500 cm^{-1}. The spectra were pretreated using different mathematical techniques before constituting a calibration model. The best pretreatment method was selected based on the criteria stated earlier.

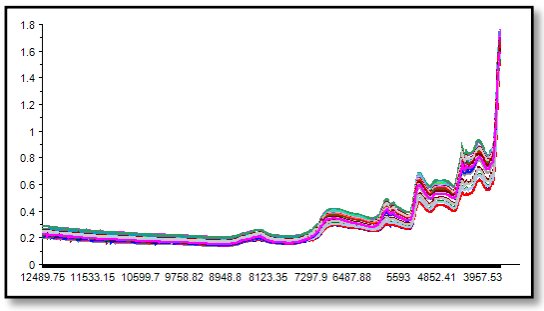

Fig1. The spectra of rice bran obtained from NIR in the range of 12,500 to 3,600 cm^{-1}.

Table 2 summarizes the best pretreatment method selected for model building, as well as the reliability of the constituted model for predicting moisture, protein, lipid, fiber, ash, carbohydrate, acid value, phytic acid, bulk density and whiteness index of the samples. All models presented good correlation between the reference values and the NIR predicted ones.

Table 2 Calibration and external validation to determine the parameters prediction efficiency

Parameter	Pretreatment	Calibration		Validation	
		R^2	RMSEC	R^2	RMSEP
Moisture content (%wb)	Raw spectrum	0.950	0.243	0.921	0.275
Protein (%db)	Raw spectrum	0.959	0.193	0.925	0.209
Lipid (%db)	Raw spectrum	0.958	0.943	0.936	0.985
Fiber (%db)	Raw spectrum	0.816	0.671	0.728	0.742
Ash (%db)	2^{nd} derivative	0.887	0.298	0.486	2.340
Carbohydrate (%db)	Raw spectrum	0.930	1.756	0.884	1.951
Acid value (mg KOH/g oil)	Raw spectrum	0.956	7.626	0.944	9.812
Phytic acid (g/100g bran)	Raw spectrum	0.970	0.098	0.950	0.112
Bulk density (g/ml)	Raw spectrum	0.961	0.009	0.902	0.014
Whiteness index	Raw spectrum	0.976	0.915	0.976	0.838

R^2 - determination coefficient, RMSEC, RMSEP - root mean square error of calibration and prediction

Table 2 also shows that raw NIR spectrum data can be used to correlate with moisture, protein, lipid, fiber, carbohydrate, acid value, phytic acid, bulk density and whiteness index with reasonable R^2. The R^2 of the calibration equation was 0.95, 0.96, 0.96, 0.82, 0.93, 0.96, 0.97,0.96 and 0.98, respectively, while root mean square error calibration (RMSEC) was 0.24, 0.19, 0.94, 0.67, 1.76, 7.63, 0.10, 0.01, and 0.92 respectively. Only the calibration model for ash prediction needed a second derivative pretreated spectra to correlate with the data from chemical analysis.

In addition, internal validation showed that NIR could be successfully used to reasonably predict moisture, protein, lipid, fiber, ash, carbohydrate, phytic acid, acid value, bulk density and whiteness index, with R^2 values in the 0.82 to 0.98 range. The prediction of fiber content gave the lowest R^2 value (0.82) and prediction of whiteness index gave the highest R^2 value (0.98). Fig. 2 shows the reference values, obtained from our laboratory, versus predicted values using NIRS.

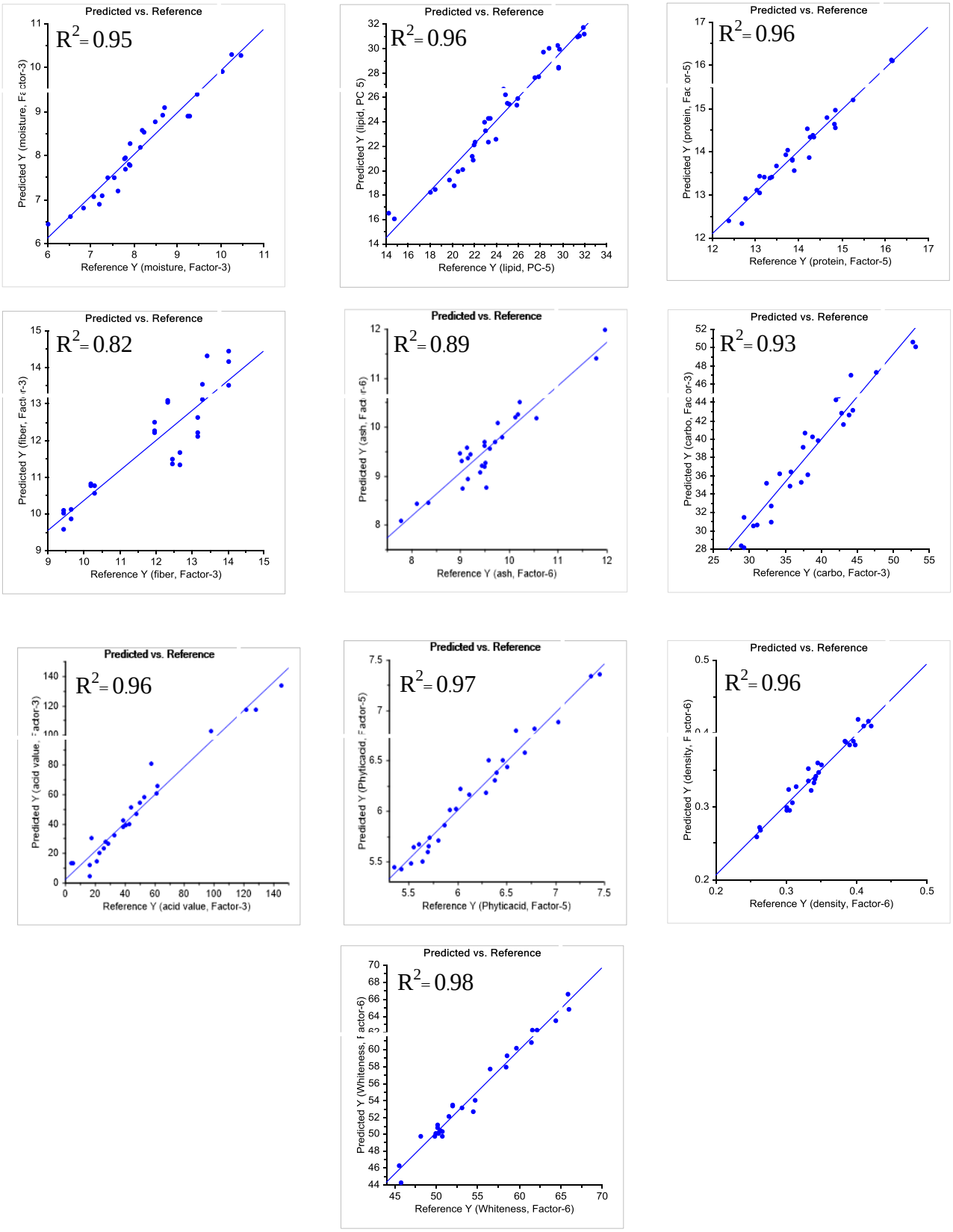

Fig. 2 Reference values versus NIR predicted values plots for moisture, lipid, protein, fiber, ash, carbohydrate, acid value, phytic acid, bulk density and whiteness index of mixed rice bran samples.

Acknowledgement

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OLEAGINOUS YEAST ISOLATED FROM MANGROVE FOREST IN CHANTHABURI PROVINCE AND ITS LIPID PRODUCTION

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Keywords: oleaginous yeast, *Pseudozyma tsukubaensis*, lipid accumulation, growth-associated, glucose solution

Abstract. Intracellular lipid content of 8 yeast strains; *Candida visiwanathii* YMTW12-2, *Debaryomyces vanrijiae* NS4-2, SFL10-1 and SFL17-2SF, *Geotrichum* sp. SRM6-1, *Kodamaea ohmeri* NS9-1, *Pseudozyma tsukubaensis* YWT 7-2, *Rhodosporidium toruloides* FRL2-4; isolated from mangrove forest in Chunthaburi province which showed high lipid accumulation by Nile red staining were quantitatively analysed. The result revealed that *P. tsukubaensis* YWT 7-2 was oleaginous yeasts. Lipid content and lipid yield of the *P. tsukubaensis* YWT 7-2 in high C/N ratio medium (lipid production medium) was compared to those in glucose solution at room temperature (28-30^{0}C), 200 rpm for 6 days. The highest lipid content and lipid yield of the *P. tsukubaensis* YWT 7-2 were 21.90, 18.73 %, w/w (dry cell weight) and 3.35, 1.70 g/l in lipid production medium and glucose solution at 6 and 3 days, respectively. This result indicated that lipid accumulation of the *P. tsukubaensis* YWT 7-2 was growth- associated.

Introduction

At present, biodiesel has gained more attention due to environmental pollution caused by fossil fuel combustion. Biodiesel has similar properties to petroleum diesel and can be used with an existing diesel engine [1]. Moreover, emission of harmful gasses such as sulfur dioxide and carbon dioxide is less than petroleum diesel [2]. In the beginning, biodiesel is produced from edible plant oil by transesterification process. But the use of the edible plant oil for biodiesel production may trigger food-price increase. Therefore, searching for other raw material was carried out. Animal fat, waste of cooking oil and non-edible plant oil were tried. However, resultant oil was not qualified and quantity of oil is insufficient for global biodiesel requirements [3].

Microorganisms such as yeast, bacteria, algae and fungi which are oleaginous accumulate lipid more than 20% of their dry cell weight when grown in high C/N ratio medium [4]. Algae accumulates high lipid but it requires large plantation area, being dependent on seasonality and susceptible to contamination [1]. Bacteria accumulates lipid in outer membrane which makes lipid extraction difficult. Fungi has slow growth rate [5]. While yeast has shorter replication time, assimilates various kinds of sugar including sugar derived from lignocellulose and can be cultivated in fermentor with easy scalability. Yeasts belonged to several genus such as *Candida* sp., *Cryptococcus* sp., *Lipomyces* sp., *Rhodosporidium* sp., *Rhodotorula* sp., *Trichosporon* sp., and *Yarrowia* sp. were reported as oleaginous [6,7].

The purpose of this study is to screen yeasts isolated from mangrove forest in Chanthaburi province for oleaginous and examine its lipid accumulation.

Material and methods

Yeasts. Twenty-nine strains of yeast isolated from mangrove forest in Chunthaburi province and kept at Microbiology department (Room 1804/15), faculty of Science, Chulalongkorn University were used in this study.

Prescreening of high lipid accumulating yeast. Cells of the 29 yeast strains grown on lipid production agar (0.1% yeast extract, 5.0% glucose, 0.1% $(NH_4)_2SO_4$, 0.005% $MgSO_4 \cdot 7H_2O$, 0.1% KH_2PO_4, 0.001% $CaCl_2$, 0.001% NaCl, 2.0% agar (w/v), pH 5.5) [8] at 30 ˚C for 7 days were stainned with Nile red solution for 10 min. Then they were observed under 1000X magnification fluorescence microscope, using excitation and emission wavelength at 470-490 and 520 nm, respectively [9]. Yeast strains which showed oil droplet equal to larger than three quarter of their cell space were selected for further quantitative analysis of intracellular lipid.

Quantitative analysis of intracellular lipid. One loop of yeasts grown on YM agar (0.3% yeast extract, 0.3% malt extract, 1.0% glucose, 0.5% peptone, 2.0% agar (w/v), pH 5.5) were transferred into 50 ml of YM broth in 250 ml flask and incubated at 200 rpm, 30 ˚C for 24 h. Then it was transferred to 90 ml of YM broth in 500 ml flask at 10% (v/v) and incubated at the same condition for 48 h. After centrifugation (8000 rpm, 4 ˚C for 10 min), cell pellet was washed with lipid production medium and transferred to 100 ml of lipid production medium in 500 ml flask and incubated at the same condition for 6 days. After incubation, yeast cells were collected by centrifugation and lyophilized for biomass determination and lipid extraction according to modified method of Zhang et al. (2014) [10]. Briefly, lyophilized cells were extracted with chloroform/ methanol (2:1,v/v), sonicated at 37 kHz for 15 min and centrifuged to collect supernatant. After addition of 0.73% NaCl (w/v) into the supernatant and centrifuged, lipid in supernatant collected was dried at room temperature. Lipid yield (g/l) was calculated from lipid accumulated (g/g dry cell weight) x biomass (g/l).Yeast strain which accumulated lipid more than 20% (w/w) of cell dry weight was selected as oleaginous yeast.

Comparison of lipid accumulation in lipid production medium and 5.0% (w/v) glucose solution. One loop of the selected yeasts was inoculated into 50 ml of YM broth in 250 ml flask and incubated at room temperature, 200 rpm for 24 h. The culture was transferred into 90 ml of YM broth in 500 ml flask at 10% (v/v) and incubated at the same condition for 48 h. Cells collected by centrifugation (4 ˚C, 8000 rpm, 10 min) were washed with lipid production medium or 5.0% (w/v) glucose solution, suspended in lipid production medium or 5.0% glucose solution (100 ml) in 500 ml flask and incubated at room temperature, 200 rpm for 6 days. Every 24 h, cells were harvested by centrifugation, washed with sterile distilled water and lyophilized. Dry cell weight and lipid content were determined as described above. The residual glucose was analyzed by Somogyi-Nelson [11].

Results and discussion

Prescreening of high lipid accumulating yeast. Eight yeast strains showed oil droplet equal to or larger than three quarter of their cell space by Nile red staining (Fig.1).

Quantitative analysis of intracellular lipid. As shown in Table 1, *P. tsukubaensis* YWT7-2 was oleaginous yeasts due to their lipid content of 31.36% w/w, dry cell wt. *P. tsukubaensis* has been reported as various biocompound producers such as biosurfactants [12], galactooligosaccharides [13] and fungicide [14]. This is the first time to report that *P. tsukubaensis* was oleaginous yeast.

Table1. Lipid content, biomass and lipid yield of the 8 yeast strains.

Strains	Lipid content [% w/w]	Biomass [g/l]	Lipid yield [g/l]
C. visiwanathii YMTW12-2	3.67	7.98	0.29
D. vanrijiae NS4-2	9.19	12.10	1.11
D. vanrijiae SFL10-1	7.20	5.87	0.42
D. vanrijiae SFL17-2SF	3.31	6.26	0.21
Geotrichum sp. SRM6-1	4.76	10.50	0.50
K. ohmeri NS9-1	3.30	12.72	0.42
P. tsukubaensis YWT 7-2	31.36	9.8	3.07
R. toruloides FRL2-4	6.80	10.80	0.73

Comparison of lipid accumulation in lipid production medium and 5.0% (w/v) glucose solution. *P. tsukubaensis* YWT7-2 suspended in lipid production medium had the highest lipid content, biomass and lipid yield at 6 days. The highest lipid content, biomass and lipid yield were 21.90% w/w, dry cell weight, 15.28 g/l and 3.35 g/l, respectively (Fig. 2a). When suspended in 5.0% (w/v) glucose solution, its lipid content and lipid yield were highest (18.73%, w/w dry cell weight and 1.70 g/l respectively) at 3 days. While its biomass was highest (9.95 g/l) at 6 days (Fig 2b). The lipid content and lipid yield of YWT7-2 suspended in lipid production medium were higher than in 5.0% glucose solution. This result indicated that *P. tsukubaensis* YWT7-2 required nutrients for enzyme biosynthesis before shifting excess carbon in energytic pathway to lipid biosynthetic pathway. The process is known as growth-associated lipid accumulation pathway. *Lipomyces starkeyi* AS. 2.1560 accumulated intracellular lipid through non-growth associated pathway [15].

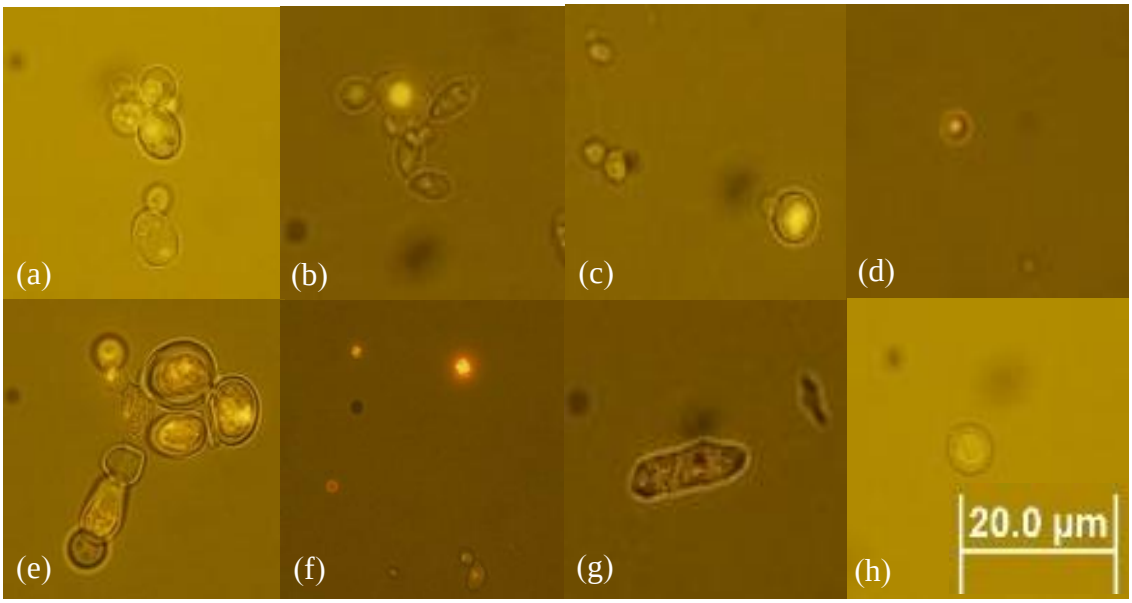

Fig.1 The 8 strains; *Candida visiwanathii* YMTW12-2 (a), *Debaryomyces vanrijiae* NS4-2 (b), *D. vanrijiae* SFL10-1(c), *D. vanrijiae* SFL17-2SF (d), *Geotrichum* sp. SRM6-1 (e), *Kodamaea ohmeri* NS9-1(f), *Pseudozyma tsukubaensis* YWT 7-2 (g), and *Rhodosporidium toruloides* FRL2-4 (h), showed oil droplet equal to or larger than three quarter of their cell space by Nile red staining.

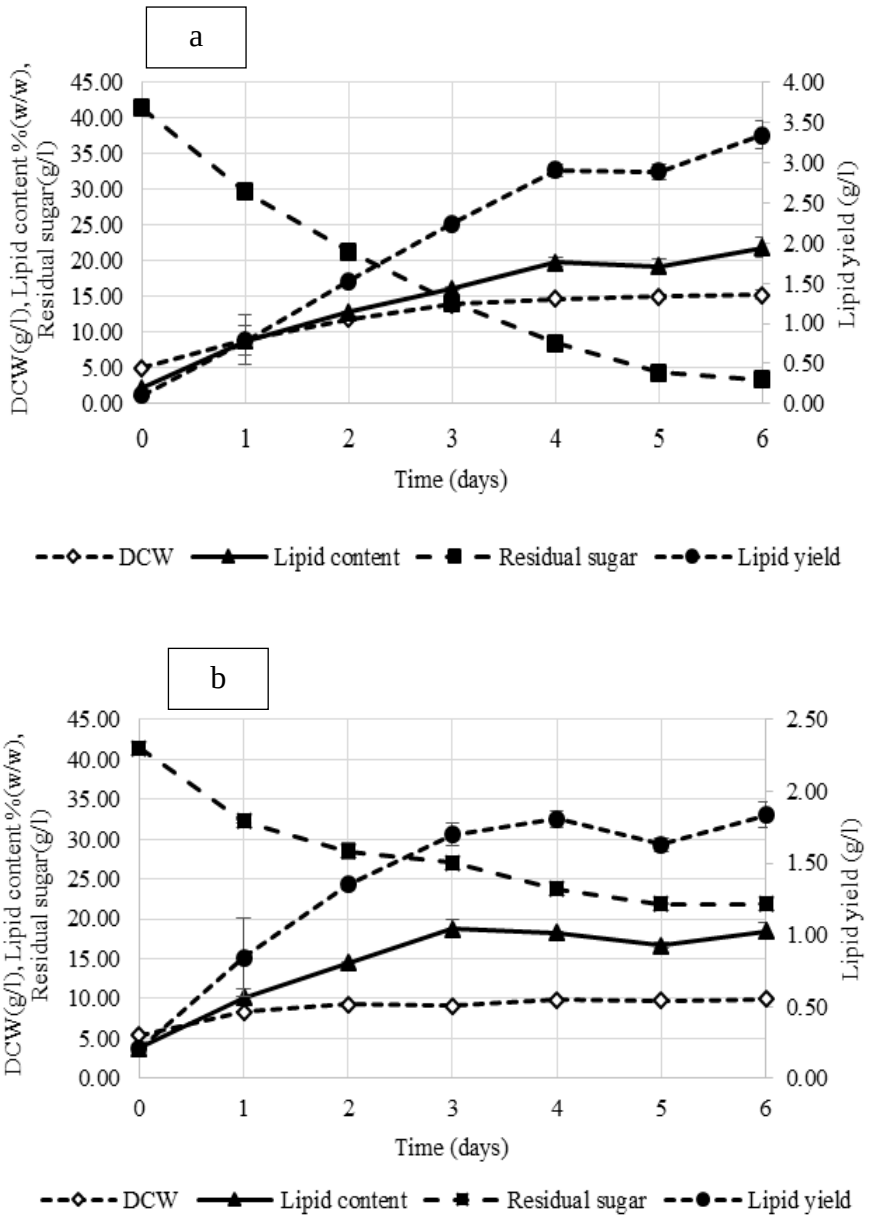

Fig. 2 Lipid production profile of *P. tsukubaensis* YWT7-2 when suspended in lipid production medium (a), 5.0% (w/v) glucose solution (b).

