Himpunan Kimia Indonesia

6th ICICS South Sumatera 2017

The 6th International Conference of the Indonesian Chemical Society 2017

PROGRAMME AND ABSTRACTS BOOK

Palembang, Indonesia October 15 – 20, 2017

http://icics.kimiawan.org

The 6th International Conference of the Indonesian Chemical Society 2017

Hotel Horison Ultima, Palembang, Indonesia

October 15 - 20, 2017

The 6th Himpunan Kimia Indonesia (HKI) annual conference on Tue-Wed, 17-18 October 2017, is organized by South Sumatera Branch of HKI in collaboration with Sriwijaya University (Unsri) and South Sumatera Province. South Sumatera was selected as the location for 2017 HKI annual conference in HKI National Meeting 2014, 3 years ago, in Ambon, Maluku. This is a bilingual conference (Indonesian and English), which means that the paper can be written in English or Indonesian language (Bahasa Indonesia), and the presentation can be delivered in English or Bahasa Indonesia.

Before, parallel to, or after the conference, there will be several satellite activities (workshop, etc.), including a meeting of the Forum of Head of Chemistry Departments in Indonesia (Temu Forum Ketua Jurusan/Prodi Kimia dan Pendidikan Kimia se-Indonesia 2017, Temu FKJKI-2017), contact: fkjki-2017@kimiawan.org) that will be started in the evening (19.00) of 17 October 2017. Any chemistry-related communities/institutions could register other satellite activities (one-day workshop, symposium, training, etc.) to icics-2017-satellite@kimiawan.org, to be offered to conference attendees. Satellite activities could be held in any date between 3 October to 31 October 2017.

One day before the conference, on Monday, 16 October 2017, HKI Congress will be held to find the next President-Elect of HKI. The elected person will be the next President-Elect of the Indonesian Chemical Society from 1 January 2018 to 31 December 2018, while Dr. Tatas Brotosudarmo will be the President of HKI.

Speach by Chairman

Assalamualaikum waromatullahi wabarakatu,

Dear Distinguished Guests and Participant,

We cordially welcome you to the 6th International Conference of Indonesian Chemical Society in Palembang South Sumatera. This conference is organized by the Indonesian Chemical Society (HKI) and Chemistry Department Faculty of Mathematics and Natural Sciences Sriwijaya University (Unsri) supported by LPPM Unsri.

I would like to inform some formal information related to this conference. The conference's theme is "Stimulating of Advanced Perspective and Current Concepts on Chemistry field". The goals of conference are to provide a vehicle the state of the art in research results and trends in chemistry field, to offer interaction, discussion and possible collaboration among chemist and the public about chemistry, to increase awareness of policy makers and public on chemistry's rule in national development.

This conference consists of 4 keynotes speakers from USA, Japan, Solomon Island, 8 invited speakers, and 229 participants who deliver as oral or poster presenters. Accompanying this conference, there are some activities: Indonesia high level meeting on chemical security by Sandia USA (15-16 October), Congress of PNHKI (16-17 October), FKJKI meeting (18 October), and Palembang city tour (19 October).

We are sincerely grateful to welcome honorable keynote speakers, distinguished invited speakers and excellent of participants for sharing their knowledge in this conference.

The keynote speakers in this conference are :

1. Dr. Andrew W. Nielson (Sandia National Laboratories, USA)
2. Prof. Hisao Yoshida (Kyoto University, Japan)
3. Prof. Dr. Basil Shelton Marasinghe (Solomon Island National University, PNG)
4. Drs. Muhammad Abdulkadir Martoprawiro, Ph.D (ITB, Indonesia)

The Invited Speakers are :

1. Prof. Dr. Subandi (UM, Indonesia)
2. Prof. Dr. Suyanta (UNY, Indonesia)
3. Prof. Aldes Lesbani, PhD (Unsri, Indonesia)
4. Dr. Jarnuzi Gunlazuardi (UI, Indonesia)
5. Dr.rer.nat. Didin Mujahidin (ITB, Indonesia)
6. Dr. Muktiningsih Nurjayadi (UNJ, Indonesia)
7. Dr. Sal Prima Yudha S. (Unib, Indonesia)
8. Prof. Dr. Muhammad Bachri Amran (ITB, Indonesia)
9. Dr.rer.nat. Ria Armunanto (UGM, Indonesia)

I would like also to express thanks and appreciation to the organizing committee for their cooperative work and efforts to make our conference a success.