Summary

P. tsukubaensis YWT7-2 was oleaginous yeasts. In lipid production medium, their lipid content and lipid yield were 21.90% w/w of dry cell weight and 3.35 g/l, respectively at room temperature. Their lipid accumulation pathway was growth-associated.

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The design environment to respond to use for people with disabilities and disabilities case study: to improve the environment of the Development Center of Social Welfare elder home, Bangkok.

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Keywords: Design environment, People with disabilities and disability, Social Welfare Development Center for the Elderly

Introduction

With an average rate increase of 1 million people per year, most disabled people with health problems and a higher risk of health problems than the general population. A key element of the problem is that people with disabilities have limited health care. Including the ability to take care of themselves than people who have normal body. There are certain types of people with disabilities who have the disorder than the general disability. Need to be taken care of than normal. The cause and the problem. The government has set up an agency or shelter. Care to assist those with disabilities. Agencies are spread out geographically in order to assist and care for the disabled, these thoroughly. To be able to care for and help themselves. Improves quality of life and care as a fundamental right which should be given.

Center for Social Welfare Development elderly home Khae. Bangkok Has opened a service and support for a long period and with disabled people and disability used a lot. The current state of disrepair The area should be designed and updated as appropriate. This will allow service providers. Disabled disability and quality of life improved. Education about the need for space applications is an important issue. Spatial needs to be aligned to real world applications. This will entail improving the quality of life in elderly homes Social Welfare Development Center Khae. Bangkok

In this study, Oriented education to fix problems in the design environment to respond to applications for people with disabilities and disability in elderly homes Social Welfare Development Center Khae. Bangkok, researchers used data collection methods used by the target group. Focus on the involvement of people living in the area. By the authorities and local residents to participate in all activities in the research.

Literature References

Researchers have studied the concepts and theories related to research and research methodology. The content is divided into four categories: the definition of disability. Types of disability and welfare Participatory design and design of shelters and standards for road design for people with disabilities

Definition of disability

Patip Assawaphom (2013) argue that the disabled population is important to the nation in many ways, but the well-being of people with disabilities is often neglected by the society. The environment is not easy to live. Attitude of people in society toward the disabled. Understanding disability is essential. As a result, the society recognizes the importance of such matters. This will lead to help and support to enable people with disabilities to live like people.

The Act on Promotion and Development of the Quality of Life of People with Disabilities, 2007, under Section 4, provides the meaning of the disabled. "Individuals who have limited access to daily activities. Or take part in social activities. They have a deficiency in seeing, hearing, movement, communication, mind, emotion, behavior, intelligence, learning, or other defect. There are obstacles in various areas and there is a special need to get help on one side in order to be able to practice activities. In daily life or in social participation as guests.

From the definition above. Medical definition in the view of disability is a problem and obstacle in the normal life. The attitude about the disabled is that people need special care. But definition of disability in the social dimension. I think that people with disabilities are human equal to everyone. It is the duty of the society to promote the participation of people with disabilities in public activities.

The type of disability and welfare

Currently, there are many types of disabilities. Each type of defect are different away. The aid scheme is different. Sorting disabled by the Ministry of Social Development and Human Security disability guidelines on the type and No. 2, 2555 were categorized into 7 types of disabilities, including the visually impaired. Hearing disability or meaningful. Disability or physical movement. Disability, mental disability or behavioral intelligence. Learning Disabilities Disabilities and autism. (Ministry of Social Development and Human Security, 2555).

Center for Social Welfare Development elderly home Khae. Bangkok Set up with the purpose of restoring health. Mental health and rights of people with disabilities. The optimum age of neglected and abandoned by their families and society. The optimum age for dependents aged 60 years and over who have contagious diseases. And people with physical disabilities or brain, and can help them in their daily lives. homeless Can not live with the family The orphanage will assist with the development and rehabilitation in areas they can help themselves. The purpose of this educational institution. Is another way to help designers understand the special nature and needs of different people. This will be used to guide the design. Improve the environment as well as allowing service providers to prioritize applications, which can increase the performance and speed of access to the service appropriately fast.

Design involved

Design participatory process that encourages stakeholders to exchange ideas. Offer solutions and create an understanding of the design work together. This will lead to the creation of partnerships for all parties. The decision to participate in the design process Information must come from those who actually use the building. This will create a sense of ownership. It also provides an opportunity to use the space to display their own needs. This approach brings to the design and the solutions to the problems which have come from the real needs (Nuntiya Hatanuwat and Narong Hutanuwat,2004).

Designed to foster and design standards for the disabled

Design Development Center for Social Welfare of the elderly. A key element to take into account the 4: 1) the composition of the primary users and secondary users such as service providers and service recipients, 2) component activities include the type of activity. Patterns of user behavior and characteristics in building support for activities 3) the location and the surrounding environment. Access to the building The social, cultural, and 4) economic factors include the budget to invest in building new or remodeling. Sources of funding The design may be more specific to different environmental conditions conducive to use. And facilities

Guide "recommendations designed facilities for all" has been identified as a thoroughfare that allows disabled people who can use it easily. To focus on two issues, namely the width of the path and the slope of the thoroughfare. The proper width will range between 0.90 to 1.50 meters and a slope of at least 1:12 if the ramp is longer than 2.50 meters must have handrails on both sides. If the length of the ramp-up period of 6.00 meters to a landing ramp has a width of 1.50 m, the surface of the ramp must not slip material is suitable for use. (Association of Siamese Architects under Royal Patronage, 2015).

Method

In the process of data collection The researchers conducted a survey of data center physical development, social welfare, the elderly home Khae. Bangkok The interviews are the primary means of storing data with the stored image and to create an environment within the actual project. The research was conducted into space three times. The physical storage conditions and issues twice. Co-designed with participation once again.

The survey for the first time on December 4, 2018 with the objective to explore and visit. The Center for Social Welfare Development elderly home Khae includes executive agencies. Procurement Officer Nurses Mentors, as well as provide more frequent. To get information about the place and the overall issues in general. The information is used to guide the research and plans are preliminary. Later on January 12, 2018, the researcher has studied the area again to collect insights. By means of interviews and participatory observation in detail. To understand the current conditions. Joint analysis of the problems and the needs of the staff interviewed in all sectors. The data were analyzed in order to design an environment for people with disabilities and disability in the initial stage to be used in preparing the detailed design.

The sample consisted of interviews, the researchers selected a group of nurses, nurse aides, office staff and maintenance technicians within the Social Welfare Development Center for the Elderly. Because the sample is based on those who actually work in practice. Information can be clearly Unlike patients who are handicapped and disabled. These groups, which are limited in their ability to provide information on the spatial applications. The researchers relied on data from the first sample-based.

On the 3rd day of March 27, 2561 were prepared and used in the design of the important issues that are involved. Using the information from the interview. Observations used as a guide to create the drawing. Environment Design Center's new home Khae Social Welfare Development elderly. And such an approach to be presented with the information from the various departments. The audience follows: An executive agency of the first group of 12 providers and patients or those with disabilities who can communicate for 3 people. All participants can provide feedback and share ideas and make suggestions. To be used in the design environment. The layout of the building The new system, roaming the area with investigators. To make sure that all the parties. The draft development plan for the project can be used to cause a real interest in the work. It also can be used as a document presenting the budget to develop a Social Welfare Development elderly Khae home for senior decision further.

Case study

Center for Social Welfare Development elderly home Khae. Bangkok With a total area of 67 acres with buildings for a total of 18 buildings divided into seven buildings, service buildings and other buildings of 11 buildings, all with a single-storey building. All the information in Dalmatia Derived from a joint survey and interview with nurse mentors and service providers in the Social Welfare Development Center for the Elderly Home Khae. Bangkok

Results Conclusions

Barriers that result in inconvenience and delay in providing and receiving services today can be split into two major areas: the problems and difficulties of the route within the area of the building.

Obstacles caused by road traffic.

The main obstacle occurs within the area. To modify applications that change based on actual usage in the area. The use of the building, according to the circumstances of each activity such as the increase in residential building handicapped and disabled. It was found that there were more people with disabilities. Issue of a thoroughfare for vehicles and pedestrians occur immediately. The main route for commuters currently used mainly by vehicles. Nature trails current bridge is narrow and steep. The center provides access to the Social Welfare Development elderly home Khae continued inconvenience. The road project is currently not linked to each other where possible. Make car travel Not accessible in all areas within the project. The land is still at large. Roads within the current size of just 4 meters, resulting in the car can run only one lane. It is impossible to access the building thoroughly. If there is an emergency such as a fire. It may be that the fire will not reach the scene within a timely manner.

Both those with disabilities and service providers need to walk down the street with the car at some point. Although the wide walkways are wide enough for the use of disabled people, especially disabled people who use wheelchairs. The areas covered. Nevertheless, the slope of the ramp does not meet the standards for the use of disabled people in general. Some of the slopes are steep, the proportion of 1: 6, which is steeper than that disabled people are able to move up and down by themselves. Many point to rail Route traffic across multiple paths to serve as general entrance buildings 1 and 2 will be used together with the transfer of food. Or disabled access to buildings, hospitals need to walk down the road to get access to services and so on.

The tower is not appropriate

Located in the main building, in the improper access by Center staff and kitchen staff as the food can lead to the building. Building nurse disabled should be easily accessible and safe, but it is far greater than the disabled, remember to arrive in time. If there is an emergency Access the ambulance was not very convenient.

Based on the information received and state issues. The researchers found that the primary focus of the Center for Social Welfare Development elderly home Khae problem is the placement of buildings and road projects. This issue affects the providers and recipients of services within the area. The research focus is on the design of the project is to improve the layout. To determine the distance between buildings. Should put an end to the new building. By requiring them to be in the proper position. Taking into account the needs of each service provider and the recipient. Routing and roaming through the various trails in the area. Traffic routes should have continuous access to the center of Ban Bang Khae Social Welfare Development elderly friendly. Not interfere with each other and are safe if there is an emergency.

Results Conclusions

Data from the surveys and interviews, physical involvement with the informant. The research data were analyzed and the draft Plan. The placement of the building System traffic Design

environment for the handicapped and disabled. The design approach can be summarized as follows environments.

1) The position of the hospital building - physiotherapy. Buildings and facilities such as the kitchen, office buildings and activities.

2) route traffic within the Social Welfare Development elderly home Khae. Must be linked together and can shorten the travel time from the overall layout of the original. Either in the form of vehicular traffic and on foot. The width of the thoroughfare for vehicles to facilitate access for large vehicles. For quick service and assistance at the time.

The Rail Master Plan and design a new layout. Representing all sectors of the Center for Social Welfare Development elderly home Khae. Bangkok has offered a detailed layout of a building using segmented by type of building applications. To make it easier to understand Connect and respond to the needs of service providers, all within easy reach. Can be divided into zones as follows.

1.) The building's accessibility. Which classify disabilities are 2 types of people with disabilities and disability. To facilitate the allocation is appropriate to the nature of their disability. Each building will be classified according to specific characteristics such as disability disabled handicapped seat next to the bed with a wheelchair.

2.) Office building The staff work department. Both the Administration Procurement and Maintenance. In addition, the area is welcome to visit the project.

3.) Building nursing and physiotherapy. Placement near a residential building of the handicapped and disabled. Also connected to each other.

4.) The kitchen and dining area. Placed in the area to cater for services in various parts of the hotel.

5.) Auditorium and recreational buildings The area in front of the project It can accommodate a group of visitors in a group then. It is also an area for the joint activities of the disabled and those who visit them.

6.) The shelter's staff and the service provider is separate from the service. To ensure the privacy of its duties.

7.) Size is 2 lane roads surrounding the project. To facilitate And improve the trails for the project to be constantly connected.

The detailed requirements for each of the sub-group of buildings. Need to be designed to contribute more. Since each building is a form of active and functional requirements specific to different away. However, a draft of the Master Plan for Social Welfare Development Center for the Elderly Home Khae. Is the starting point for the development of the quality of life of those involved in the area. This will lead to the development of future projects.

Acknowledgment

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THE INFLUENCE OF PREBIOTIC TYPES (GOS AND FOS) AND FAT CONTENT ON THE CHEMICAL, PHYSICAL AND SENSORY CHARACTERISTIC OF YOGHURT ICE CREAM AND MIX

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Abstract

Yogurt ice cream (YIC) containing prebiotics as nutrient enhancing sources for probiotics has been popular due to its taste and its advantage on gastrointestinal tract. However, using galacto-oligosaccharides (GOS) and fructo-oligosaccharides (FOS) (0, 1, and 2%) as prebiotic and varying fat content (2 and 10% as LYIC and FYIC, respectively) in YIC might affect its chemical, physical and sensory properties. The results showed that pH of FYIC mix was lower than that of LYIC mix. Fat content and prebiotic type did not significantly affect the total acidity of the mix. The increase of fat content significantly increased the fat particle size however, both prebiotics could reduce the size of fat in FYIC mix. Higher fat content and prebiotic types gave a higher solid-like behavior of YIC mix however, FOS seemed to enhance the solid-like behavior rather than GOS. When the mix was whipped and frozen, GOS or FOS could reduce hardness of YIC however, FOS seemed to enhance the hardness rather than GOS. High fat content significantly decreased melting rate of the ice cream. The highest hedonic sensorial score on overall acceptance was found in FYIC with 2% FOS, compared to the rest of all samples. Conclusively, prebiotics and fat content used in this study truly impacted to the chemical, physical and sensorial characteristics of the ice cream mix and YIC.

Introduction

Nowadays, the demand for functional foods has increased continuously because of consumers pay more attention on their health. Yoghurt ice cream (YIC) is one of famous dairy products, which such consumers still favor [8] but question about its benefit for their health. Addition of prebiotic is a choice to answer the consumers' concern. YIC is a fermented frozen dairy dessert; it is a combination of physical characteristics of ice cream with the sensory and nutritional properties of fermented milk products. However, prebiotic might have affected to ice cream and ice cream mix properties.

Prebiotics are thus a sub-category of functional food ingredients and can be added to many foods including yoghurts, cereals, breads, milk, ice creams and drinks [5]. Prebiotics are an oligosaccharide containing a small number (typically 2 - 10) of simple sugars (monosaccharides). The prebiotic concept considers that many health promoting microorganisms, such as bifidobacteria and lactobacilli, are already present in the human colon. Oligosaccharides are carbohydrates consisting of 3 to 9 saccharide units, while polysaccharides consist of 10 or more saccharide units. Some prebiotics occur naturally in several foods such as leeks, asparagus, chicory, Jerusalem artichokes, garlic, onions, wheat and oats as well as soybeans.

Currently, prebiotic, such as fructo-oligosaccharides (FOS) and galacto-oligosaccharides (GOS) have more interest for food applications. There are non-digestible carbohydrates that increase the colonic microorganism to balance. FOS is fructose oligomers, which are found in many vegetables, derived from inulin but it has a shorter chain. GOS consists of short chains of galactose molecules, derived from digestion of lactose with the β-galactosidases enzyme. Both of FOS and GOS are known as prebiotic that could stimulate the survival of probiotic in gastrointestinal tract. However, addition of such prebiotics might affect the physicochemical

properties of ice cream. Thus, the objective of this study was to determine the effects of prebiotics (GOS and FOS) and fat content on the chemical, physical and sensory characteristic of yoghurt ice cream and mix.

Methodology

Ice cream ingredients

Butter fat with 99% fat content and stabilizer (Fulfil 400, SKW Biosystems, Fr ance) was supplied from Vicchi Enterprise Co., LTD (Bangkok, Thailand), sugar with 0.04% moisture content was a contribution of Mitrphol group (Bangkok, Thailand). Other ingredients for YIC mix including glucose syrup (10-12 DE) was obtained from Thai glucose Co., LTD, skim milk with 4% moisture content was purchased from Thaifood and chemical Co., LTD (Fonterra, Wellington, New Zealand) and prebiotic (GOS 55% syrup, pH 3.0-5.5 was obtain from Yakult Pharmaceutical Industry, Tokyo, Japan and FOS 90% powder was purchased from Sigma-Aldrich, St. Louis, Missouri, USA).

Ice cream preparation

Yoghurt was prepared by mixing Thermophilic YoFlex® culture (Chr. Hansen, Hoers Holm, Denmark) and pasteurized milk containing 2% skim milk powder. Then, this mix was kept at 43˚C for 5 hours or until pH drop to 4.6. This condition provided the sour curd of yoghurt. The yoghurt was kept in a refrigerator immediately to prevent the further fermentation. The mix of YIC was formulated following table 1.

Table 1. Ice cream mix formulations

Formulas	Code	Skim milk powder	Sugar	Glucose syrup	Fat	Stabilizer	FOS	GOS
Control Fat 2%	C2	13	11	6	2	0.4	-	-
Control Fat 10%	C10	13	11	6	10	0.4	-	-
Fat 2%+ FOS 1%	F2-1	13	11	6	2	0.4	1	-
Fat 2% + FOS 2%	F2-2	13	11	6	2	0.4	2	-
Fat 10% + FOS 1%	F10-1	13	11	6	10	0.4	1	-
Fat 10% + FOS 1%	F10-2	13	11	6	10	0.4	2	-
Fat 2% + GOS 1%	G2-1	13	11	6	2	0.4	-	1
Fat 2% + GOS 2%	G2-2	13	11	6	2	0.4	-	2
Fat 10% + FOS 1%	G10-1	13	11	6	10	0.4	-	1
Fat 10% + FOS 2%	G10-2	13	11	6	10	0.4	-	2

To prepare the ice cream mix, glucose syrup and butter fat were mixed in the water and heated to 60°C. Then a mixture of skim milk, sugar, stabilizer and prebiotic (GOS; Yakult Pharmaceutical Industry, Tokyo, Japan and FOS; Sigma-Aldrich, St. Louis, Missouri, USA) were added until the mix had fully melted. The mix was pasteurized at 80°C for 1 minute and then was homogenized by two-stage homogenizer at 2000/500psi (Model 2000, APV Lab Homogenizer, APV, Alberts Lund, Denmark). Then, the mix was cooled to 4°C in ice batch and refrigerated at 4°C overnight in refrigerator (Model SPA-0303D41A, Sanden intercool, Thailand) for aging step.

After aging, the 20% yoghurt were add into the ice cream mix (based on total mix weight). Then, mix was frozen in batch ice cream freezer (103-34, Taylor, Illinois, USA) for 15 minute with the drawing temperature was around -6˚C. The YIC was packed in 30 ml plastic cups and stored at -20˚C for hardening in freezer (Model SNQ0103-170100063, Sanden intercool, Thailand).

Chemical Analysis

A measure of acidity and alkalinity in terms of potential of hydrogen (pH) of melted YIC was measured by digital pH meter (MP220, Mettler Toledo, Greifensee, Switzerland). Total acidity was measured by titration 10g of melted YIC with 0.1N NaOH

Physical Analysis

Overrun of YIC was determined following Thaiudom, Singchan and Saeli (2008) [16]. Using the following equation:

$$\%\text{Overrun (Constant volume)} = (\text{mix weight} - \text{ice cream weight})/\text{ice cream weight} \times 100 \quad (1)$$

Fat particle size measurement was adapted from Marzo et al. (2016) using laser scattering particle size distribution analyzer (LA-950V2, Horiba, Tokyo, Japan) [4]. The refractive index for the particles (milk fat) and the suspending medium (water) was set at 1.458 and 1.33, respectively. The parameter reported as particle size distribution d(0.5) is the median of volume distribution. The median size of fat particles of sample was collected and represented to fat particle size of YIC mix.

Melting rate analysis was adapted from Muse and Hartel (2004) [9]. The YIC was stored in a 30 ml plastic cup (ϕ 50 mm) at -20 ˚C and placed on top of a sieve that supported with beaker below in the temperature control room (25˚C). Then, weight of melted YIC in the beaker was carried out every 10 minutes for 1 hours. Melting rate calculation as a slope of plotting melted YIC weight versus testing times was detected.

Analysis of hardness was modified from Javidi et al. (2015) using Texture Analyzer (Stable Micro System, TA-XT plus, Surrey, England) with P/2 cylindrical probe [6]. The YIC stored in a 30 ml plastic cup (ϕ 50 mm) at -20 ˚C was pressed at speed 2 mm/second for 15 mm of testing depth. The determination of hardness was measured from the peak compression force during penetration.

The rheological properties of YIC mix were evaluated following Adapa et al. (2000) with a little modification [12]. YIC mix was determined in a frequency sweep test mode at 0.1-5 times per second with torque 0.2 µNm using Rheometer (AR-G2 Rheometer, TA Instruments, New Castle, USA). The 1 degree angle of cone and plate probe with 27 µm gap was used for this measurement. All samples were placed on temperature-controlled plate at 4^{o}C for at least 1 min before the measurement. Linear viscosity region (LVR) was examined with a mode of torque sweep at 0.08 Hz of frequency before the frequency sweep test. The LVR was in the range of 0.1-1 µNm. Storage modulus (G'), loss modulus (G") and loss tangent (tanδ) were determined.

The sensory evaluation of YIC was determined using hedonic 9 point scale-acceptance test (1 = extremely unlike and 9 = extremely like) by 30 consumer panels. The acceptance of color, flavor, sweetness, sourness, firmness, sandiness, melting behavior, and overall acceptance were evaluated. Since the limitation of human tasting in sensory evaluation, The Balance Incomplete Block design (BIB) with t = 10, r = 9, b = 30, k = 3 was used

Statistical analysis

All statistical analyses were analyzed using SPSS Statistics 17.0. The mean difference among groups were determined by Duncan's Multiple Range Test (MRT). All samples were produced in a duplicate. All measurements were done in a triplicate.

Results and Discussion:

Chemical and Physical properties

The results showed that FYIC possessed lower pH than LYIC (Table 2). The decreased pH in FYIC might be attributed to the higher fatty acid content compared to the one in LYIC [7].

For the result of total acidity, all samples non-significantly gave the same total acidity value. From a point of view of YIC, generally, a lower pH could be occurred because of the presence of lactic acid produced from yoghurt microorganisms. All samples used in this study contained the same level of 20% yoghurt, consequential in the same amount of lactic acid. This was relevant to

Pinto et al. (2012) who described that there was not significant in a change of total acidity of frozen yoghurt containing microencapsulated *Bifidobacterium* BB-12 [14].

Overrun of all samples was about 32-35% (Table 2). Addition of GOS and FOS did not significantly increase or decrease the overrun of YIC. The major factor of overrun are operating time and machine performance; in this study, we use laboratory-scale batch freezer, which might give a lower overrun compared to the continuous freezer which generally gave an overrun value up to100%. However, the figure 4 shows the many small air cells in YIC comprising prebiotics rather than those in control. This exhibited that the small air cells did not affect the overrun in this study at all.

The result of fat particle size is shown in Table 2. Increasing of fat content in FYIC presented a bigger particle than LYIC because the more fat content existed; the more fat coalescence could happen. Consequently, the occurrence of fat coalescence in LYIC, possessing the amount of fat also small, was lower than that in FYIC. However, the addition of prebiotic, especially FOS, could decrease the size of fat particle in FYIC. This might be because GOS and FOS could prevent fat coalescence by blocking the opportunity of colliding among fat particles in FYIC.

Table 2. Chemical and Physical properties of yoghurt ice cream

Sample	pH	Total acidity [%]	Overrun [%]	Fat particle size [µm]
C2	6.464^{b}	0.289^{ns}	33.04^{ns}	0.25736^{a}
G2-1	6.447^{ab}	0.279^{ns}	34.86^{ns}	0.23105^{a}
G2-2	6.449^{ab}	0.276^{ns}	34.30^{ns}	0.22300^{a}
F2-1	6.454^{b}	0.265^{ns}	34.42^{ns}	0.22198^{a}
F2-2	6.463^{b}	0.272^{ns}	35.36^{ns}	0.21595^{a}
C10	6.433^{a}	0.273^{ns}	34.27^{ns}	1.09153^{d}
G10-1	6.429^{a}	0.285^{ns}	34.57^{ns}	1.01056^{c}
G10-2	6.433^{a}	0.279^{ns}	35.80^{ns}	1.00952^{c}
F10-1	6.429^{a}	0.277^{ns}	34.62^{ns}	0.99850^{c}
F10-2	6.432^{a}	0.272^{ns}	34.74^{ns}	0.92681^{b}

$^{a-c}$ Means in the same column followed by letters were significantly different ($\rho<0.05$)

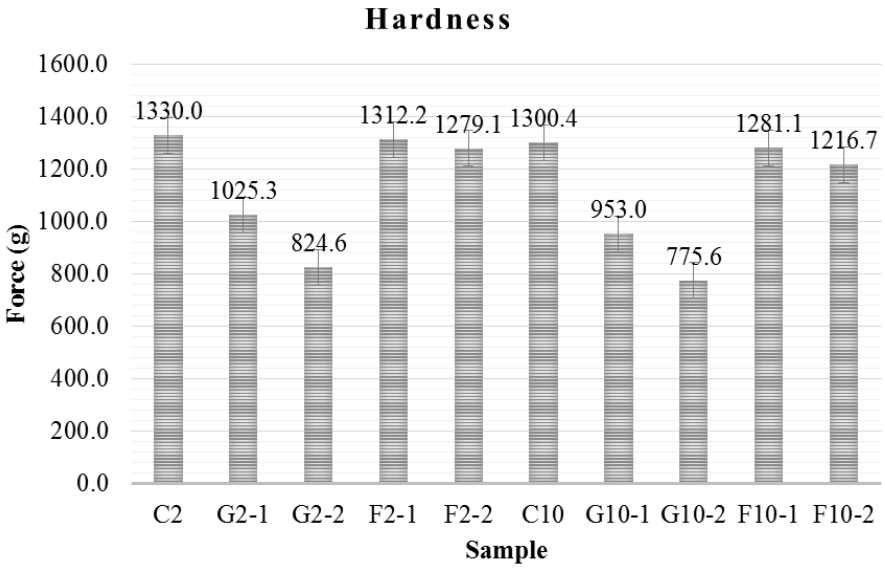

Fig. 1 The hardness of yoghurt ice cream

For the hardness, LYIC possessed a higher hardness than FYIC (Fig. 2). This might be because the proportion of water in LYIC was higher than that in FYIC (calculated based on the subtraction of amount of fat content in the formula). Thus, a higher amount of water in LYIC could be frozen and transferred to be the ice crystals rather than water in FYIC. The more ice in the ice cream presented, the lower the depth of penetration by Texture Analyzer could be done, resulting in a harder sample [9]. Thus, remarkably, the hardness in this case was affected by amount of water rather than amount of fat content. Generally, the more fat content, the more easily penetrated and softer texture of ice cream [1]. However, the increasing of GOS and FOS showed the decreasing of hardness. The use of GOS and FOS gave a lot of air cell than the control sample. This caused the softer texture in such ice cream [10].

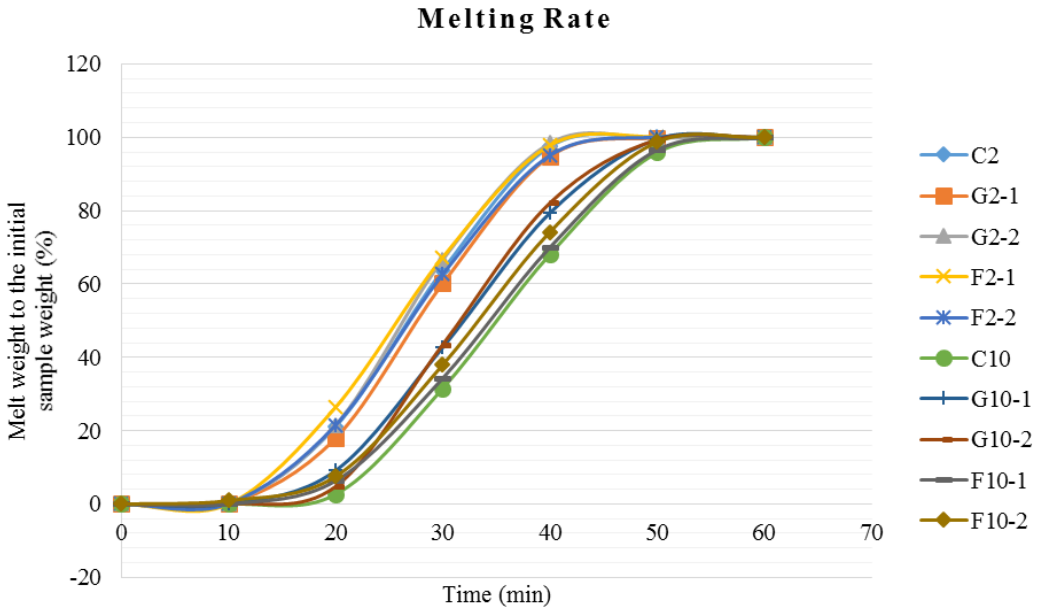

Fig. 2 The melting rate of yoghurt ice cream

For the melting rate (Fig. 3), high fat content could decrease the melting rate of samples because higher fat particles assisted the air cell in YIC more stable by entrapping the air cells into fat networks [9]. With higher amount of fat networks from fat coalescence during aging process and many air cells during the whipping process of ice cream making, this could act as an insulator to prevent heat from outside transferring into the ice cream [15]. This subsequently exhibited a less melting of ice cream. Moreover, our results showed that the ice cream with higher fat content was softer and had a lower melting rate, relevant to a work of Alamprese et al. (2002) [2]. Moreover, the addition of GOS and FOS, short chain of oligosaccharide, into YIC could enhance the concentration in unfrozen serum phase in ice cream, resulting in freezing point depression. This could influence to the softer texture and higher melting rate of such ice cream. Thus, prebiotic and fat content seemed to affect the physical and chemical properties of such ice cream.

The lower tanδ was found in LYIC mix compared to FYIC when the frequency applied to the sample was increased. This means that the FYIC possessed the solid-like behavior rather than LYIC. This was relevant to the research results of Adapa et al. (2000) that increasing in fat content to the ice cream resulted in high elastic property and low tanδ [12]. Moreover, an increase of fat content also increased the viscosity of ice cream mix when compared to the ice cream with low level of fat [11]. The addition of both prebiotics could increase the viscosity of ice cream mix because of these prebiotics possessed their long chain structure which could absorb and hold the water within their molecules, resulting in increasing of the mix. However, addition of FOS seemed to increase the viscosity and solid-like behavior but decrease tan δ rather than addition of GOS since FOS had the longer backbone chain (containing C 3-9 molecules) than that of GOS (having C 2-5

molecules) [4]. This was agreed with the work of Balthazar et al. (2017) [3]. Moreover, increasing in the concentration of FOS from 1% to 2% or 0% to 1% could reduce the tanδ significantly.

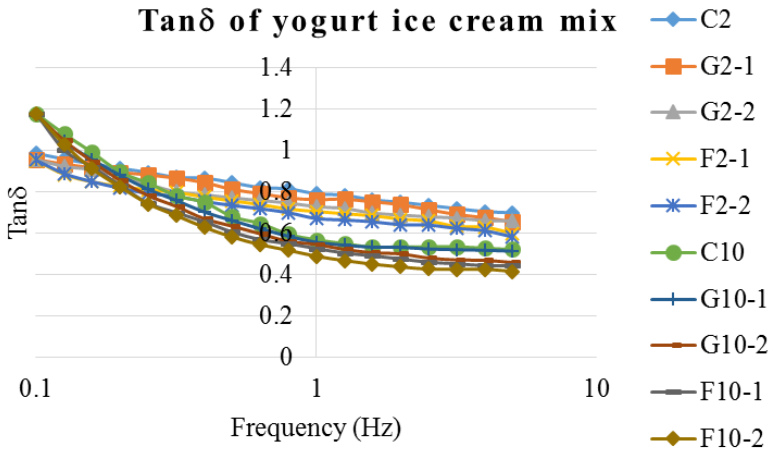

Fig. 3 The reology of yoghurt ice cream

For the sensory evaluation (Table 3), color, flavor, sweetness, sourness, sandiness, and melting in the mouth of each YIC were not significantly different. This might be because all YIC containing the same amount of yoghurt. This confirmed that fat content and type of prebiotic did not affect those sensorial characteristics of YIC. However, the firmness and overall acceptance of each YIC were significantly different. Firmness of all FYIC was higher than that of all LYIC, except in C2 and F2-2. This might be due to the higher amount of fat content in that ice cream could form more three dimension networks of fat rather than that in LYIC. For the overall acceptance, all samples of ice cream were scored at very high (about 6 to 8) but the samples of G2-2, C10, F10-1, and F10-2 had the highest score from the evaluation. This might be due to the personal liking of each panelist. However, form the panelist comments, smoothness, creamy taste, and feeling of fatty taste were also noted in FYIC rather than in LYIC which was agreed with Soukoulis et al. (2014) [13] and Isik et al. (2011) [11].

Table 3. Sensory evaluation scores

Sample	Appearance^{ns}	Yogurt Flavor^{ns}	Sweet^{ns}	Sour^{ns}	Firmness	Sandiness^{ns}	Melting behavior^{ns}	Overall Acceptance
C2	7.11	6.00	5.44	4.89	6.44^{ab}	4.67	5.89	6.33^{a}
G2-1	6.56	5.56	6.00	4.56	5.22^{b}	5.11	5.89	6.22^{a}
G2-2	7.22	5.89	5.00	4.56	5.89^{b}	6.11	6.56	6.89^{b}
F2-1	5.67	5.22	6.33	5.00	5.89^{b}	5.56	5.33	5.89^{a}
F2-2	6.56	5.44	4.44	3.78	6.11^{ab}	5.56	6.33	6.56^{a}
C10	6.11	5.56	5.00	4.78	7.56^{a}	4.89	6.78	6.89^{b}
G10-1	6.67	7.00	5.67	5.56	6.89^{a}	5.00	6.67	6.44^{a}
G10-2	6.33	5.56	5.22	4.00	6.11^{a}	5.56	6.22	5.78^{a}
F10-1	7.00	4.89	6.44	5.11	7.00^{a}	5.89	7.22	6.78^{b}
F10-2	6.78	6.44	7.22	5.44	7.33^{a}	6.56	7.33	8.00^{b}

^{a,b} Means in the same column followed by letters were significantly different ($\rho<0.05$)

Conclusion

This present study has exposed that the both prebiotics (GOS and FOS) and fat content could impact to the chemical and physical properties of YIC in terms of pH, total acidity, overrun, fat droplet size, hardness, melting rate, rheological characteristics, and sensorial properties. Even though GOS, FOS, and fat content affect those properties, panelists still accepted the product at a very high score of hedonic test.

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The investigation of Dielectric Barriers Discharge Plasma Jet (DBDJ) for bactericidal in wound healing

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Keywords: Atmospheric pressure plasma, Dielectric barrier discharge plasma jets, Wound healing, *Staphylococcus aureus, Pseudomonas aeruginosa*

Abstract. The cold atmospheric pressure plasmas (CAPPs) technique have been recognized in health care for wound healing enhancement while the patient's pain relieving without side effects. In this study, dielectric barrier discharge plasma jet (DBDJ) was used for bactericidal. This cold plasma jet is driven by high voltage dc pulse at 20 kHz and using 1 L/min of helium (He) as plasma gas. The DBDJ plasma was varied the plasma dissipated power from 0.27 to 0.50 watt and the treatment time 15 to 60 s. Plasma radical species were utilized by using an optical emission spectroscopy (OES). The results of the OES study was found NO and OH radical groups which is an important role of bactericidal and wound healing. The increasing of radical plasma density depends on the dissipated power. The Colony Forming unit (CFU) method was used to monitor the efficiency of bacteria killing. *Staphylococcus Aureus* (*S. aureus*) and *Pseudomonas Aeruginosa* (*P. aeruginosa*) were used for in vitro bacteria killing test. The results showed that the dissipated power and treatment time were affectively factors for bactericidal. When increasing the plasma dissipated power at 0.50 watt and treatment time to 60 s, the effect of bacteria killing was increased up to 100%.

Introduction

Bacteria are prokaryotic micro-organisms, it has great adaptability to the environment and is the main cause of illnesses, wound infections, including chronic wound, meningitis, pneumonia etc. The difference of the cell wall structure bacteria can be divide into two groups. Gram-positive bacteria have a relative thick peptidoglycan (20 to 80 nm) cell wall, while gram-negative bacteria have a thinner peptidoglycan (< 10 nm) cell wall [1, 2]. The difference of bacterial cell wall lead to different properties to the cell, especially the cell responses to external stressors such as a heat, UV radiation and also antibiotics [2]. One of the gram-positive bacterial strains is *S. aureus* and gram-negative bacterial strains is *P. aeruginosa*. These are causing public health concerns in the postsurgical patient population. The *S. aureus*, *P. aeruginosa* including methicillin-resistant *Staphylococcus aureus* (MRSA) are the most commonly identified bacterium in wounds [3], including being the cause of a range of sickness from skin and wound infections, pneumonia with empyema and bacteremia that may cause of sepsis and death. Therefore, an alternative technique to

stop the growing bacteria antibiotic resistant are required. The physical technique such as the CAPPs technique are report an efficiency against antimicrobial and a wide range of pathogens such as fungi, viruses and bacteria including antibiotic resistant bacteria such a MRSA. The CAPPs in medical field has become a rapidly developing interdisciplinary field that brings a new innovative approach in a broad range of biomedical applications [4]. For medical applications, the plasma temperature should be at room temperature without any electrical and chemical harm. The CAPPs sources have been operated at an excitation frequency, either in the several tens of kilohertz ac range or in the radio frequency (RF) range. Because of various design configurations and operation conditions of plasma, the factors controlling discharges, for instance temperature, charged particle, ion, electromagnetic field and radical species are obvious. For suitable control of the plasma treatment processes, it is important to understand the basics of physical and chemical properties in plasma, such as power deposition and consumption, electromagnetic, electrical characteristics, optical emission spectrum, gas temperature and other parameter in plasma [5]. They play important roles in bactericidal by CAPPs.

Materials and methods

The emission spectrum of this plasma jet was detected by broadband CCD spectrometer (Fiber Optic Spectrometer: AvaSpec-2048). The high voltage waveform was determined by using a high-voltage probe (Tektronix, P6015A). The plasma dissipated power was estimated by using Lissajous figure [6], where the discharge charge was estimated from the voltage across the 1 nF capacitor measured by a HV probe (Hantek, T3100). The NO and O_3 concentration were measurement by using the two gas detectors (Shenzhen YuanTe Technology); model SKY2000-NO for measuring NO concentration and model SKY2000-O_3 for measuring O_3 concentration. The bactericidal efficiency was observed by using Colony Forming unit (CFU) method. Samples of *S. aureus* TISTR 2329 and *P. aeruginosa* TISTR 2370 were obtained from Thailand Institute of Scientific and Technological Research (TISTR). The sample bacteria of *S. aureus* and *P. aeruginosa* will be prepared in nutrient broth (NB) 5 ml and orbital shaker 150 rpm in incubator at 37 ^{o}C for 24 hr. After 24 hr. *S. aureus* and *P. aeruginosa* in NB have density of approximately $1x10^{7}$ to $1x10^{8}$ CFU/mL and dilute with serial dilution to 10^{-4} before prepared in nutrient agar (NA).

Results and discussion

The Lissajous figure of DBDJ is shown in Fig. 1. At applied frequency 20 kHz, the plasma dissipated power at 0.27 watt. Therefore, when increasing frequency to DBDJ the percentage of duty cycle, power and dose of DBDJ increased. These factors have influence on the intensity of radicals in DBDJ. Intensity of radicals in plasma play an important role for bactericidal.

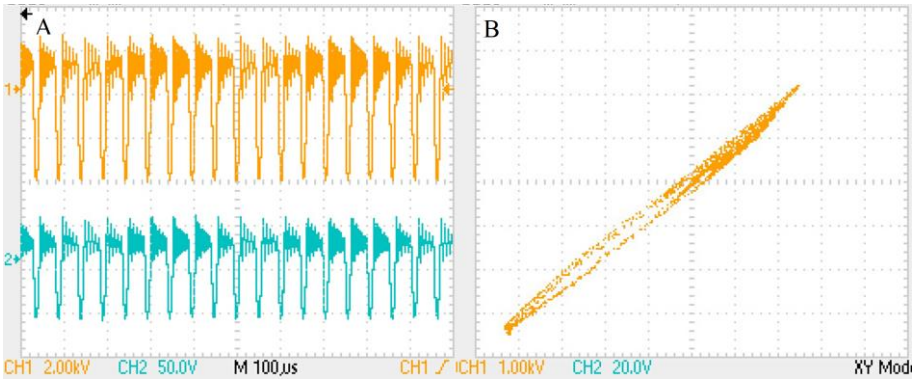

Figure 1 A) The applied voltage signal (channel 1) the voltage across the 1 nF capacitor (channel 2) and **B)** the Lissajous figure of DBDJ the plasma dissipated power at 0.27 watt.

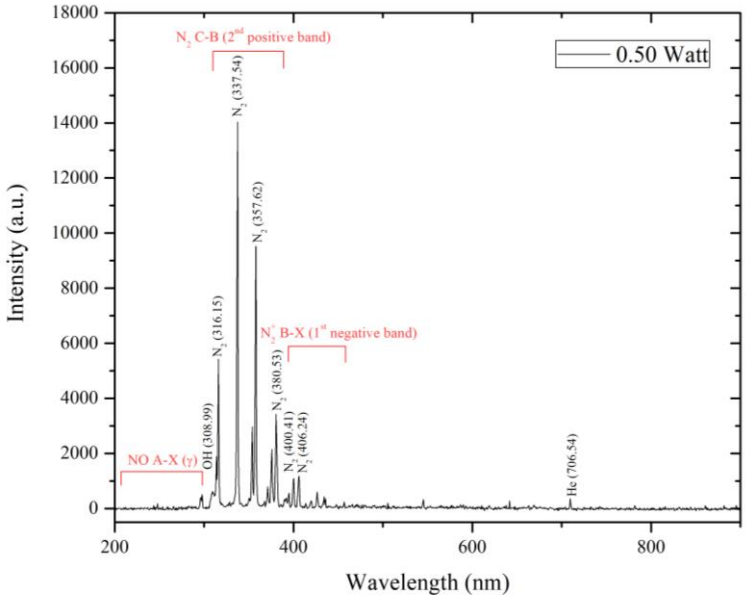

Figure 2 The emission spectra of the plasma dissipated power at 0.50 watt.