Finally, I would like to thank to all participants and their respective institutions that have made this conference possible and I wish you all have a pleasant meeting.

Waalaikumsalam warohmatullahi wabarakatuh

Hermansyah, M.Si., Ph.D.

Chairman of Organizing Committee

The 6th International Conference of Indonesian Chemical Society

Forward by the Dean

In the Name of Allah, the Most Beneficent, the Most Merciful.

It gives me a great pleasure to welcome you to the 6th International Conferences of Indonesian Chemical Society (ICIC) 2017 organized by the Department of Chemistry Faculty of Mathematics and Natural Sciences University of Sriwijaya in collaboration with the Indonesian Chemical Society. The theme for this conference is "*Stimulating of Advanced Perspective and Current Concepts on Chemistry Field*".

I am very happy and grateful that many distinguished Academicians, Scientist, Researchers and practitioners of Chemistry have come from both home and abroad to share their knowledge and experience. On behalf of the Faculty of Mathematics and Natural Sciences University of Sriwijaya, I would like to take this opportunity to express our deep appreciation for all of national and international keynote speakers as well as invited speakers for their willingness to come to Palembang and honoring us a keynote speeches for this conference. I also wish to give special thanks to the Sandia America that has hold a special workshop on the "*Indonesia high level meeting on chemical security*" for the last two days. Last but not least, I would like to extend our appreciation to the Indonesian Chemical Society, government, university colleagues and companies for their continued and invaluable support to make this meeting a success.

I sincerely wish you would have most productive days of interesting and stimulating discussions. I believe that this conference is a great opportunity not only for sharing knowledge and experience in chemical research, but also for starting a long and fruitful cooperation and friendship among Academicians, Researchers and practitioners of Chemistry.

Finally, I would like to thank and congratulate the organizing committee for their dedication and tremendous efforts in organizing the conference. I wish you all an enjoyable meeting and fruitful discussion.

Prof. Dr. Iskhaq Iskandar, M.Sc.

Dean, Faculty of Mathematics and Natural Sciences
University of Sriwijaya

Speach by Rector of Sriwijaya University

Bismillahirrohmaanirrohim

Assalamualaikum warohmatullahi wabarakatuh,

In the name of Alllah SWT and all praise belongs to Him who is blessing us today to come and attend this important conference.

In accordance with the university status as a research university, it is important for the university to disseminate new research findings and discoveries in the community, the nation and the world. I am pleased that Chemistry Department Faculty of Mathematics and Natural Sciences Sriwijaya University (Unsri)supported by LPPM Unsri collaborate with the Indonesian Chemical Society (HKI) have organized the sixth international conference of Indonesian chemical society (ICICS) in Palembang.

With the theme of this conference, "Stimulating of Advanced Perspective and Current Concepts on Chemistry field". I believed that this conference served as platform for the discussion and dissemination of research findings information on research trends, and latest development in the area of chemistry. It is hoped that this meeting of academicians, researchers,and professionals from universities, government institutions, research institute, and private companies can lead to much bigger things in the future.

Therefore, I sincerely expect this conference generate more cooperation in research and education. Such cooperation can lead to progress in all areas of chemistry for the welfare of mankind.

By this conference also I hope that it facilitates Indonesian chemists to publish their research results in reputable journal/proceeding.

I am sincerely grateful to welcome honorable keynote speakers, distinguished invited speakers and excellent of participants for sharing their knowledge in this conference.