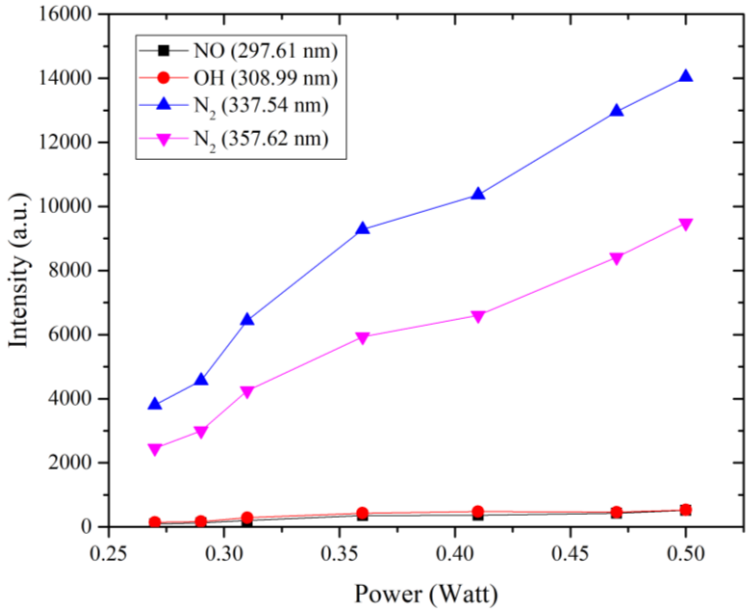

Figure 3 The relative of the RONS intensity and the plasma dissipated power.

The reactive oxygen and nitrogen species (RONS) play an important role in bactericidal [7]. These radicals and electrostatic force of ions break down bacteria cell, DNA damage and charge accumulated leading to cell lysis. The main bactericidal are RONS that could kill bacteria [8, 9]. The OES spectrum of DBDJ found the peak of NO at 297.61 nm, OH at 308.99 nm, N_2 at 337.54 nm and He at 706.54 nm as shown in Fig. 2. The NO lines are primarily from the NO A–X (γ) in the ultraviolet region at wavelength 200 to 300 nm but intensity very low. The N_2 C-B (2^{nd} positive system at 334.27 nm) and N^+_2 B-X (1^{st} negative system at 406.24 nm) are observed between wavelength 300 to 450 nm because the excitation processes like the electron impact excitation from the ground state N_2 (X1Σ g+) and the first metastable state N_2 (A3Σ u+) and pooling reaction [7]. Also found OH at 308.99 nm and He at 706.54 nm. The Fig. 3 shows that when increasing the plasma dissipated power from 0.27 to 0.50 watt the intensity of RONS was increased. The increasing of NO intensity is significant but ineffective for the intensity of OH. The O_3 concentration were increased with the plasma dissipated power. The same trends were observed with significantly higher concentration of NO was show in the Fig. 4. However, the operational condition the O_3 concentration was in the safety regulations of medical devices.

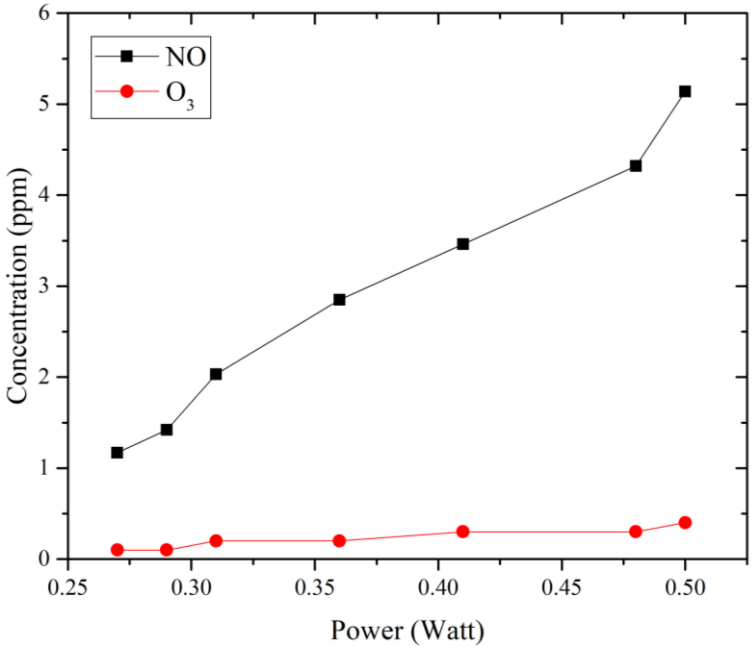

Figure 4 The relative between concentration of NO and O_3 and the plasma dissipated power.

The bactericidal efficiency of DBDJ can be observed in Fig. 5-8. The inactivation areas were clearly increased with the plasma dissipated power and treatment time. At a short exposure time, the inactivation areas were limited only the head zone area. While the longer exposure times, the clear zones were larger and diffused to the neighbor area. It is mainly with the OH and O_3 density. However, the killing zones expanded to cover the neighbor area that related with the long-life time of O_3 and high NO concentration in the superoxide ambient area. There was could be involved in an increased nitroxidative stress which was leading to the formation of highly reactive radicals and oxidative species. RNS induces nitric oxide and nitric acid influences bactericidal [10, 11]. Acidified nitrite has a strong antimicrobial ability on bacteria cell leading to cell death. The CAPPs treatment prompts the acidic conditions and accumulation of nitrite and hydrogen peroxide. Consequently these factors are the main cause for CAPPs to induced toxic effects on bacteria cell [10].

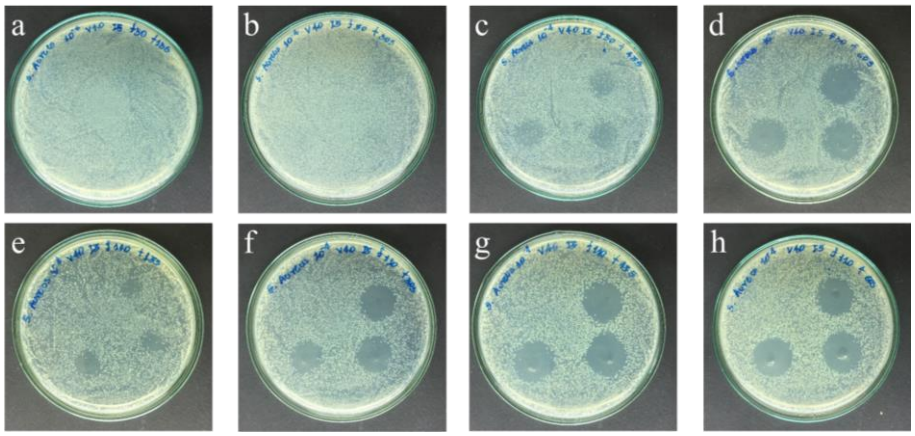

Figure 5 The efficiency bactericidal *S. aureus* of DBDJ, the plasma dissipated power at 0.27 watt and treatment time 15 to 60 s (a, b, c and d), the plasma dissipated power at 0.50 watt and treatment time 15 to 60 s (e, f, g and h).

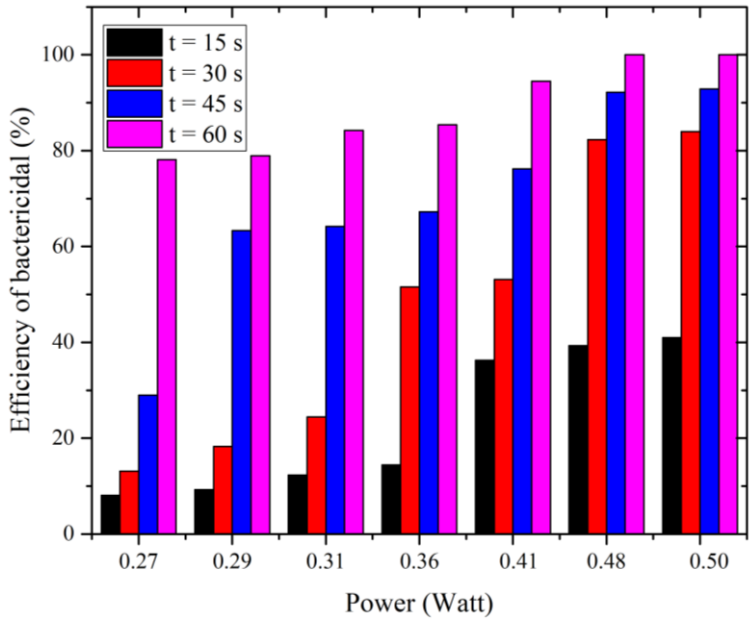

Figure 6 The percentage efficiency of bactericidal *S. aureus* by DBDJ.

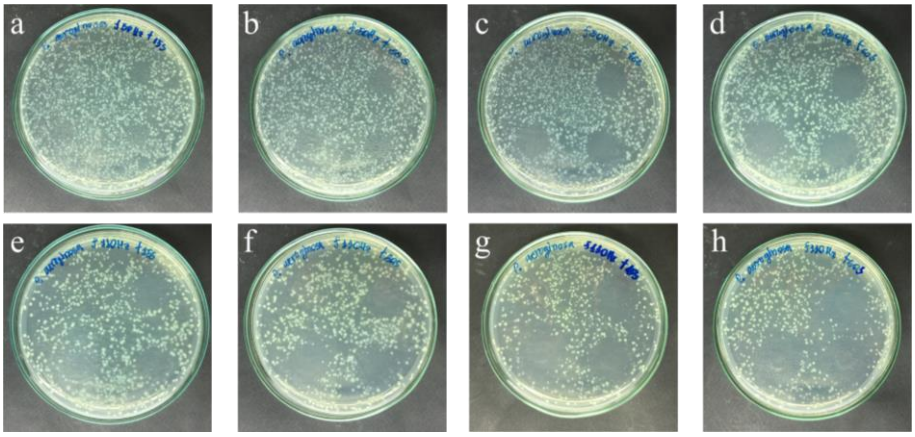

Figure 7 The efficiency bactericidal *P. aeruginosa* of DBDJ, the plasma dissipated power at 0.27 watt and treatment time 15 to 60 s (a, b, c and d), the plasma dissipated power at 0.50 watt and treatment time 15 to 60 s (e, f, g and h).

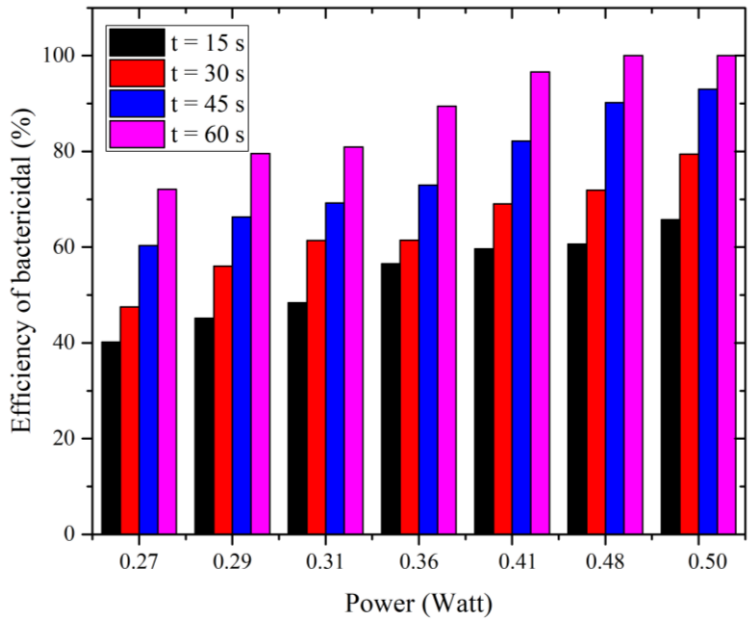

Figure 8 The percentage efficiency of bactericidal *P. aeruginosa* by DBDJ.

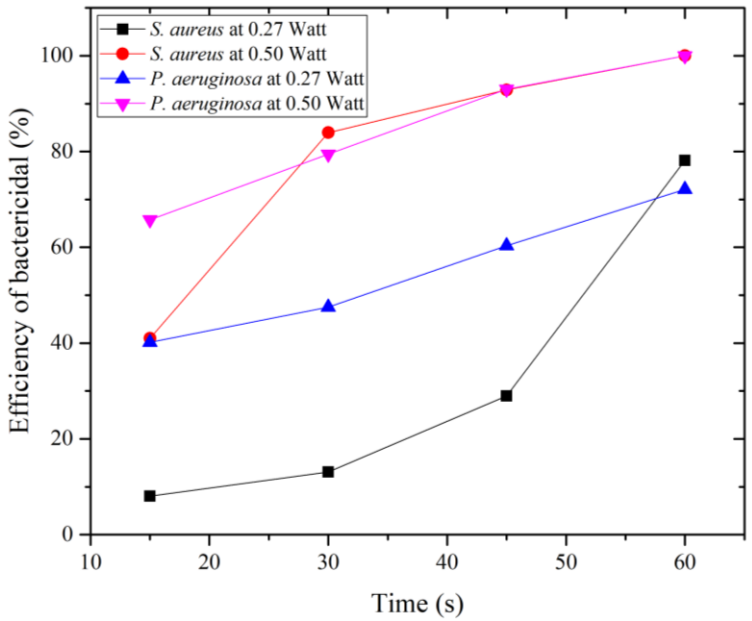

Figure 9 The percentage efficiency of bactericidal *S. aureus* and *P. aeruginosa* by DBDJ the plasma dissipated power at 0.27 and 0.50 watt, treatment time 15 to 60 s.

Comparing the bacterial efficiency of *S. aureus* and *P. aeruginosa* are shows in Fig. 9. It was found that the *P. aeruginosa* have a higher bactericidal efficiency than *S. aureus* under the same condition. Because of the main difference of the cell wall structure of bacteria. The outer structure of *S. aureus* cell wall is the multi layers of peptidoglycan which is the stronger bonding than the *P. aeruginosa* cell wall. *P. aeruginosa* cell wall consists of phospholipids and lipopolysaccharides, there are have an influence of the polarity. Destruction of peptidoglycan through external stresses will lead to cell lysis. Therefore, the different thickness of cell wall between two group of bacteria, the outer membrane of gram-negative as well as cell appendices of gram-positive bacteria play an important role for bactericidal in DBDJ [2, 12]. The inactivation of CAPPs to bacterial well-know is peroxidation of lipids [13] and membrane lipids are the most vulnerable to physical stresses because the position is outside of the cell envelope and it is sensitive to RONS. Furthermore, the charged particles in plasma played an important role for bactericidal with the rupture of bacteria cells wall [14, 15]. When the charge particles accumulated on outer surface of the membrane being more than the tensile strength of the membrane lead to cell rupture by electrostatic force [16]. If no force exists, the repulsive force will only impact on the charges and little damage to the cell membrane. The electric field generated between charge particles have non-uniformity. When time of charge accumulate the transmembrane potential increases. On the other hand, the ions generated in the CAPPs cannot get through the cell membrane. Hence, charge accumulation is still execution. If the intensity of electric field generated form charge particles strong enough it could change the three dimensional of the proteins structure, separate out the cell membrane and be forceless. Thus, the charge particles forming CAPPs have ability and destroy the proteins and enzymes activity into the cell. Most likely the cytoplasm will leaks out the cell through these holes, which is the reason leading the cell death why the cell dies [9, 15]

Conclusions

The DBDJ have a high efficiency on bactericidal both of *S. aureus* and *P. aeruginosa* at 20 kHz, plasma dissipated power 0.41 to 0.50 watt and treatment time 45 to 60 s. All the death of bacteria was increased with plasma dissipated power and treatment time. The lager clear zones affected by RONS and charge particles. Electrostatic force of ions in plasma play an important role for bactericidal leading to cell lysis. Moreover, the difference of cell wall structure between gram-positive and gram-negative bacteria leading to difference sensitivity by DBDJ. Hence, the DBDJ have a high bactericidal efficiency and assist in wound healing.

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Innovative Technology and Sustainability Engineering

A CONCEPTUAL FRAMEWORK FOR THE INNOVATIVE DESIGN OF TEMPORARY ACCOMMODATION FOR FLOOD VICTIMS IN THA KORPAI COMMUNITY, WARIN CHAMRAB, UBON RATCHATHANI PROVINCE, THAILAND

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ABSTRACT

Tha Korpai community in Warin Chamrab, Ubon Ratchathani Province, Thailand, which is adjacent to the Mun River contains 187 houses located at the foot of the Democracy Bridge. The area is affected by floods every year during the rainy season. It is often caused by heavy rains that occur for a long time until flood levels rise. Sometimes it is caused by a tropical cyclone or just Low pressure in the area. In addition, Ubon Ratchathani is the last province where the water masses of the Mun River and the Chi River meet up before flowing together into the Mekong River. There is a large drainage dam from the north of the province to the Mun River that accomodates every rainy season. However, there is still damage to housing, to habitats and organisms. Each rainy season, nearly 70 villagers are displaced on the roadside where they become temporary residents. They reside at the foot of the Democratic Freedom Bridge, waiting for the water level to decrease. After the disaster, the common problem of the victims is a lack of housing that is both safe and comfortable because it is not prepared well in advance. It is not enough to respond to the needs of the victims.

Nowadays, many architects and designers have created innovations to help people cope with natural disasters, both in terms of design and development of effective materials. So, the purpose of this study are the following: (1) To do a case study or some research on the characteristics and patterns of temporary accommodation of the flood victims in Ubon Ratchathani province, (2) To do a case study about the temporary accommodations available in Thailand and abroad, (3) To study the problems and important factors that will create a conceptual framework and innovation for the management of temporary accommodation suitable for the area in Ubon Ratchathani. (4) To study relevant research papers about disasters in Thailand and other countries around the world that were hit by significant natural disasters and to compare them in various aspects such as innovative solution, management, transportation, construction and materials. This includes the assessment of the following: the space requirements for the victims after the disaster, the model of materials needed and the construction method of the house. This study also aims to explore and collect information about the primary needs of the survivors post- disaster, analyze some data and get to know the main issue at hand, evaluate the things that need to be improved and fixed, and, lastly, to gather information on how to design temporary accommodation for flood victims.

KEYWORDS: innovation, conceptual framework, design, temporary accommodation, flood victims, Ubon Ratchathani Province

INTRODUCTION

Each year, riverside communities in Ubon Ratchathani Province have flooded rivers. The water level is constantly increasing, flowing across the street and flooding people's houses on the banks of the Mun River in the Warin Chamrap district of Ubon Ratchathani. Due to this, officials annually urge more than 70 people to stay in temporary shelters.

Table 1. Previous records of flood statistics. Maximum water volume each year at the foot of the Democracy Bridge. (2013-2017)

Year	2002 (maximum)	2013	2014	2015	2016	2017
water level (M.)	10.78	9.20	5.50	5.00	6.94	7.70

source : provided by The Hydrology and Water Management Center for Lower Northeastern Region, Ubon Ratvhathani,. Thailand.

There is a lack of housing and utilities necessary for daily living resulting from limited construction materials and labor, a lack of technical knowledge of the construction and proper house style, delays in transportation of materials and equipment as well as coordination with government agencies. As a result, the housing patterns of the residents are not hygienic and do not respond to life as they should be. This may affect the physical and mental health of the victims along the way. Long-term solutions need to be developed.

Based on the survey of the researcher's field of temporary housing after the flood, the condition of the temporary house has deteriorated due to leaking roofs during heavy rains and weathering due to low quality materials as a result of budget constraints. The choice of materials and construction is not appropriate because villagers lack knowledge of construction methods. These reasons affect the quality of life of the residents. This study analyzes the problem by looking at temporary housing for victims in Thailand and in other countries that were hit by significant natural disasters. Similarly, the social and landscape areas were used to compare and find solutions to improve the habitat for victims in similar areas in Ubon Ratchathani.

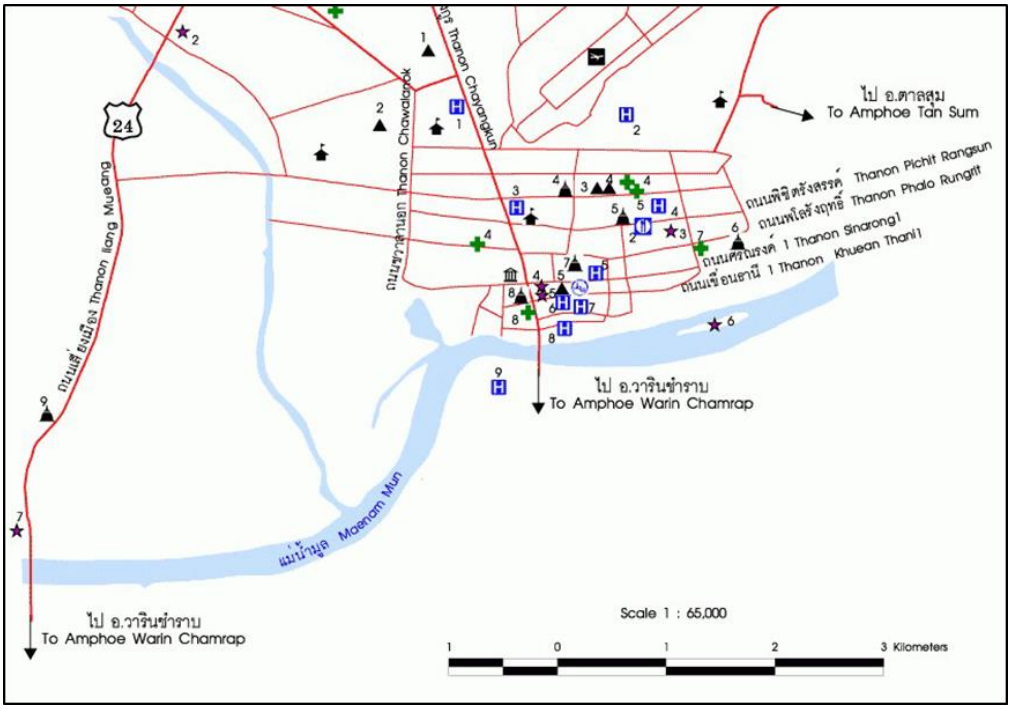

Figure 1 Areas affected by floods along the banks of the Mun River.

Figure 2 The area after rain and flooding in Ubon Ratchathani Province

RESEARCH OBJECTIVES

1. To study the characteristics and patterns of temporary accommodations for victims in Ubon Ratchathani as well as in other countries.

2. To study design guidelines and innovative solutions for temporary accommodations suitable for the area in Ubon Ratchathani.

3. To study the problems and important factors as a guideline for temporary accommodation management.

4.To create a conceptual framework for the management of temporary accommodations suitable for the area in Ubon Ratchathani.

LITERATURE REVIEW

1.Temporary accommodation for flood victims in Tha Korpai community, Warin Chamrab, Ubon Ratchathani Province, Thailand.

When a flood occurs, all affected households will migrate to nearby highways, community offices, or tents provided by government staff. People use the public utilities system including public utilities from nearby places such as gas-station bathrooms, etc. After that, they create temporary housing by applying for a temporary building structure from the municipality. This structure consists of wood and steel rods, and villagers will use the materials provided every year to install the structure. It is made up of easily accessible materials in the area such as a vinyl sheet, a canvas, an advertising sheet, a zinc sheet, which has limitations on suitability for use as building parts whether it is strength, suction - heat exchanger, moisture protection, smoke, etc.

The rainy season occurs from the middle of May until the end of October. Heavy rains and water levels along the Mun River have continued to rise to the roof of the house causing people in the area to exceed the water level. The people have to carry their belongings to the temporary accommodation provided by government agencies. After that, people build temporary houses using limited supplies along with some additional materials they bring. Therefore, the characteristics of the house depends on the construction skills of each household. If the people have a lot of construction knowledge or skilled technicians, they will be able to use cost and materials appropriately and cost effectively. The result is that the house will meet standards for quality and safety. From the interviews, most villagers needed a standard home and fast construction material that was stable, strong, and easy to assemble without specific skills.

Table 2 Materials used in building construction.

Materials used in building construction								
Structure	House							
	1	2	3	4	5	6	7	8
Column	steel	steel	steel	steel	steel	steel	steel	steel
Beam	wooden	wooden	wooden	wooden	wooden	wooden	wooden	wooden
Ground	wooden	wooden	wooden	wooden	wooden	wooden	wooden	wooden
Wall	canvas - zinc	canvas - zinc	canvas - zinc	canvas - zinc	canvas - zinc	canvas - zinc	canvas - zinc	canvas - zinc
Roof	wooden-zinc	wooden-zinc	wooden-zinc	wooden-zinc	wooden-zinc	wooden-zinc	wooden-zinc	wooden-zinc

2.1 The general characteristics of temporary shelters in Ubon Ratchathani Province are wooden and steel structures, which are easily accessible in community areas. They are built on the edge of the Democracy Bridge which connects the districts of Ubon Ratchathani and Warinchamrab. The area is rough and steep. The structure is at risk of erosion because some villagers do not have the knowledge of construction. The building is surrounded by canvas and the shed is roofed with zinc because of the budget constraints and the lack of knowledge concerning the construction of temporary houses. The result of this is many things are deficient: hygienic living conditions, physical security, property, and privacy. Sanitary facilities are also lacking because the number of shared toilets that government agencies provide is not enough. People have to use the toilet at the gas station or public buildings nearby. The bridge area will be used for accommodation by raised to fit the physical characteristics of the area.

Figure 3 Temporary accommodation for flood victims in Tha Korpai community, Warin Chamrab distric, Ubon Ratchathani Province,Thailand.

Figure 4 Materials used in building construction.

Figure 5 Mobile toilets for victims are provided by government agencies.

2. Innovative temporary shelters of flood victims in Thailand and abroad

- The Reaction Housing System, Thailand

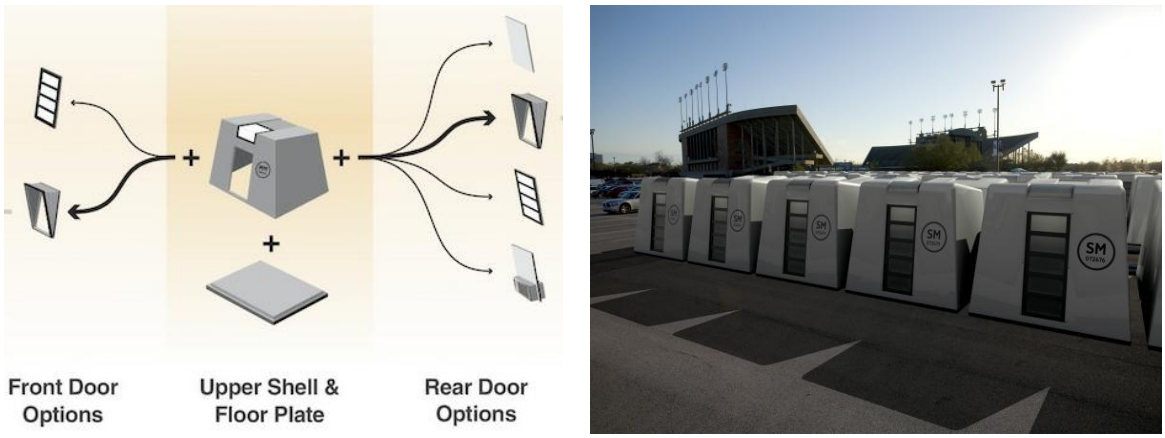

Figure 6 the Reaction Housing System, Thailand .

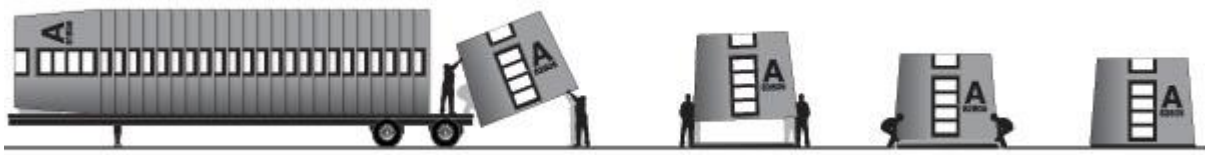

Figure 7 the Reaction Housing System, Thailand .

The Reaction Housing System is an emergency accommodation designed for people to live normally. The living space also adjusts into a rest area. The building can maintain a living space for about 4 people. The building is fully equipped for living including utilities—

water and lighting systems with external access points. The rugged construction material can sustain earthquakes or wildfire. The interior of the building is comfortable because it has an air conditioning system which can be transported to other places. The houses are easy to assemble. All parts are only 2 pieces: the base (floor) and the house. (Wall + roof) use only 4 people or less. It can be assembled without any special tools or machinery. Interestingly, the building designed for the Reaction Housing system uses non-toxic materials such as aluminum. Furthermore, composite materials and all building components are recyclable.

- Hex House, USA.

Figure 8 Hex House.

Architects for Society (AFS) has designed a temporary shelter for victims known as the 'Hex House' due to its hexagonal shape. The cost of construction is not high. Building components are easy to set up and move easily and sustainably. This building is different from other emergency shelters. It is a building that is designed to be long-term housing. The basic components of this shelter include: galvanized steel pipe, structural insulated panel (SIP), floor and roof. In addition, the hexagonal shape also enhances the stability of the house. There is no need to use a reinforced structure. Roofing is a self-support that is locked to the tongue joints to create a strong, stable structure. Each shelter can be installed adjacent to each other to build a larger shelter. There is also a system of rainwater storage that can be trapped through the gutter which will filter the water into the water tank and pump the water back into the house. The ventilation system is installed on both sides of the accommodation while the electrical power is provided by the solar panels. The interior space is designed to look modern with gypsum walls, bamboo flooring, ceramic tile in the bathroom, and kitchen cabinets made of bamboo. It is a very useful shelter for disaster victims, and can be used for 15-20 years.

- **La Matriz ,Peru**

Figure 9 La Matriz.

As a result of global warming, people living in Peru's coastal areas have been hit by natural disasters and are constantly facing dry weather. As a result, students from the Pontifical Catholic University of Peru (PUCP) in Peru developed emergency, temporary shelters for those affected by the disaster. This shelter is called 'La Matriz.' It is shaped like an Inuit house with a self-supporting structure. It is lightweight, sturdy and easy to install. The exterior of the building is covered with a layer of foam to help reduce heat loss, while the exterior is made of interlocking aluminum sheeting to reflect sunlight. Some panels can also be opened to allow air to circulate and maintain internal temperatures. The 'La Matriz' can be stored in a flat shape for easy transportation by boat or helicopter. The building can be assembled and installed within 4 hours and accommodates up to 8 people.

- **Lofty, Portugal**

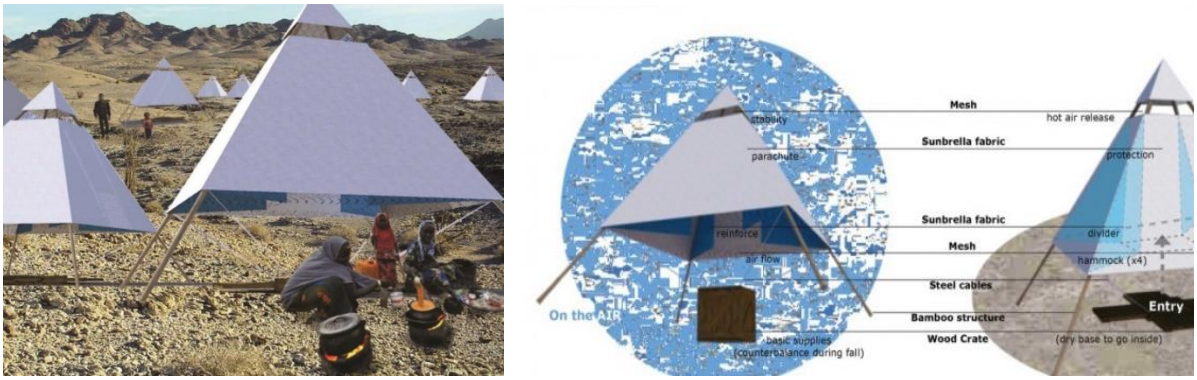

Figure 10 Lofty.

Studio Muda, a design studio based in Portugal, has designed a simple, easy-to-use, lightweight refueling shelter that can be dropped from a plane. The building can be moved by hand or transported by car. This shelter comes in a triangular structure similar to a marquee designed to float like a parachute. The frame is made of 4 lightweight bamboo stretched with nylon mesh. In transportation, the building parts are dropped from an airplane in wooden crates containing essential materials. Canopies made from canvas protect against the sun, heat and rain. The height of the roof also allows the air to flow easily.

- **Living Shelter,Singapore**

Figure 11 Living Shelter.

Singapore architects WY-TO have created a shelter called 'Living Shelter' for disaster victims in the Asian Pacific. This shelter is affordable, easy to move, and can be easily dismantled without the need for complicated tools. Using a Folding Mechanism, the design is inspired by the theme of the kampong village in Southeast Asia. The structure and walls are strong enough for all weather conditions. It can be created on uneven floors and can be recycled. In addition to privacy and security, this shelter also provides energy through solar panels on the roof. There is a water storage system and folding facilities such as beds, shelves, tables and small furniture that can be moved. All interior furniture is made of lightweight materials. The 'Living Shelter' prototype was showcased at the Architecture Biennale 2016 in Venice, Italy.

No.	concept design	The Reaction Housing System	Hex House	La Matriz	Lofty	Living Shelter
1	Area management	Good	Best	Average	Average	Good
2	Facility	Best	Best	Best	Best	Best
3	Unit Expansion	Good	Good	Average	Average	Good
4	Construction and material selection	Best	Best	Good	Best	Best
5	Management and Transportation	Best	Best	Best	Best	Best
6	Applicable	Good	Average	Average	Good	Best

Table 3 Comparative Case Study by Researcher

The results of the comparative analysis can be summarized as follows.

1. In terms of space allocation, Hex House has the best living space, as each unit can be connected so that the space can be clearly defined while La Matriz and Lofty have a hard-to-use shape. The distance from floor to ceiling is not equal.

2. All homes provide comfort by using insulation materials (temperature control) and having openings designed for ventilation (airflow).

3. In terms of space constraints, La Matriz and Lofty are more difficult to fill than the other two due to their inferior plane, Hex House and Living Shelter. It is not designed to be added vertically, which is necessary in the case of limited construction space.

4. In terms of construction and material selection, La Matriz is the most cost effective , but uses indispensable materials in factory production. While with Lofty, Hex House and Living Shelter, people can use commercially available ingredients.

5. Management and transportation found that all houses were occupied after the victims had left. The temporary home can be used temporarily by other residents.

6. The suitability of the application is that each building has the following limitations:

Hex House requires a large area for installation which is not suitable for the area in Ubon Ratchathani.

La Matriz has a memorable press, a rare material in the space and shape that does not meet the lifestyle of the people in the area.

Lofty uses material that can find space. But the shape does not meet the living of people in the area.

Living Shelter is most suitable for application. The shape of the building suitable for the case study. Living space in a home that resembles a home of an immigrant in the area. However, the limitation is the continuity of the usable space in the case of addition, which is a factor of secondary importance.

METHODOLOGY

Qualitative research by collecting field data from local victims.

1.Researching documents and innovation research related to disaster cases in Thailand and other flood areas with contextual conditions similar to those in the case study area considering the use of building styles, selection of materials and construction methods.

2.Searching through the field trips for the area needs, information on various aspects of the victims and what should be improved for residents—whether living space,utility requirements or construction methods.

3.Studying the social, economic, and environmental conditions that affect the design of temporary accommodations

4.Creating a conceptual framework by setting criteria for the design of temporary accommodations for victims

RESULTS

Analysis of problems and important factors to create conceptual framework for temporary housing design.

The results of the survey and study of 8 temporary houses from 70 households can be analyzed in 4 factors: 1. The proportion of land use. 2. Factors that affect the use of space 3. The problem of space usage that affects daily life. 4. Guidelines for the correction and development of housing.

- The results of the analysis of the use of space.

1.1 Most home furniture uses compact, foldable, and lightweight furniture because of the limited space available in the home, but the usage varies over time, such as the central hall. During the day, it can be a resting and eating area. At night it may be a bedroom.

1.2. The proportion of the traffic of all houses is less than 25% of the total area of the house because of inadequate living space as needed. For example, in the case of house 1, overlap area is a bedroom, living room, dining room. These are not enough to meet the needs of the activity.

1.3 The use of overlap in every home uses overlapping areas, such as living space, dining area, and sleeping area.

1.4. Solution to the open plan design. Most houses can be expanded if the number of members increases. The increase in the number of bedrooms can be difficult because the interior space is narrow, making it difficult to build.

Table 4 Space usage

Space usage	1	2	3	4	5	6	%	order
1. The use of folding furniture.	1	0	1	1	1	0	66.67	2
2. Has less than 25% circulation area.	0	0	0	0	0	0	0	3
3. Overlapping Area.	1	1	1	1	1	1	100	1
4. Open plan.	0	1	1	1	0	1	66.67	2

- The results of the analysis of factors affecting the living space (Table 3). The details are as follows.

2.1. Number of residents, family members with varying number of members have an effect on the number and size of living space. Families with different number of members affect the number and size of living space. For example, “family 3” has 6 members, with 2 bedrooms. Unlike a family with 2-3 members who are small families. Parents, children or grandchildren will have a bedroom.

2.2. Relationship of family members. For example, the "family 1", the old father will separate the living room outside, let the daughter and grandchildren sleep in the bedroom, in the case of "family 2", father and son. Mom will separate the living room. The child sleep in the bedroom. In case of "family 3", it is a family consisting of parents and children (teenagers) who separate their parents with their parents. In case of "family 4", which is a large family. Relative Relationship The bedroom is completely separate. The differences in the family members. The size and number of living space varies, such as the use of living room for lunch. It is a sleeping area at night.
2.3. Sex and age. Part of the elderly, both men and women are concerned about the structural strength of the structure because of the time it takes the storm to make the structure that members of the family do. The temporary building material is vibration-like.
2.4. Construction budget. The data collected from the interviews showed that the agencies had to help and make money for the construction of temporary houses of 10,000 baht. Some victims used private money for construction. The fifth family has added a living space extension. Number of rooms increased. Construction budgets have resulted in dramatic increases in size and type of living space, such as terraces larger than other homes. The terrace is used as both a cooking area and dining area. In the larger living room, it can be used as a sleeping area at night and a sitting area. Daytime play, resulting in overlapping areas.
2.5. Construction. Based on interview data. Government agencies have helped with the budget and materials with a few builders. In terms of labor, there are volunteers to build temporary houses, but they do not have enough knowledge of construction. Some home owners are technicians, so they can design their own home according to their needs. Therefore, the form of temporary residence is dependent on the owner and the volunteer.
2.6. Timeline and selection of building materials. Because flood victims need emergency shelters during floods, the construction process, such as the provision of refinement, is reduced. Plus, with a little budget, the housing is out of standard.

Table 5 Factors affecting the usable area.

Family	**1**	**2**	**3**	**4**	**5**	**6**
1.Number of residents	3	3	2	4	2	2
2. Member	Father/ Mother/ Children	Father/ Mother/ Grandchild	Husband/ Wife	Father / Mother / Daughter / Son / Grandchild	Husband/ Wife	Brother / Brother
3. Sex	Male/ Female/ Male	Male/ Female/ Female	Male/ Female	Male/Female/ Female/Male/ Female	Male/ Female	Male/ Male
4. Age of Chief Family (Year)	68	51	22	55	57	54
5. Construction Budget (USD.)	320 $	320 $	320 $	320 $	320 $	320 $
6. Construction	Self-build	Self-build	Self-build	Self-build	Self-build	Self-build
7. Construction Period (days)	3	7	3	3	5	2

- The results of the analysis on the problems of using space that affects daily life are as follows.

3.1 Daytime temperatures, most activities during the daytime are relaxation in the living room and terrace. From the survey, it was found that a house with hot weather was a house where both the roof and walls were zinc-plated and had one side window. The ventilated home has a high ceiling and windows on both sides of the wall, allowing the wind to blow into the house, make the residents feel comfortable living.

3.2 Temperature during the night, most activities during the night are to sleep and watch TV in the living room, the temperature during the night is lower than the day, allowing the air to cool down.

3.3. The ventilation is unstable, depending on the height of the folk and environment around the house, such as temporary " house 1" raised from a floor height of 0.50 meters and there are other houses in the surrounding area, blocking the direction of the wind to the house, causing poor ventilation and wetting.

3.4.Leakage of heavy rain due to limited construction time, the construction is not detailed. Most of the rain is leaking from the roof due to incomplete roofing, such as roof joints.

3.5. Security to property, most houses can not store valuables because they do not have sturdy doors and windows. If the windows are closed, the house will be safe, but the air in the house is not ventilated.

3.6. Toilet after flood The toilets received from the municipality are insufficient for all affected households. Most of the public toilets are located nearby, including the gas station.

Table 6 Daily Life Problems

Family	1	2	3	4	5	6
1. Daytime temperature	Maximum	Maximum	Maximum	Maximum	Maximum	Maximum
2. Night Temperature	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
3. Ventilation	Poor	Poor	Poor	Moderate	Poor	Poor
4. Rain splash / leak	Poor	Poor	Poor	Poor	Poor	Poor
5. Security	Poor	Poor	Poor	Poor	Poor	Poor
6. Toilet	lack	lack	lack	lack	lack	lack

- Guidelines for the correction and development of housing.

The result of the analysis of temporary residence of flood victims in Ubon Ratchathani province in terms of the size of living space and problems affecting daily life. Can be summarized as a design guidelines for the victims in each of the following areas.

The proportion of area used for each type of work. The study found that each house occupied different areas, divided into three factors.

1) Foldable furniture is used.

2) The roaming area is less than 25%.

3) There are overlapping areas of activity.

It's an open plan design. The study found that each house has different living space according to different factors. If the family has many members, the area will be larger and the number of rooms will increase. Parents may use overlapping areas such as parents may live in the living room in the bedroom at night, etc. The age and gender of the homeowner are important factors in the size of the living space. The high income families have the capacity to expand and expand their space more comfortably than those with lower incomes. Construction management, skilled technicians are quicker to build than unskilled ones and better able to choose materials and designs. The problems that affect the daily life of the survey found that the residents of the temporary shelters experienced many problems and affect their daily living, including the temperature in the house, day and night. Ventilation, leakage and rain splashing into the house, property security, toilets and kitchen. The study and analysis of the three issues can be summarized in terms of advantages and disadvantages, as well as the needs of the people and the factors that contribute to the problem and the concept of temporary accommodations design for the flood victims.

DISCUSSION AND CONCLUSION

A conceptual framework for the innovative design of temporary accommodation for flood victims in Tha Korpai community, Warin Chamrab, Ubon Ratchathani Province, Thailand.

Results from the survey and interviews with flood victims, study of documents and statistics from related organizations. Including the study of the limitations of the sample of temporary shelters for victims. The analysis of the data can be used to define the concept of building design in the following topics.:

1. Management and Transportation

1.1 Management

- Victim homes must be designed to be prepared before an incident occurs.
- Reusable

1.2 Transport

- The building parts can be transported in trucks and not complicated. People can lift
- Transportation of building parts can be carried multiple and overlapping without damage.

2. Construction and material selection.

2.1 Construction

- The building must be completed within 1 day.
- Residents can build their own buildings without the need for a construction contractor.
- Construction without steps and using complex tools. Temporary shelters after floods must take into account the impact of rain storms, including the shape of buildings, structures and materials and joints (Supawadee, 2004).

2.2 material

- The main structure of the house, including pillars, beams and roofs, must be durable. Be prepared before the event, such as steel pipes, plastic, wood, insect protection, etc.
- Secondary structures such as walls, roofs, doors and windows can be used with local materials.
- Material must be re-used if moving or demolishing. Main materials must not make the house hot during the day and can be used daily in the daytime routine.

3. The use of space.

The living area must be divided. Depending on the type of use, there may be some areas that need to be overlapped, such as clothing and valuables, possibly with the bedroom. The cooking area may be shared with the dining area or the dining area may be shared with the living area. The living area can also be used as a sleeping area at night.