This conference will be able to meet our goals and objectives and provide a rewarding experience to all participants, from local and international. My appreciation also goes to the organizing committee for making this conference a success.

I take this opportunity to thank and to appreciate the Sandia and CRDF United State of America which have hold the workshop on 'Indonesia high level meeting on chemical security' on October 15-16, 2017.

Congratulation also address to Indonesian chemical society and head of chemistry department from Universities in Indonesia for their annual national meeting and congress during this conference.

Finally, in anticipation of successful conference, in the name of Allah, the beneficient, the merciful.

"Bismillahirrohmaanirrohim"

I hereby officially open the 6th International Conference of Indonesian Chemical Society 2017"

Good luck, I wish you all an enjoyable meeting and fruitful discussion.

Wassalamualaikum Warohmatullohi wabarakatuh.

Prof. Dr. Ir. AnisSaggaf, MSCE.
Rector of Sriwijaya University

Conference Activities

TIMELINE		ACTIVITIES
Sunday, Oct 15, 2017	09.00–16.00	High Level University Meeting on Chemical Security **(Sandia Laboratory, USA)**
Monday, Oct 16, 2017	09.00–16.00	High Level University Meeting on Chemical Security **(Sandia Laboratory, USA)**
	13.00 – 17.00	**Indonesian Chemical Society Forum Meeting**
Tuesday, Oct 17, 2017	08.00–16.00	ICICS Seminar
	19.00-21.00	Indonesian Chemical Society Congress
Wednesday, Oct 18, 2017	08.00–16.00	ICICS Seminar
	08.00–16.00	Department Chief of Chemistry Meeting
Thurday, Oct 19, 2017	08.00–16.00	**City/Musi Tour**
	13.00–17.00	**Computational Chemistry Workshop**
Friday, Oct 20, 2017	08.00–16.00	**Computational Chemistry Workshop**

keynote SPEAKERS

Prof. Hisao Yoshida,
Kyoto University, Japan

Andrew W. Nelson, Ph.D, MPH
Sandia Lab, USA

Prof. Dr. Basil Shelton Marasinghe,
Solomon Islands National University, PNG

Drs. Muhamad Abdul Kadir Martoprawiro, PhD
Chemical Society, Indonesia

invited SPEAKERS

Prof. Jarnuzi Gunlazuardi, Ph.D.
Universitas Indonesia

Prof. Aldes Lesbani, Ph.D.
Universitas Sriwijaya

Dr. rer.nat. Didin Mujahidin
Institut Teknologi Bandung

Dr. Multiningsih Nuryandi
Universitas Negeri Jakarta

Dr. Salprima Yudha S.

Universitas Bengkulu

Dr. Suyanta

Univ. Negeri Yogyakarta

Prof. Dr. Subandi

Univ. Negeri Malang

Prof. Dr. Muhammad Bachri Amran

Institut Teknologi Bandung

Dr.rer.nat. Ria Armunanto.

Universitas Gadjah Mada

keynote SPEAKS

Photocatalysis in various chemical reactions

Hisao Yoshida*

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Photocatalyst can catalyze various chemical reactions by using photoenergy. When the semiconductor photocatalyst absorbs a photon, an excited electron and a hole are generated at the conduction band and the valence band, which can promote reduction reaction and oxidation reaction, respectively, at the surface. This mechanism is quite different from that of the conventional catalysis, that is, the adsorption of the molecule makes the molecule be active. The application of photocatalysis can be classified into three: utilization for environmental application, energy conversion, and unique chemical reactions. The first is nowadays quite popular in literature: the photocatalysts can promote degradation of many kinds of organic compounds even in aqueous solutions, in air, or on the surface of materials to keep them pure and clean. This will contribute to the comfortable environment of our life. The second is the solar energy conversion to chemical potential, e.g., hydrogen production via water splitting, carbon dioxide conversion to useful chemicals and so on. This class is quite important for utilization of the sustainable solar energy and contribute to solving the energy and environmental issues. The last is also attractive: photocatalyst can realize new types of catalytic reactions that cannot proceed in the conventional methods. These kinds of photocatalyses will open a new field of chemistry. In the lecture, I will introduce several unique photocatalytic reactions by using some kinds of photocatalysts that we have developed so far, such as methane conversion, reduction of carbon dioxide, and organic synthesis.