- The bedroom must have an area of at least 8.00 square meters or a narrowest width of not less than 2.50 meters.

(Ministerial Regulation No.55, B.E. 2543 (2000) Issued pursuant to the. Building Control Act, B.E. 2522 (1979). 1. Publication Date: 28 July 2000.)

- One home must consist of sleeping areas, storage space and valuables, rest areas, cooking areas and dining areas. All areas must be separated according to the type of application.

4. Facility

- The house needs good ventilation.
- Access to system utilities.
- Safe for life and property

- Residents can live comfortably throughout the day with daytime temperatures not too hot in the home.

5. Increasing the space per unit.

- One house must be divided into 1 unit from the number of additional members.
- Big families can increase the number of units without damaging the structure.

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COMPARISON OF IEEE 802.11N AND IEEE 802.11AC WIRELESS TECHNOLOGY PERFORMANCES ON 2.4 GHZ AND 5 GHZ

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Keywords: Wireless Technology, Throughput, Wireless Standards Performance, IEEE 802.11n and IEEE 802.11ac Performances

Abstract

This study compares the performances of different wireless interoperable technologies of IEEE 802.11n and IEEE 802.11ac standards on 2.4 GHz and 5 GHz frequencies. Tests were carried using a testbed with various adjustable parameters such as channel bandwidth, distance, obstacle, and some extra techniques. Eight experiments were conducted to measure the signal strength and throughput in each scenario to determine the performance for each case. Experimental results showed various interesting standpoints as follows. By adjusting channel bandwidth, the throughput could be improved up to 54.71%, while UDP and IPv4 yielded throughput more than those of TCP and IPv6, respectively. Authentication mode could decrease the throughput by the maximum of 4.41%. IEEE802.11ac standard should be employed in the outdoor area with distance between client and access point not over 20 m. However, the deployment of IEEE 802.11ac standard is still possible in the indoor area with few obstacles inside the radius of 5 m from the transmitter. Signal strength could be deterred by the 15 cm thick concrete wall with the loss up to 20 dB. Beamforming and MIMO technologies would improve throughput up to 39.63%. With proper technologies, features and parameter settings, optimal outputs can be achieved.

I. Introduction

The internet has become a vital part of human daily life. Presently, the Internet of Things (IoT) has been on the rise as there were 6,381.8 million connected devices in 2016 [1]. Every physical device has network communication via internet and most of them use wireless network. Thus, the demand of bandwidth is constantly growing. For this reason, we need to develop and organize the internet system in order to use it with the maximum efficacy. Moreover, fixed line or home internet using FTTX technology is becoming popular as it provides very high bandwidth over the optical link. Using fixed line internet would be more convenient if a user adds a signal generator known as a wireless router or an access point. It allows a user to use a computer, laptop, smartphone, any mobile devices, or even IoTs to connect to the internet without any cable, but the wireless ability is limited and there are many parameters needed to be properly set. Thus, performance on wireless communication is generally worse than one on wired communication. Choosing the appropriate technology and configuration setting becomes a key to achieve high performance of wireless communication.

Recently, most of researchers focus on factor and performance measurement. The performance comparison between IEEE 802.11n and IEEE 802.11ac has been reported [2], but it was only a simulation using NS-3 with the fixed bandwidth at 40 MHz. Perhaps, this does not

indicate the true performance comparison between two standards because IEEE 802.11ac has 20 MHz and 80MHz available, so it does not cover all possible channel bandwidths of each standard. Experiments on different bandwidths to compare throughput and number of access points used in each frequency were reported [3], but all tests were performed only in indoor environment. Furthermore, tests for internet protocol (TCP) performance were conducted [4, 5], but they were done only for IEEE 802.11ac standard and on WPA2 authentication mode. Currently, many users still use WPA authentication method. Therefore, from our best knowledge, performance testing of wireless standard may not cover all-important factors that really indicate the overall performance aspect.

This paper presents the comparison of the aforementioned wireless standard performance on various frequencies and bands with 8 different scenarios. Related theories are stated in section II, followed by the experiment setup and design in section III. The comparison results are discussed in section IV and the conclusion is expressed in section V.

II. Methodology

A. Wireless Standard Parameters for Comparison Study

The IEEE 802.11 standards [6] are widely used for wireless communication. Their performance depends on various parameter settings. The current popular standards are IEEE802.11n and IEEE802.11ac. Both standards have different communication requirements such as maximum bandwidth, operating frequency, data rate, etc. Practically, IEEE 802.11n operates on both 2.4 GHz and 5 GHz spectrum, while IEEE 802.11ac operates on only 5GHz frequency. Add-on technologies or features of each wireless standard can affect the throughput and quality of signal, e.g. beamforming technology, Multiple-Input and Multiple-Output technology, security features, channel bandwidth, internet protocol (TCP/UDP), internet protocol version (IPv4/UPv6), and TCP window size.

Beamforming Technology is a technique to improve the signal stability and speed of data transmission [7] from the wireless routers or access points. Suitable phase and power of the transmitted signals are adjusted to the location of the detected clients for higher data throughput.

Multiple-input and Multiple-output technology or MIMO [8] utilizes multiple transmitters and receivers for more data transmission in the same frequency channel. It supports both IEEE802.11n and IEEE 802.11ac standard. With the technology, multipath data streams are combined by smart antennas to increase receiver signal-capturing power. The spatial diversity technology also increases its range when the data streams are outnumbered by the antennas.

Authentication modes on wireless connectivity, such as Wired Equivalent Privacy (WEP), Wi-Fi Protected Access (WPA), Temporal Key Integrity Protocol (TKIP), or Advanced Encryption Standard (AES), increase the network security. However, their encryption and decryption can reduce the throughput.

Basically, channel bandwidth controls traffic of transferring data [10]. Theoretically, wider channel bandwidth allows higher data transmission. However, noise and interference can make the transmission unreliable, thus decreasing the quality of signal and throughput. IEEE 802.11ac allows 4 types of channel bandwidth, e.g. 20 MHz, 40 MHz, 80 MHz, and 160 MHz. IEEE 802.11n only allows two types of channel bandwidth, e.g. 20 MHz and 40 MHz. Channel bandwidth should be selected with minimal signal interference in operating range.

Choices of Internet Protocol can also affect the data throughput. Transmission Control Protocol (TCP) is a connection-oriented protocol that requires connection setup and data handshaking for data transmission. User Datagram Protocol (UDP) is connection-less [11] and allows some data lost. Thus, UDP is relatively faster than TCP because of no delay time for creating and maintaining connection.

Two Internet Protocol versions, e.g. IPv4 and IPv6, are still debatable on their performance. Network Address Translation (NAT) is required for IPv6 due to its large number of available addresses. It has been reported that IPv6 is faster than IPv4 from IPv6 rDNS Nameservers when round-trip time (RTT) is compared by testing with Facebook website [12]. On the other hand, a comparison of connecting time and total time responses on 22 domains and 6 locations of servers demonstrated that IPv4 is slightly faster than IPv6 [13].

TCP window size specifies the amount of data to be transmitted before an acknowledgment is received. If a sender does not receive an acknowledgement packet, the data needs to be re-transmitted. This potentially limits the throughput.

B. Test Setup and Design

This section describes the setup and design of the performance tests. The hardware consists of an ASUS RT-AC5300 wireless access point, an Intel Core i5-6200U 2.3 GHz, 8 GB RAM server with IEEE 802.11ac WLAN and Gigabit LAN support, an Intel Core i5-4250U 1.3 GHz, 4 GB RAM client with IEEE 802.11ac WLAN support, and CAT6 RJ45 LAN cables. JPerf 2.0.2 is used to simulate the network traffic and its throughput and jitter measurement on both client and server. The signal strength and disturbance on the client were monitored by Insider 2.1.6.1394.

The testbed to determine the throughput comparison between each standard is designed by varying the following parameters as:

1) Channel bandwidth: IEEE 802.11n (20-MHz and 40-MHz bandwidths) and IEEE 802.11ac (20 MHz, 40 MHz, and 80 MHz bandwidths).
2) Internet protocol: TCP and UDP.
3) Internet protocol version: IPv4 and IPv6.
4) Security or Authentication mode: None, WPA, and WPA2.
5) Distance between access point and client.
6) Same as 5) with an obstacle of 15 cm thick concrete wall placed between an access point and a client.
7) Distance at 20 m plus 15 cm thick well and beamforming technology.
8) Same as 7) plus MU-MIMO technology.

The default values of the network parameters for each testbed configuration are as follows:

1) Channel bandwidth: 40 MHz
2) Internet protocol: (TCP)
3) Security/Authentication Mode: No
4) IPv4
5) No Beamforming
6) Modulation Scheme: MCS 11 (1024-QAM)
7) Length: Fixed at 1 m
8) Port: 5001
9) No Interference signals
10) Transmit time: 60 s
11) TCP Default Setting
    a. Buffer Length: 2 Mbytes
    b. TCP Windows Size 64 Kbytes
    c. Max Segment Size 1 Kbyte
12) UDP Default Setting
    a. UDP Bandwidth: 1024 MBytes/sec
    b. UDP Buffer Size: 64 KBytes
    c. UDP Packet Size: 1,500 Bytes

Figure 1 shows the test setup for all test configurations. On each configuration, only one parameter will be varied from the default values.

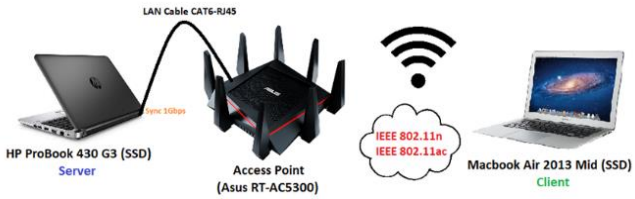

Fig. 1. Test setup

III. Experimental Results

The experimental results of 8 aforementioned testbeds can be expressed in order as:

Channel bandwidth: The performance test results of this case were depicted in Fig. 2. For 5 GHz band with 40-MHz bandwidth, IEEE 801.11ac provided higher throughput than IEEE 802.11n around 9.23%. By considering the throughput of 5GHz-IEEE 802.11ac deployment, the results showed that 80-MHz bandwidth yielded better throughput than those of 40-MHz and 20-MHz by 15.49% and 54.71%, respectively. By fixing the bandwidth at 20 MHz and 40 MHz for IEEE 801.11n, 5 GHz band returned greater throughputs than those of 2.4 GHz by 36.12% and 78.32%, respectively. The results also showed that bandwidth did not have much effect on the signal strength or RSSI.

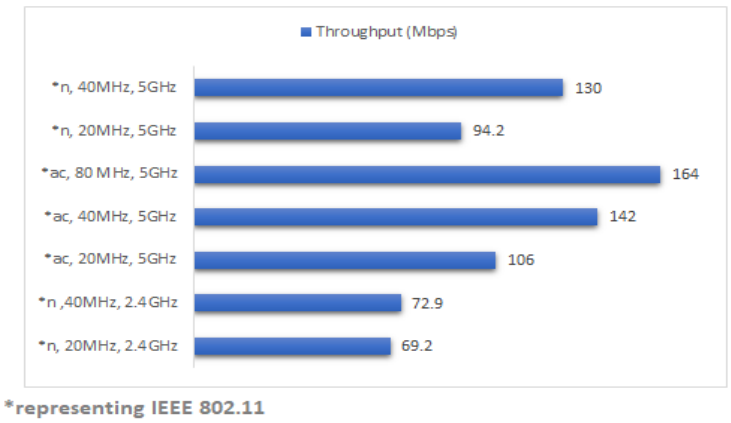

Fig. 2. Measured throughputs for various channel bandwidths using IEEE 802.11n and 802.11ac standards.

Internet Protocol: The results were in similar agreement for both IEEE 802.11n and IEEE 802.11ac standards as UDP protocol returned the higher throughput than one of TCP as shown in Fig 3. Besides, UDP protocol could transmit and receive data faster than TCP, although some data might be lost during the process. Results also showed that a protocol did not have any effect on signal strength. This can be explained as TCP protocol is connection-oriented that needs time to complete data transmission to the destination, whereas UDP is connectionless without the need of extra transmission time as in the previous case.

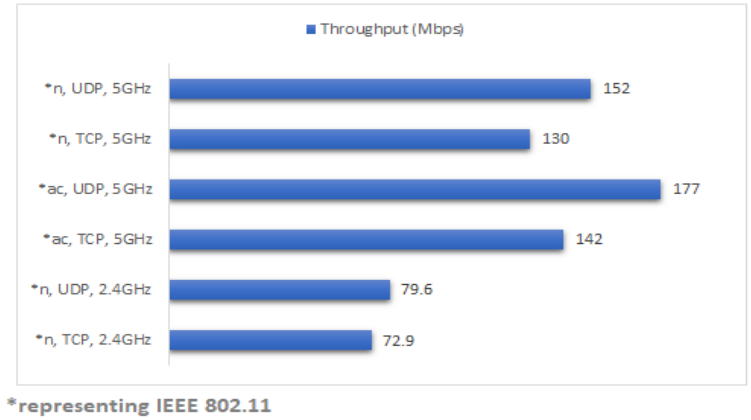

Fig. 3. Measured throughputs for different internet protocols using IEEE 802.11n and 802.11ac standards.

Internet Protocol Version: The results showed that the throughputs of IPv4 were higher than that of IPv6 for both IEEE 802.11n and IEEE 802.11ac standards as illustrated in Fig 4. These can be described as the size of IPv6 header is bigger than that of IPv4. IPv6 addresses are 128-bit binary numbers while IPv4 addresses are only 32-bits binary numbers. Besides, the results indicated that the protocol did not play a big role to the signal strength.

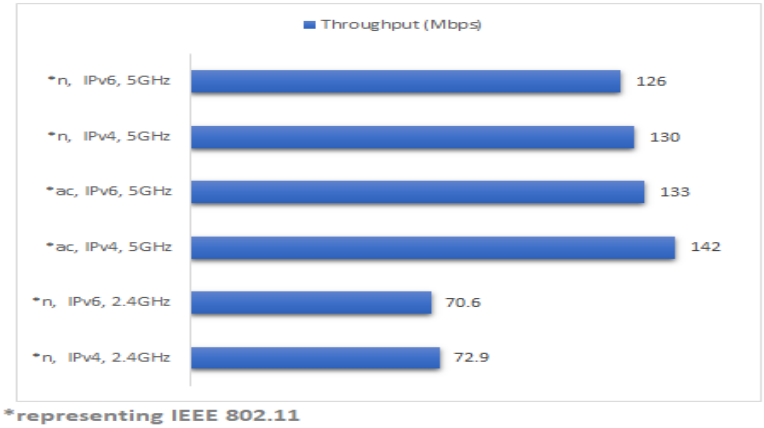

Fig. 4. Measured throughput comparison for IPv4 and IPv6 using IEEE 802.11n and 802.11ac standards.

Security or Authentication Mode: Fig. 5 shows the throughput comparison of various authentication modes for IEEE 802.11n, IEEE 802.11ac standards. By having authentication mode, the throughput decreased in the range of 0.77 % to 4.41% depending on the standard deployment. By applying WPA-TKIP authentication, the throughput decreased from the case without security by 0.77%, 1.42%, and 2.38% with 5GHz-IEEE 802.11n, 5GHz-IEEE 802.11ac, and 2.4GHz-IEEE 802.11n, respectively. While, in case of WPA2-AES, the numbers from previous comparison became 4%, 4.41%, and 3.55%, respectively. Thus, we have to make a trade-off between getting good data security and having large throughput for fast data rate.

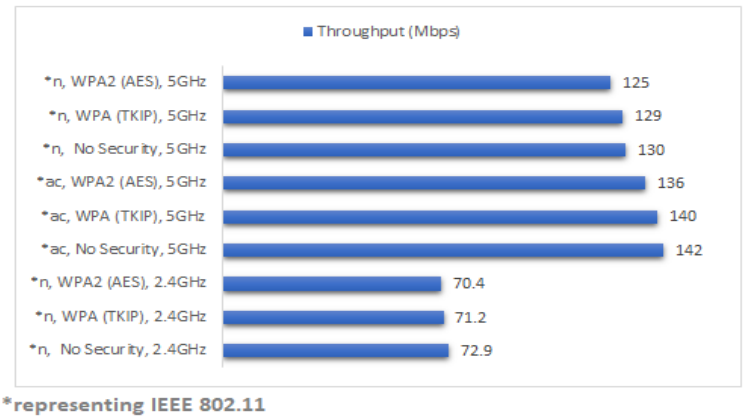

Fig. 5. Measured throughputs with no security, WPA, and WPA2 using IEEE 802.11n and 802.11ac standards.

Distance between access point and client: The test results for measured throughputs in several situations as a function of distance between access point and client are depicted in Fig. 6. At 1 m separation between a server and a client, IEEE 802.11ac on 5 GHz yields the maximum throughput of 142 Mbps that is better than ones of IEEE 802.11n on 5 GHz and 2.4 GHz for 9.23% and 94.78%, respectively. On the other hand, if the distance between client and server greater than 20 m, IEEE 802.11n on 2.4 GHz returned the best throughput.

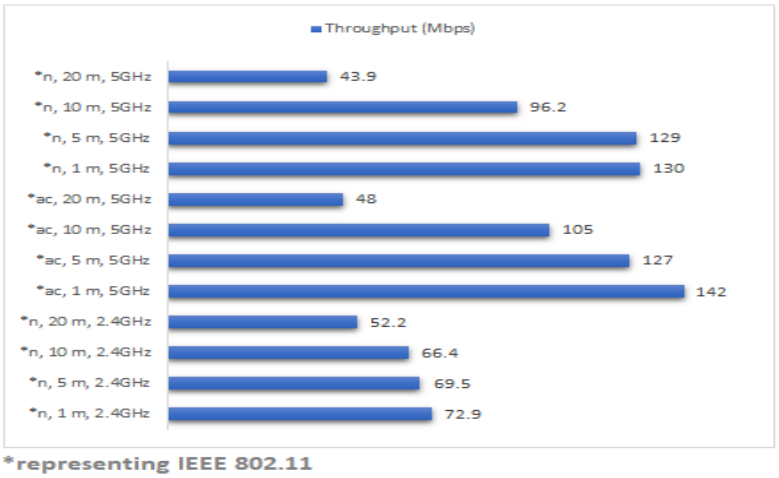

Fig. 6. Measured throughputs under a variety of distances between client and server using IEEE 802.11n and 802.11ac standards.

Distance with an obstacle of 15-cm thick wall placed between an access point and a client: The results in this case can be classified into 4 different distances between client and access point, 1 m, 5 m, 10 m, and 20 m as shown in Fig. 7. At the distance of 1 – 5 m, the 5GHz-IEEE 802.11ac gave the highest throughput. For the distance further than 10 m, the 2.4GHz-IEEE 802.11n provided the best throughput as expected due to the limitation of 5 GHz band on the obstacle. At 10-m separation, IEEE 802.11n yielded higher throughput than that of IEEE 802.11ac by 86.78%. However, both standards on 5 GHz frequency deployment returned very low signal power (lower than -80 dBm) at the distance 10 m onwards. The detected RSSIs in diverse situations are concluded in Fig. 8. It can be clearly seen that 2.4 GHz frequency yielded stronger signals than ones of the 5 GHz with the presence of a wall.

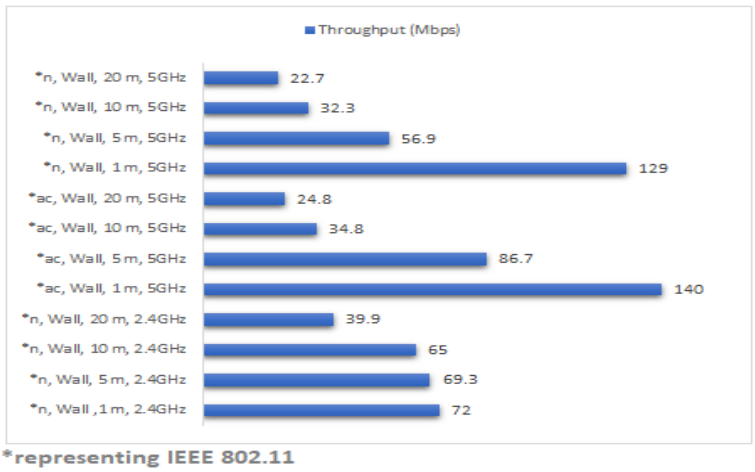

Fig. 7. Measured throughputs under different scenarios between client and server using IEEE 802.11n and 802.11ac standards.

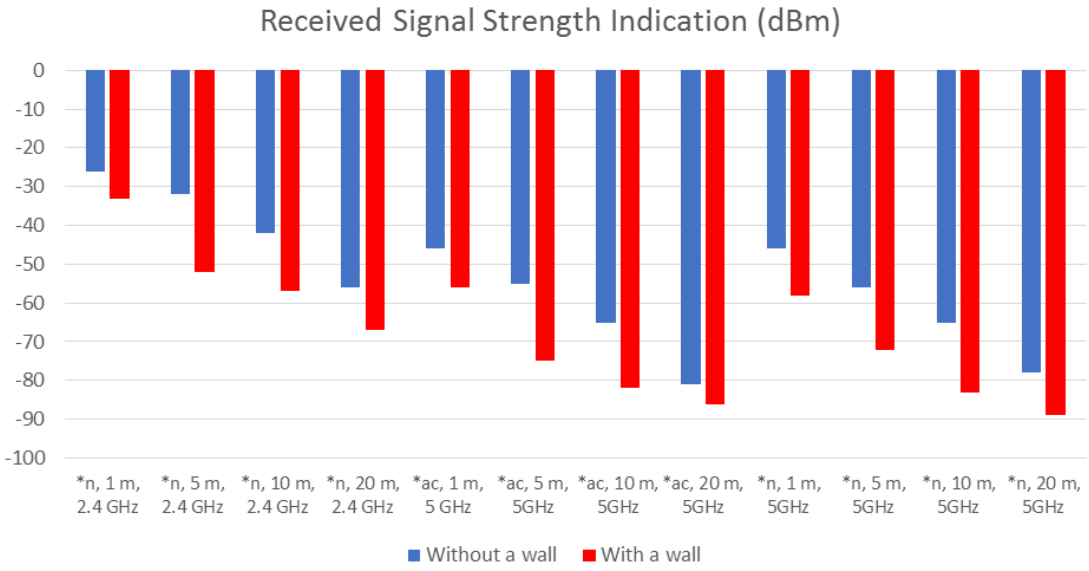

Fig. 8. Measured RSSI for various scenarios and standards.

Distance at 20 m plus beamforming technology: Beamforming technology was added into the testbed number 6 with 20 m separation between client and server. The results, shown in Fig. 9, indicated that both standards yielded the similar agreement as beamforming technology improved both throughput and RSSI. The utilization of IEEE 802.11n and IEEE 802.11ac on 5 GHz band with beamforming technology could improve the throughput up to 44.49% and 48.38%, respectively. Unlike the case of 5 GHz band, using such technology with 2.4 GHz-IEEE 802.11n could marginally improve the wireless performance.

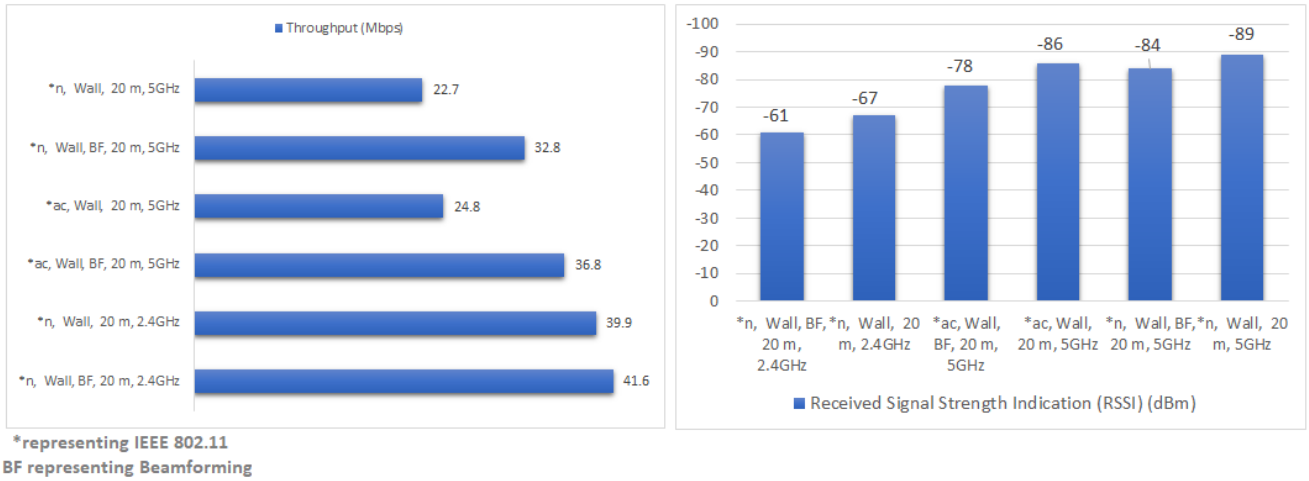

Fig. 9. Measured throughputs (Left) and received RSSIs (Right) with beamforming technology deployment at distance 20 m between client and server using IEEE 802.11n and 802.11ac standards.

Distance at 20 m plus MIMO technology: By adding MIMO technology into the previous testbed, the throughput could be increased by 39.63%, 30.43%, and 28.60% in case of using 5GHz-IEEE 802.11n, 5GHz-IEEE 802.11ac, and 2.4GHz-IEEE 802.11n, respectively. While, the RSSIs were marginally improved for both testing standards. The measured results are expressed in Fig. 10.

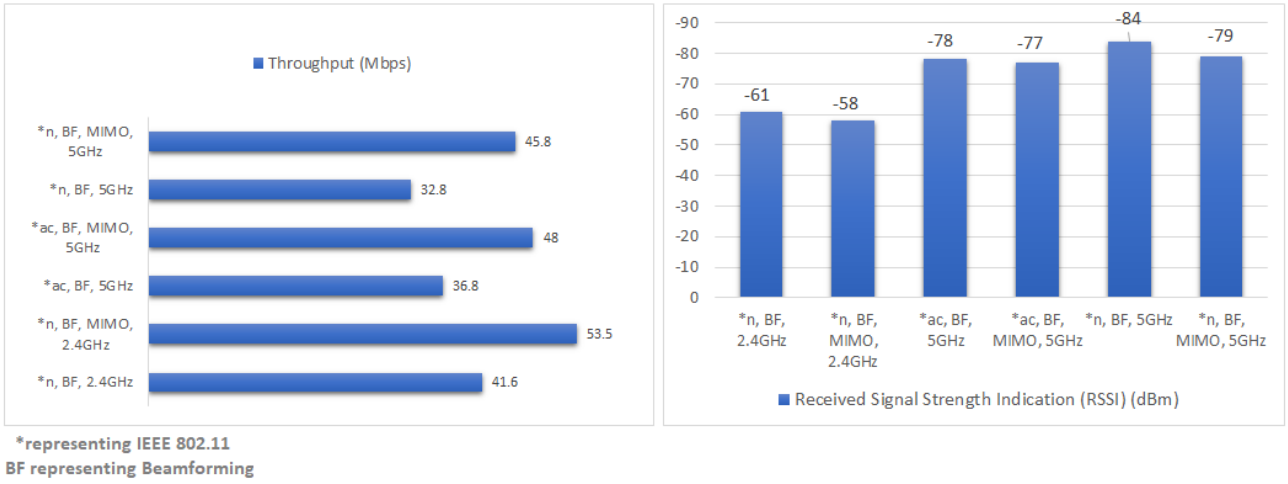

Fig. 10. Measured throughputs (Left) and RSSIs (Right) with beamforming and MU-MIMO technology deployment and at distance 20 meters between client and server using IEEE 802.11n and 802.11ac standards.

IV. Conclusion and Discussion

This paper reports the performance comparison of IEEE 802.11n and IEEE 802.11ac wireless technology on 2.4 GHz and 5 GHz bands. Eight different testing scenarios were performed to determine the throughput and the RSSI. The experimental results showed that, by increasing channel bandwidth from 20 MHz to 80 MHz for IEEE 802.11ac deployment, the throughput could be improved up to 54.71% and it showed no effect on the value of RSSI. In the area without any or slightly interference, we found that a user should set the highest value for channel bandwidth to achieve the largest throughput. The UDP Protocol yielded greater throughput than TCP protocol, but lost data may occur during the transmission. IPv4 returned higher throughput than IPv6 because the

size of its header is smaller than that of IPv6. By adding authentication mode, the throughput decreased by as much as 4.41%, subject to the security mode setting. For all of standard, WPA2 is recommended due to its security and little decease throughput. For the short distance between client and access point (less than 20 m), IEEE 802.11ac is recommended for wireless outdoor application. For wireless indoor area with an obstruction thicker than 15 cm, the IEEE 802.11ac standard still provide decent service at the distance between client and server less than 5 m, however, at the further distance than 5 m, the 2.4GHz-IEEE 802.11n is the best choice for throughput and signal strength aspects. With the help of beamforming technology and MIMO technique, they could improve both throughput and RSSI; therefore, users should activate these features on their devices. In conclusion, the experimental results confirmed that the IEEE 802.11ac yielded better performance than IEEE 802.11n on the same 5 GHz band in several scenarios. However, the comparison of performance between 2.4 GHz and 5 GHz bands using IEEE 802.11n showed that the higher the frequency returned better wireless performance except with the presence of some obstacles between client and server. Therefore, if users select proper technologies with suitable configuration settings, wireless devices can perform at the highest level.

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DEVELOPMENT OF READING ACTIVITIES FOR KINDERGARTEN 2 STUDENTS WITH AN APPLICATION

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Abstracts

This research aimed to 1) study reading behaviors of the early childhood children before, during, and after the experiment with an application and 2) to compare the early childhood children's development of reading behavior before, during, and after the experiment with the reading application. Samples in the study was conducted for 30 persons.2 kindergarteners who were studying in the second semester of academic year 2017 in Muang Ratchaburi Kindergarten, Ratchaburi province, sampled by purposive sampling. The study consisted of 8 week data collection for 3 days per a week, 20 minutes per a day, 24 sessions in total. The instruments of this research were reading promotion application and early childhood reading behavior observation form developed by the researcher with reliability (α) = 0.91 and reliability of observation (RAI) = 0.90. The data was analyzed using average score and standard deviation and then plotted as line graphs to compare the development of reading behavior in each group of the year-2 kindergarteners in each aspect every week. Wiscoxon Matched Pairs Signed-Ranks Test was used to test the hypothesis.

The result has shown that 1) reading behavior of the year-2 kindergarteners who were experienced with reading promotion application before, during, and after the experiment had significantly higher scores at p = .01. Increasing of the before experiment scores were measured from observation. During week 1, 2, 3, 4,5,6,7 and 8 the average scores were 9, 14.5, 18.6, 18.6,25.1,27.6,30.4,33.5 and 35.6 respectively. 2) There was a significant change in the year-2 kindergarteners' reading behavior before and after the experiment with reading promotion application at p = .05, 74.64 percent of the kindergarteners had higher reading development score accordingly.

Keywords: reading experience promotion, year-2 kindergartener, application

1.Introduction

Guidelines for practicing children's skill in the 21st century that is important for the goal of developing early childhood readiness for all changes (Early childhood education curriculum 2017: preface) Educators had found that well preparation for children with intelligence readiness highly affected their self-development (Prasart Isarapreeda, 2004:44) Piaget stated that well developed early childhood children must be developed cognitively (Sirima Pinyoanantapong, 2007:15-16) while cognitive development includes early childhood language development, consisting of listening, speaking, reading and writing. In-depth interviews of teachers from 78 schools in educational service area district 1, Ratchaburi province, had shown that out of 55 schools with early childhood education, most schools based their teachings on listening and speaking skills. From the lack of supports on accurate and clear pronunciation, kindergarteners appeared to be reading from symbolic images such as

vegetables and fruits instead of writing out children's names because they were unable to read or spell but they could tell what they saw.

Reading does not only important in early childhood but also significant and relevant to every individual's living regardless of their gender or age. Reading is considered highly essential as it is the basic skill toward learning of everything in the surroundings. To be good at reading also depends on good environment. As a group of students in Thailand uses their local language to communicate, using central language to communicate could create trouble in teaching (Wanida Sopaphan, 1987:1) .

Office of the Education Council (2005 : preface) had suggested that many aspects of language provision is needed for the creation of good language learning. The critical development of early childhood cognition is "reading". Whether what is read are books or other media, all could help promoting and creating appropriate learning behavior if the early childhood children could exercise the activity regularly. Furthermore, it would continually facilitate the development of thoughts indefinitely.

Children are currently born with technology that affects their social and environment (Hutchison & Reinking, 2011; Vanscoter & Ellis 2001); however, the selection of tools needs to be considered when utilizing such technology with early childhood children. Applications used in learning and teaching should emphasize the children ability to research, create alternatives to use their imagination together with solving problems by themselves. Current technology with touch screen command such as tablets could be utilized with early childhood children with ease. Shiffet, Toedo, and Matton studied the usage of tablets as a mean of children's cooperative learning and had found that when using tablets, children had higher development and able to cooperate with other children, besides they could share opinions and discuss among each other. This finding conformed to Bagan (2013)'s idea who stated that in order to utilize technology with children, teachers need to be able to integrate the technology with learning curriculum and the surrounding environment.

According to the aforementioned reasons, the researcher proposed to build an application that supports year-2 kindergarteners' reading experience so that they are able to devise around the clock learning, generate knowledge by themselves, and help learners to study in the way that suit their mental ability which would create true learning and ability to utilize knowledge in daily lives.

2.Objectives

2 .1 To compare early childhood children's reading skill before and after the provision with group reading application.

2.1. To compare early childhood children's reading skill among those who were provided with reading activity by application

3.Procedures

In this research, the researcher had proceeded through the following procedures respectively:

3.1 Determine population and samples

Population

The population of this research were year-2 kindergarteners in Muang Ratchaburi Kindergarden, Ratchaburi province who were studying in the 2nd semester of academic year 2017 at the time of the study.

Samples

Samples of this study was conducted for 30 persons.kindergarteners of Muang Ratchaburi Kindergarden, Ratchaburi province, who were studying in the 2nd semester of academic year 2017 at the time of the study, sampled by selective sampling.

3.2 Instruments

The researcher had created research instruments as follows:

3.2.1 Reading skill support application for year-2 kindergarteners were obtained by the following means:

3.2.1.1 Studied contents in early childhood education curriculum B.E. 2546.

3.2.1.2 Studied Muang Ratchaburi kindergarten's provisional plan for early childhood students.

3.2.1.3 Studied principles, concepts, theories and researches from papers to develop application for early childhood children.

3.2.1.4 Developed application to support year-2 kindergarteners' reading skill.

3.2.1.5 Presented the application to 5 experts for examination of appropriateness.

3.2.1.6 Improved the application as suggested by the 5 experts.

3.2.1.7 Tried out the reading skill support application with year-2 kindergarteners who were not, but similar to, the samples of this research to detect flaws of reading skill provision activity, then improved the activity once again to complete the development.

3.2.2 Created early childhood reading behavior observation form.

3.2.2.1 Studied documents, theories, textbooks that is relevant to early childhood education, and studied the development of early childhood reading skill.

3.2.2.2 Developed early childhood reading behavior observation form from the information gathered.

.3.2.3.3. Studied scoring criteria for early childhood. The criteria consisted of 3-level scale which teachers can choose the most suitable behavior and ability according to each child.

Level 1 is when a child cannot pronounce.
Level 2 is when a child can pronounce but need guidance from the teacher.
Level 3 is when the students can pronounce by themselves without any guidance

3.2.2.4 Presented the reading behavior observation form developed by the researcher to 3 experts to examine its reliability.

3.2.2.5 Adjusted the behavior observation form according to the opinions of at least 2 of the 3 experts which was an appropriate criteria.

3.2.2.6 Tried out the behavior observation form with kindergarteners who were not, but similar to, samples of this research to detect the flaws of the observation form and adjusted the form once again to complete the development.

3.2.2.7 Examined observational reliability by trying out the developed early childhood reading behavior observation form with 10 of year-2 kindergarteners who were not, but similar to, samples of this research. Observations were made by the teachers and researcher and calculated the obtained observation score to estimate the reliability according to RAI (Burry-Stock.1996:256). It was found that RAI = 0.90 which means that there were high level of consistency.

3.3 Data Collection

The researcher had scheduled the experiment in 8 weeks, 2 days a week, 16 session in total during the 2nd semester of academic year 2017.

3.4 Statistics

3.4.1 Descriptive Statistics including the mean and standard deviation.

3.4.2 Statistics used to examine quality of the instruments which were Cronbach's Alpha Method, Alpha coefficienct, and Rater Agreement Index (RAI).

4. Results

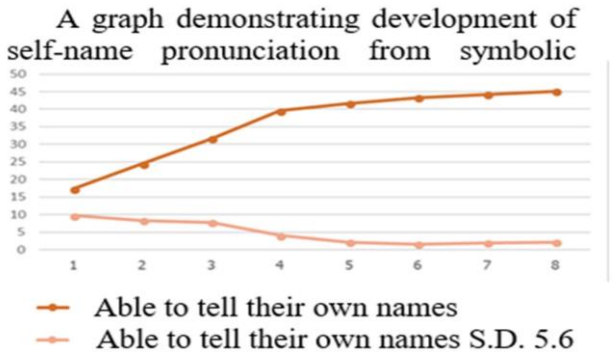
The analysis of the score of reading skill development by application in each aspects of the early childhood children was presented as follows:

Researcher calculated mean and standard deviation of the observed reading development score of early childhood children throughout 8 weeks, shown in table 1.

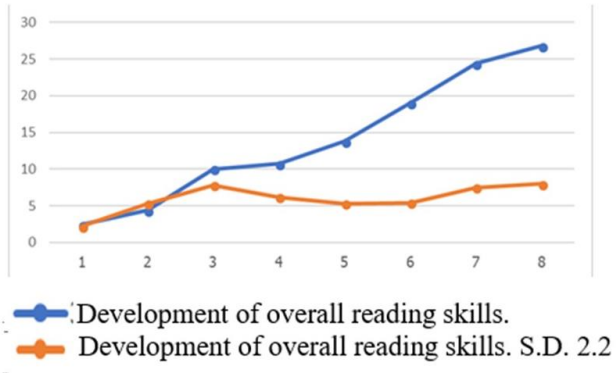
Development	Descriptive Statistics	Before Activity	Sessions of Activity							
			1	2	3	4	5	6	7	8
1. Able to tell name from the symbolic images.	$\bar{x}$	11.3	17.4	24.5	31.7	39.6	41.7	43.3	44.2	45.1
	S.D	5.8	9.7	8.4	7.8	4.1	2.2	1.6	2.0	2.2
2. Able to pronounce from the images seen.	$\bar{x}$	7.3	13.7	20.1	23.0	31.8	36.0	36.4	39.2	40.8
	S.D	1.6	5.5	5.3	4.6	4.7	3.5	3.9	2.9	3.1
3. Able to tell characteristic of the images seen.	$\bar{x}$	1.2	2.4	4.4	10.0	10.7	13.8	19.0	24.4	26.3
	S.D	2.2	2.2	5.3	7.8	6.2	5.3	5.4	7.5	3.0
4. Overall reading development	$\bar{x}$	5	9	14.5	18.6	25.1	27.6	30.4	33.5	35.6
	S.D	22	4.8	5.8	5.9	4.7	3.7	3.5	4.1	4.6

From table 1, the average reading score before taking the activity was moderate ($\bar{x}$ = 5). After considered each aspect, it was found that the highest mean score was 0-11.3. The highest score received belonged to the item that required children to tell their names ($\bar{x}$ = 11.3), followed by the item that required pronunciation from the seen images ($\bar{x}$ = 7.3), telling characteristics of the seen images ($\bar{x}$ =1.2), and overall development ($\bar{x}$ = 5), accordingly.

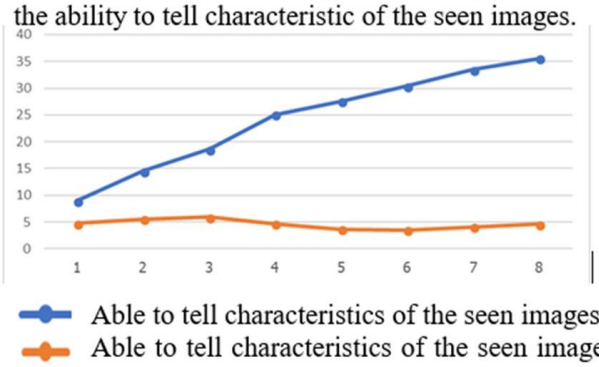
As for the analysis of all 4 aspects of reading development, the researcher presented the year-2 kindergarteners' scores in line graphs as follows:



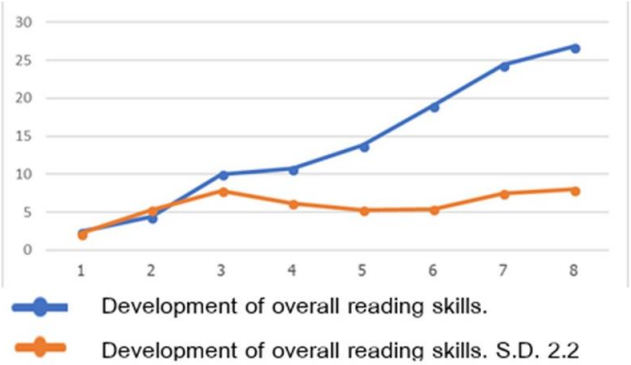
A graph demonstrating the development of overall reading skills.



A graph demonstrating the development of the ability to tell characteristic of the seen images.



A graph demonstrating the development of overall reading skills.



From the 4 graphs above, it is clearly shown that all aspects of reading skill has developed accordingly.

5. Conclusion

Early childhood children who participated reading skill support activity by application had significantly higher development at .05 level both before and during the experiment accordingly. The clear visibility of development was seen after the 4th week onwards.

6. Discussion

There were two important issues regarding the reading skill of the year-2 kindergarteners who were provided with the support by application that worth the discussion as follows.

Ability to read out their names from symbolic images. The result had shown that before the participation with reading skill support activity by application, 63.46 percent of year-2 kindergarteners had the reading skill. After the reading skill support activity, 91.46 of year-2 kindergarteners had the reading skill, which was 28 percent increased. Since the researcher had developed the activity that went step by step which was appropriate for year-2 kindergarteners, including every student's identity symbolic image so that they could choose from the application and tell which image belongs to who. If they could answer correctly, they would receive compliment from the application. This is congruent with the work of Ploy Supisa (2010) who studied the development and efficiency of provision using picture books in the story-telling as supplementary activity for year-2 kindergarteners which had found that language ability development score had significantly increased from before the provision at .05 level.

7. Suggestion

7 . 1 In order that early childhood children would fully gain language skills, teachers and parents should support listening, speaking, reading and writing both at home and in school.

7 . 2 Each activity created for early childhood children should also consider each child's ability as sometimes they might not be able to follow.