Keywords: hydrogen, splitting, semiconductor, energy, conversion

Advancing Chemical Sciences in Indonesia by Attracting More Students to Chemistry

Basil Marasinghe*

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In order to advance chemical sciences in any country, it is important to get best students to study chemistry. To achieve this object, chemistry has to be made very attractive to students. 10-15 years ago, chemistry was not an attractive subject among undergraduates in Papua New Guinea. 12 years ago the author set about introducing several measures to make chemistry more popular among undergraduates. They included the use of information technology, introduction of weekly industrial visits and work experience programs in chemical industries, moving away from tests and examination being memory based to those based on understanding concepts and processing of knowledge, making learning more students centred than teacher centred, discussions on ethnochemistry and last but not least, addition of some humour to chemistry. This paper details some of these measures which most probably have led to a significant turnaround in students' attitude to the subject and its increased popularity among them.

Keywords: ethnochemistry, ethnomedicine

The Evolution of Chemical Risk Management

Andrew W. Nelson

International Biological and Chemical Treat Reduction Sandia National Laboratories, Albuquerque, USA

Abstract / presentation could be downloaded from:

docs.kimiawan.org/icics/andrew.pdf

If requested, fill in user: **icics** password: **2017**

Computational Chemistry in Indonesia

Muhamad Abdul Kadir Martoprawiro*

Department of Chemistry, Institut Teknologi Bandung

Abstract / presentation could be downloaded from:

docs.kimiawan.org/icics/muhamad.pdf

If requested, fill in user: **icics** password: **2017**

invited SPEAKS

Artificial Photosynthesis for Water Splitting: New Device Type Based on Modified Dyes Sensitized Solar Cell Having Catalysis Zone Extension.

Jarnuzi Gunlazuardi

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Water splitting induced by visible light is one of the interesting tasks to produce hydrogen (fuel). However to split water in to hydrogen and molecular oxygen by visible light induction is a difficult task. Titania (TiO_2 crystal) was reported being able to split water[), but need light with wave length less than 410 nm. Fortunately, titania can be composited with other small band gap semiconductor but has a conduction band level slightly higher (e.g. CdS). The visible light excites electron of CdS to its conduction band, that will flow down to the titania's conduction band. Hence the CdS/Titania system is considered as visible light active semiconductor composite. Having this system along with ability to morphologically control of highly ordered titania nanotubes array film[), we developed a system that have a potential to produce hydrogen from water under induction of visible light. A Highly Ordered Titania Nanotubes (HOTN) arrays have been successfully prepared by electrochemical oxidation of titanium metal sheet in a viscous electrolyte. The electrolyte comprises of ethylene glycol and water containing fluoride ion. By varying anodization voltage and time, at certain electrolyte composition, a typical tube length (2 - 7 µm) , inner tube diameter (40 – 80 nm), and thickness of the tube's wall (10 – 27 nm) can be controlled. The prepared HOTN then was sensitized by CdS nano particle by a SILAR (successive ionic layer adsorption and reaction) method[6)]. The resulting CdS/HOTN showed excellent response toward visible light. The obtained CdS/HOTN then was employed to construct a modified dyes sensitized solar cell (DSSC) having catalysis zone extension. To assembly the modified DSSC, the HOTN sheet was prepared carefully, in which half part of HOTN was sensitized by CdS (hence CdS/HOTN), dedicated as DSSC zone and another half part was leave it uncovered, managed as catalysis zone. The DSSC zone is a sandwich of CdS/HOTN, electrolyte (Na_2S/S; KCL in methanol water), and Pt/SnO_2-F Glass. Upon absorbing light, the CdS in the DSSC produce exited electron that flow to titania and subsequently migrate to the catalysis zone. The "hot" electron in the catalysis zone eventually reduce proton (water) in its adjacent to generate hydrogen. The deficit electron in CdS semiconductor (valence band) will be compensate by electrolyte in the DSSC zone, which will have uptake electron from the counter electrode in catalysis zone. So in the catalysis zone there will be reduction reaction of water (proton) to produce hydrogen (acceptor electron from the DSSC zone) and oxidation reaction of water to produce molecular oxygen or hydroxyl radical (donor electron to the DSSC zone). As long as light strike the DSSC zone the catalysis zone will eventually produce hydrogen.
The above modified DSSC which employing CdS/HOTN absorb visible light and convert it to energy which induce a chemical reaction in the catalysis zone to produce hydrogen from water. In our typical modified DSSC, when the active counter electrode (semiconductor) was being employed, the system can split water to hydrogen and molecular oxygen, by solely visible light, thus a kind of artificial photosynthesis. The proof of concept and features for further development will be discussed.