8. Acknowledgement

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LEARNING ACTIVITY PROVISION ACCORDING TO 4H LIFE SKILLS PRINCIPLE USING ONLINE LESSONS VIA GOOGLE SITE FOR EDUCATION INFORMATION SYSTEM MANAGEMENT COURSE

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Keywords: 4H Life Skills, Google Site, Education Information System Management Course

Abstracts

This research aimed to 1) compare academic achievements within Education Information System Management course, and 2) study satisfaction of learning activity provision according to 4H Life Skills Principle using online lessons via Google Site. Samples of this research were 30 of the 3rd year students who enrolled in Education Information System Management course in the 2nd semester of academic year 2017, Computer Education Program, Faculty of Education, Nakhon Si Thammarat Rajabhat University. The instruments used in the research were 1) learning activity according to 4H Life Skills using online lessons via Google Site, and 2) learner's satisfaction questionnaire toward the provision of learning activity according to 4H Life Skills using online lessons via Google Site. Statistics used to analyze data were Mean, Standard Deviation (S.D.) and t-test dependent for hypothesis testing. The result had shown that 1) after receiving the provision of learning activity according to 4H Life Skills principle, academic achievement was significantly higher comparing to before the provision at .05 level. 2) There were high level of overall learners' satisfaction toward the development of online lessons via Google Site.

Introduction

Learning methods should be adjusted so that they comply and balance with the changing world of competition. The new century of learning has arrived along with the new keywords, Teach Less and Learn More, which implies the alteration from former goal of knowledge to the goal of skills. Instructors are, as a result, redefined as a mere facilitator, or a coach, and the focus of learning is shifted to the learners, instead of the instructors. Thus, contents of learning must come from many different sources and must encourage self-learning in the learners [1], and behave as media that facilitate quality learning. Google Site is one of the online applications that could assist instructors' teaching because of its ability to link many parts of contents; whether they are files, audio, or video; that learners can easily, conveniently, and fast access. No matter where or when, self-learning can occurs.

Results of learning provisions from the past 3 academic years of the Education Information System Management course had shown that students had good level of learning results in each aspect. However, there is still a lack of an aspect of learning that comply with work and life skills which was reflected by the results of learning provision in each aspect and the evaluation of the learning provision in some activity that was shown to be less than 55 percent [2].

The researcher had studied learning activity provision of the Education Information System Management course for the 3rd year students of Computer Education program, Faculty of Education, Nakhon Si Thammarat Rajabhat University, using 4H life skills as a principle, including 1) Intelligent aspect of life skill (Head) 2) learning and practice aspect of life skill (Hand) 3) attitude aspect of life skill (Heart) and 4) health aspect of life skill (Health) [3]. Details of the activity, learning measurement, and evaluation concur with the learning results of the course. Furthermore,

as an instructor of the Education Information System Management course, the researcher had designed learning provision that concur with the aforementioned method in order to be the guideline for learning activity provision that can increase the outcome of the learning and to attract more of the learners' attention so that this teaching method could also become a prototype for learning activity provision for other courses.

Objectives

1. To compare academic achievements within Education Information System Management course.
2. To study satisfaction toward the learning provision according to 4H Life Skills principle using online lessons via Google Site.

Method

Population and Samples

Population was 60 of the 3rd year students of Computer Education program, Faculty of Education, Nakhon Si Thammarat Rajabhat University.

Samples were 30 of the 3rd year students of Computer Education program, Faculty of Education, Nakhon Si Thammarat Rajabhat University, sampled by purposive sampling.

Instruments

1) Online lessons of Education Information System Management course via Google Site.

2) Satisfaction questionnaire toward learning provision according to 4H Life Skills using online lessons via Google Site for Education Information System Management course.

Results

The researcher had presented results of learning provision according to 4H Life Skills principle using online lessons via Google Site for Education Information System Management course into 2 sections:

Section 1: result of academic achievement comparison within the Education Information System Management course, before and after learning provision.

Section 2: result of the study of learners' satisfaction toward learning provision according to 4H Life Skills using online lessons via Google Site for Education Information System Management course, details as follows:

Section 1: Result of academic achievement comparison within the Education Information System Management course, before and after learning provision, shown as table 1

Table 1: Result of academic achievement comparison within the Education Information System Management course, before and after learning provision.

Learning activity provision	Number (N)	Full score (Score)	Average score (Mean)	Standard Deviation (S.D.)	t-test
Before learning	30	25	11.00	0.94	21.59*
After learning	30	25	19.20	0.71	

*Significant at .05 level

Table 1 has shown that there were significantly higher achievement score after the learning provision at .05 level compared to before receiving learning provision as hypothesized.

Section 2: Result of the study of learners' satisfaction toward learning provision according to 4H Life Skills using online lessons via Google Site for Education Information System Management course, shown in table 2

Table 2: Result of the study of learners' satisfaction toward learning provision according to 4H Life Skills using online lessons via Google Site for Education Information System Management course.

List of Evaluation	Mean	S.D.	Level
1. 4H Life Skills learning provision aspect	**4.47**	**.88**	**High**
1.1 Compliance between learning activities and its objectives	4.52	.87	Highest
1.2 Corresponding between course contents and learning activities.	4.36	.86	High
1.3 Appropriateness of the duration of activities.	4.52	.92	Highest
1.4 Satisfaction towards 4H Life Skills learning provision.	4.48	.87	High
2. Instructor's provision of learning activity aspect	**4.45**	**.90**	**High**
2.1 Appropriateness of the instructor's technique.	4.56	.87	Highest
2.2 Interestedness of the instructor's presentation of content.	4.52	.87	Highest
2.3 Appropriateness of the instructor's time management.	4.36	.95	High
2.4 Completeness of the activity set.	4.36	.91	High
3. Benefit gained from the learning activity aspect	**4.46**	**.92**	**High**
3.1 Benefit gained from the learning activity	4.48	.92	High
3.2 Well-preparedness of the learning activity.	4.44	.92	High
3.3 Appropriateness of the applicability of knowledge.	4.52	.92	Highest
3.4 Satisfaction toward the overall provision of learning activity.	4.40	.91	High
Total	**4.46**	**.90**	**High**

Table 2 has shown that the result of the study of learners' satisfaction toward learning provision according to 4H Life Skills using online lessons via Google Site for Education Information System Management course was high in overall (Mean = 4.46).

When considered each aspect, the 4H Life Skills learning provision aspect (Mean = 4.47), followed by Benefit gained from the learning activity aspect (Mean = 4.46), and Instructor's provision of learning activity aspect (Mean = 4.45) had received high level of satisfaction.

Discussion

The development of online lessons via Google Site for the Education Information System Management course can be discussed as follows:

The comparison of academic achievement has shown that there were significantly higher academic achievement score for Education Information System Management course after learning (Mean = 19.20) compared to before learning (Mean = 11.00) at .05 level. This is compliance with the work of Laddawan Srichim and Buncha Sumruayruen (2016) who had studied the development of Web-based instruction using Google Site based on the constructivist theory which had shown that the academic achievement score after learning was 70 percent higher than the criteria, reflected the higher academic achievement as a result of utilization of online lesson. [4]

Result of the study of satisfaction had shown that learners' satisfaction toward learning provision according to 4H Life Skills using online lessons via Google Site for Education Information System Management course was high in overall (men =4.46). This is compliance with the work of Heather M. Gray and colleagues (2015) who stated that the utilization of information technology media and social media in learning provision could facilitate the learning outcome. Furthermore, it could facilitate students' learning and lead them to positive living. The presentation of media using features and colors that could draw learners' attention to participate the activity would help them learn with happiness and enjoyableness. [5]

Summary

The development of online lesson via Google Site for the Education Information System Management course entailed as follows:

The comparison of academic achievements had shown that there was significantly higher academic achievement score of Education Information System Management course after learning (Mean= 19.20) compared to before learning (Mean = 11.00) at .05 level, which complies with what was hypothesized.

The study of satisfaction had shown that learners' satisfaction toward learning provision according to 4H Life Skills using online lessons via Google Site for Education Information System Management course was high in overall (men =4.46).

When considered each aspect, the 4H Life Skills learning provision aspect (Mean = 4.47), followed by Benefit gained from the learning activity aspect (Mean = 4.46), and Instructor's provision of learning activity aspect (Mean = 4.45) had received high level of satisfaction.

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Textiles and Clothing Sustainability

The Influence of Hedonism on Fashion Impulse Buying Behavior among Teenagers in Thailand.

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Abstract

In recent research, Thailand retail market is expected to grow at a compound annual growth rate (CAGR) of more than 6 percent from 2016 until 2020. The economic growth of Thailand shows the predicted growth in fashion retail sector reaching $ 9.19 billion by 2020, growing at a CAGR of more than 3 percent. An increasing demand for clothing among teenagers in Thailand has become interested to explore. Moreover, there is an influence of hedonic motivation to their impulse buying. The purpose of this research is to study the influence of hedonism on fashion impulse buying behavior among teenagers in Thailand. The research tool used in is a mix-methodologies approach involves an analysis and observation. It used analysis of a chi-square test with the sample of 100 teenagers. The chi-square results show of $p < 0.01$ indicates a strongly significant of the hedonism with regard to fashion impulse buying behavior among teenagers in Thailand. In-depth interview finds the respondents are agree to buy fashion due to gain adventure, stimulation, and excitement. The respondents also said go shopping to cope and reduce stress, to elevate their mood, to follow fashion trend, to find the perfect gift for others, and shop when there are discounts. This finding and its dimensions have an impact on impulse buying, which will affect CAGR and finally economic growth.

Keywords: Hedonic, Impulse Buying, Fashion, Teenagers, Thailand.

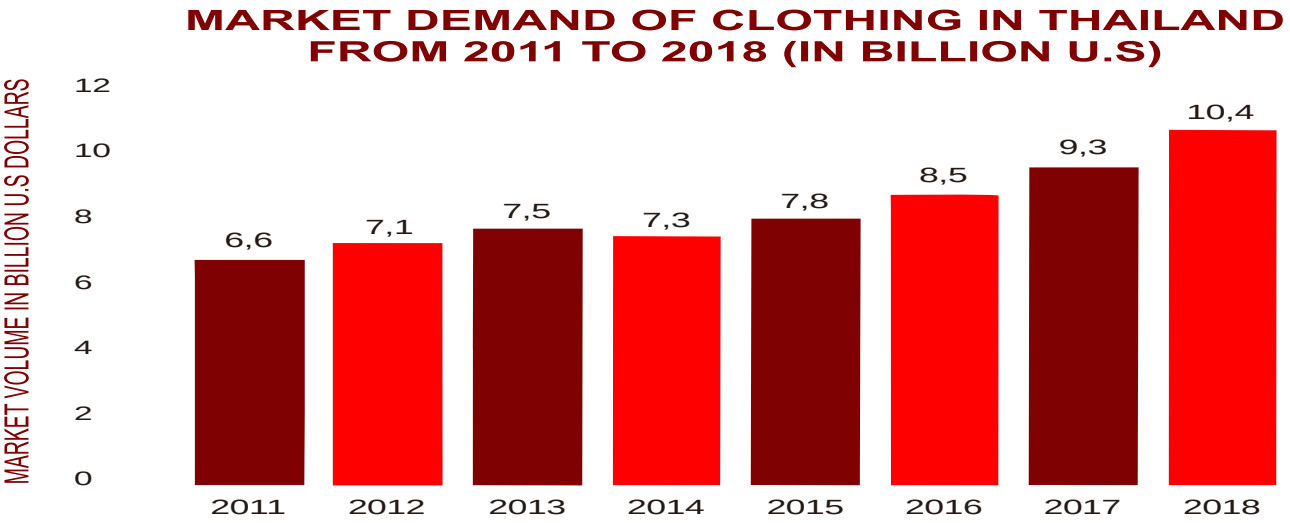
Introduction

Thailand is an upper middle-income country in South East Asia. It also has a continuous growth in the economy. In recent research, Thailand Retail Market 2016-2020, reveals that retail market is expected to grow at a compound annual growth rate (CAGR) of more than 6 percent from now until 2020. The economic growth of Thailand shows the predicted growth in fashion retail sector reaching $ 9.19 billion by 2020, growing at a CAGR of more than 3 percent [1]. Owing to that fact, Thailand becomes a competitive country in fashion retail in Asia.

Researchers have taken an interest in the study about fashion increasing demand due to consumer behavior that continuously evolved. Furthermore, the tendency of Thai teenagers to make impulse buying based on hedonic motivation become interesting to explore. Arnold and Reynolds (2003) emphasize the importance of hedonic motives in terms of impulse buying and declare that there should be studies focusing on the relationship between the hedonic motives and impulse buying [2]. Moreover, Scholars have taken an interest in impulse purchasing for over 50 years (Clover, 1950; Stern, 1962; Rook, 1987; Gardner and Rook, 1988; Peck and Childers, 2006) [2].

Fashion is a billion-dollar industry and fast evolving in many economies. Consumers generally tend to equate fashion with clothing and accessories which is an essential part of an individual's well-being (Holmberg & Öhnfeldt, 2010). Statistic data shows, Thai demand in fashion

has increased from 2014 to 2016, approximately 7.3 to 8.5 billion US Dollars. The forecast shows there will be a continuous growth in fashion demand until 2018 [3].



The survey conducted by shopper agency the Integer Group found that 90 percent shoppers buy items not on their shopping list, indicating that impulse buy is alive and well [4]. Owing to that fact, many fashion businesses are doing competition and improvement in order to gain more purchases from the targeted customer, especially teenagers. Fashion business considers teenagers buying behavior that based on hedonism motivation, among others: adventure shopping, social shopping, gratifications shopping, idea shopping, role shopping and value shopping. Based on that, many strategies have been created with the intention to make teenagers do more impulse buying.

The millennial generation has successfully been attention as a consumer benchmark in many studies, especially study the influence of hedonism on fashion impulse buying behavior. One of study that authors perceive relevant to support authors' research is the previous study in Thailand. According to the research the level of impulsive buying is higher in younger people as compared to other people. The study also reveals the preference of teenagers compared to old people in conducting the research. It based on consideration, when teenagers too young, they could not afford things, whereas if people become aging they have to think about their pension life [5]. Owing to the finding from the previous study, authors perceive the study is most suitable for teenagers.

Methods and Procedures

- Conceptual Framework

Some of the consumers are affected by motivational when shopping. These motivational aspects can be described as the adventure, socializing, taking pleasure, having an idea, exchange of values and roles (Arnolds and Reynolds, 2003) [5]. There is a tendency for consumers to buy impulsively when they are hedonistic and enjoy shopping (Hoch and Lowenstein, 1991; Dittmar et al., 1995) [5]. This paper focuses on six motivation of hedonism including adventure shopping, social shopping, gratification shopping, idea shopping, role shopping and value shopping. This study focuses on exploring those six hedonism' motivation with the connection to impulse buying behavior (see figure 2).

Data

In this study, authors use mix methods such as quantitative and qualitative methods. In quantitative methods, authors spread questionnaires of which the questions were arranged to be relevant to the topic under study. The sample for this study consists of 100 teenagers in Thailand, while 10 respondents partaking in the in-depth interview. Their age is between 18-25 years. In data analysis, authors perform chi-square (X^2) test analysis to examine the relationship between hedonism motivations on fashion impulse buying behavior among teenagers in Thailand.

Empirical Results

The questionnaires were completed by 68% female respondents and 32 % male respondents. The age range between 18-25 years. Results show that respondents are affected by 6 hedonic shopping motivation when making impulse buying (see Table 1).

Table 1: The influence of hedonism on fashion impulse buying behavior among teenagers in Thailand

Influence of Hedonism	Impulse Buying					Total	X^2 value	X^2 Prob
	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree			
Adventure Shopping	5%	18%	41%	30%	6%	100%	63.375[a]	0.000
Social Shopping	2%	11%	42%	43%	2%	100%	78.971[a]	0.000
Gratification Shopping	2%	9%	52%	36%	1%	100%	31.747[a]	0.002
Idea Shopping	0%	6%	26%	57%	11%	100%	26.771[a]	0.008
Role Shopping	0%	5%	25%	66%	4%	100%	41.187[a]	0.000
Value Shopping	0%	3%	19%	61%	17%	100%	26.183[a]	0.002

Hypothesis

HO: There is no significant influence of hedonism on fashion impulse buying behavior among teenagers in Thailand.

H1: There is a significant influence of hedonism on fashion impulse buying behavior among teenagers in Thailand.

Table 1 shows the chi-square p-value of 6 motivation of hedonism, among others: (0.000), (0.000), (0.002), (0.008), (0.000), (0.002) are less than α value (0.01). HO is rejected indicating that there is a strongly significant relationship between hedonism in relation to the fashion impulse buying behavior

among teenagers in Thailand. The highest percentage of respondents (66 %) who select Role shopping, agree that there is the influence of hedonism on their impulse buying decision.

In-depth Interview

10 respondents are partaking in-depth interview. The respondents claimed they are agree to buy fashion due to gain adventure, stimulation, and excitement. They also said went shopping to cope and reduce stress, to elevate their mood, to follow fashion trend, to find the perfect gift for others, and shop when there are discounts.

Discussion

This paper finds the results of the significant relationship between six hedonic motivations in relation to fashion impulse buying behavior among teenagers in Thailand. The benefit of this study is giving a finding of hedonic motives and its dimensions that affect impulse buying. Moreover, the study also gives the benefit in marketing sectors to plan its marketing strategy to targeted customers. The further study about the relationship between those variables still needs to be conducted in order to gain a better approach. It is based on consumer behavior that continuously changes and make researchers have to follow their massive development.

Conclusion

The paper explores the relationship between hedonism on fashion impulse buying behavior among teenagers in Thailand. The population of this study is Thai teenagers in 2017. Their ages are between 18-25 years old. Result find there is a significant relationship between hedonism motives on fashion impulse buying behavior among teenagers in Thailand. This finding is expected to be a source of reference that hedonism was a motive in making fashion purchases. The benefits of this study help to further explore the influence of hedonism on impulse buying behavior among teenagers in Thailand from the previous studies. In addition, this research is also intended to help the fashion business in optimizing its product sales and gives the benefit in marketing sectors to plan its marketing strategy to targeted customers.

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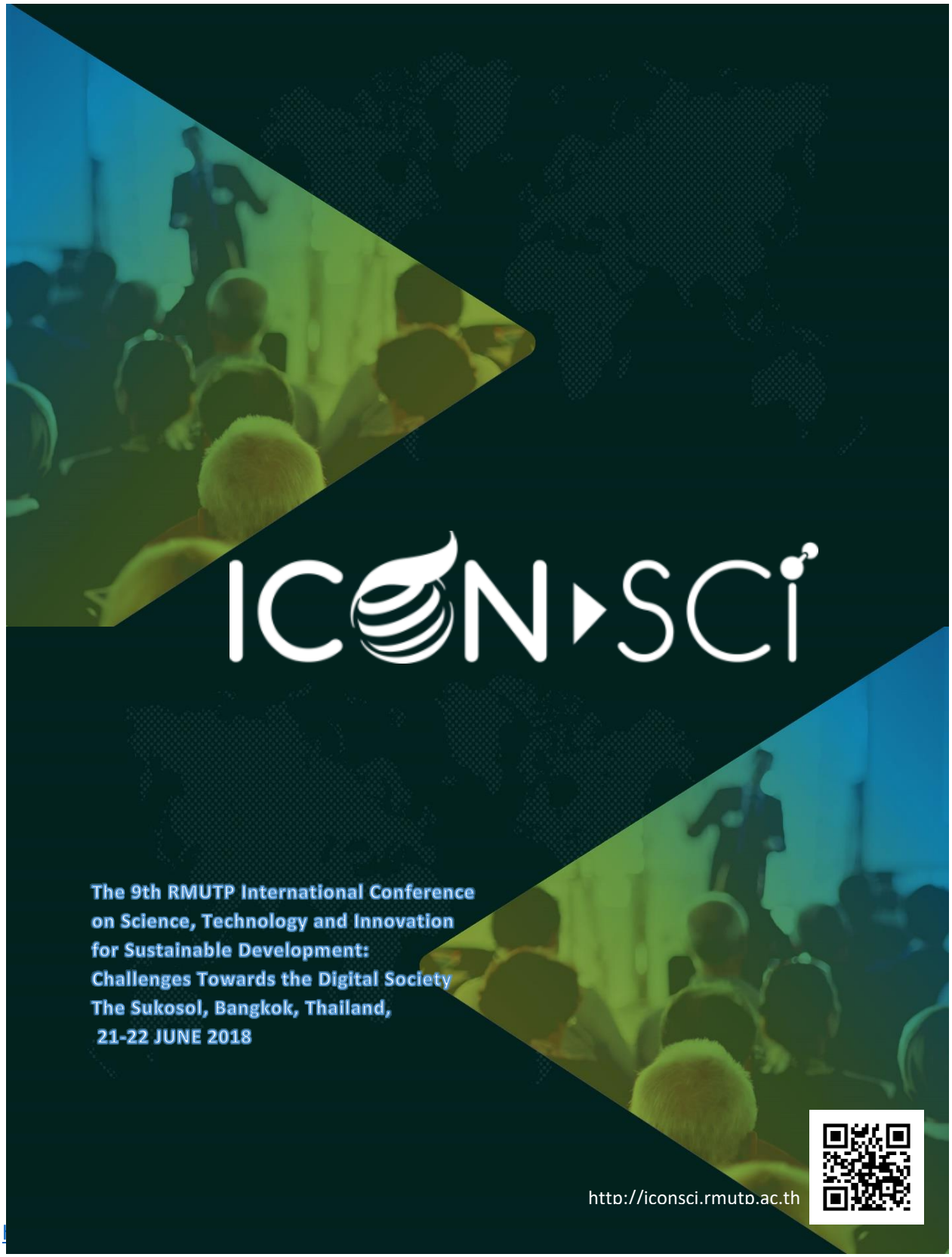
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