Keywords: Water Splitting; Hydrogen; Titania nanotubes; Cadmium Sulfide; Artificial photosynthesis

Supramolecular Ionic Crystals Based on Polyoxometalates-Organometallic Complexes

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Polyoxometalates are early transition metal oxygen anions clusters, which have various properties such as acid bases, redox potentials, shapes and structures, and solubility depending on counter ions. The researches of polyoxometalates are rapidly growing in this decade due to application not only in laboratory but also in industrial scales such as supramolecular building blocks, catalysis, membranes, adsorbents, and also sensors. In this report, polyoxometalates are used as anions in reaction with organometallic complexes as cations to form supramolecular ionic crystals. Several kinds of polyoxometalates and organometallic complexes are used in order to know the structural effect for formation of supramolecular ionic crystals. The applications of these

supramolecular ionic crystals are also addressed especially for separation and catalysis.

Keywords: ionic crystal, polyoxometalate, organometallic complexes

The Utilization of Palm Oil as Renewable Block Building Source in Chemical Industry

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Palm oil is one of the important national commodity and contributes significantly to the national income in Indonesia. Modern chemical reaction can modify the palm oil components into fatty acid derived high economic value materials, in addition to the palm oil utilization in food industry, traditional oleochemicals and fuels. Oleic acid is the major components in palm oil with a content of ca. 40%. Ethenolysis of methyl oleate successfully furnished methyl 9-decenoate and 1-decene via cross olefin metathesis reaction in the presents of Grubbs II catalyst. Valorization of methyl 9-decenoat as a new building block have an important role as renewable building block on further transformation to produce many high-value chemicals. In this presentation, we will show the transformation of methyl 9-decenoate in the synthesis of several potential monomers and the synthesis of civeton. The well-defined strategy on a target-oriented transformation could be a great contribution of organic chemical synthesis in improving the economic value of palm oil.

Keywords: palm oil, oleic acid, olefin metathesis, renewable building block.

Immunogenicity Evaluation of Recombinant Fim-C *S. Typhi* Protein as Typhoid Vaccine Candidate on Wistar Rat to Increase the Quality of Urban Health in Indonesia

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Typhoid fever is a world health problem and often occurs in developing countries, including Indonesia. The cause of typhoid fever in humans is *Salmonella typhi* bacteria. Transmission of the disease is generally through a pattern of life that is less healthy and hygienic. In a previous study, the UNJ Salmonella team had successfully isolated, cloned, expressed, and purified recombinant protein Fim-C *S. typhi* inclusion bodies sized 31 Kilo Dalton (KDa). Furthermore, these proteins have been used as antigen in immunogenicity test with ddY mice as test animals and give excellent results. This study aims to determine the immune response of rodent test animals with higher levels against recombinant protein Fim-C *S. typhi* inclusion bodies as antigen. Immunogenicity test was performed using male Wistar rats. That were divided into five test groups: Normal group (control, without injection), Control Group 1 (injected with PBS), Control Group 2 (injected with Adjuvant FCA/FIA), Samples Group 1 (injected with Fim-C Inclusion Bodies S. typhi protein), Samples Group 2 (Injected with Fim-C Inclusion Bodies S. typhi plus Adjuvant FCA/FIA protein). The results of the ELISA (Enzyme-Linked Immunosorbent Assay) analysis showed an increase in antibody titers produced by Wistar rats after subcutaneous injection with Fim-C protein emulsified adjuvant or without adjuvant. The result of analysis by Western Blot method showed the specific interaction between Fim-C *S. typhi* antigen with anti-Fim-C *S. typhi* antibodies. Data obtained from both methods confirm that the antigen has a high immunogenicity. It can be concluded that recombinant protein Fim-C *S. typhi* inclusion bodies can be used as a potential vaccine candidate for typhoid disease. These results are expected to be an alternative in the discovery of new vaccines that can improve the quality of life of Indonesian society.

Keywords : Typhoid Fever, Fim-C S. Typhi, Recombinant Protein, immunogenicity test, Wistar Rat

Biomolecules-Mediated Synthesis of Gold and Silver Nanoparticles: Recent Developments

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An environmentally-friendly approach was developed to synthesize gold and silver nanoparticles using biomolecules. The biomolecules were extracted using demineralized water and the extracts were used to reduce silver or gold cations to form silver and/or nanoparticles. In general, the reactions were carried out under open air condition at room tempeature (without any elevated temperature). Their characterizations along with some applicationshave also been discussed.

Electrocoagulation Technic for Improvement Quality of Swimming Pool Water

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This study aims to improvement quality swimming pool water by electrocoagulation process. The condition electrocoagulation are find to make good process and determine the quality of the water pool based on the parameters of Ca^{2+} concentration, pH, and TDS, after electrocoagulation process is carried out according to Indonesian Ministry of Health Regulation No. 416 / Menkes / Per / IX / 1990. The object of this research was the optimum condition electrocoagulation efficiency to remove of Ca^{2+} metal ions, pH and TDS in the FIK's swimming pool water, Yogyakarta State University. Optimization of the electrical voltage was done on variation 2, 4, 6, 8, 10 and 12 volts and optimization of the time electrocoagulation process was done on variations of 2, 4, 8, 16 and 24 hours. Parameters used are concentration of Ca^{2+} in the water, TDS and pH. Effectiveness of the electrocoagulation based on the graph, the separation efficiency of Ca^{2+} metal ion, TDS and pH values. The samples were analyzed using Atomic Absorption Spectroscopy (AAS), TDS meter and pH meters. The results showed the optimum potential is 10 volt and the optimum time of electrocoagulation process is 24 hours. The quality of the water pool based on the pH parameter after electrocoagulation process according to Indonesian Ministry of Health Regulation No. 416 / Menkes / Per / IX / 1990 is well as water quality standard swimming pool is pH 6.7 and TDS 231,3.

Keywords: electrocoagulation, swimming pool water.

Exploration of Herbal Anti Gout Drug: A Case Study on Xanthin Oxydase Inhibitor

Subandi

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The gout prevalence was increase sharply in recent decade. On other hand, as a mega-biodiversity country, Indonesia is a home to 11 percent of the world's flowering plant species and potencial as resource of many bioactive metabolites, including herbal antigout drug. Therefore, the herbal antigout exploration by biochemical studies is important to do. In this paper we presented some results of our preliminary exploration on herbal juice and extract that have activity as xanthin oxydase inhibitor, so they have potency as anti gout drug. Among them are seed peel extract of: melinjo (Gnetum gnemon), mangoosten (Garcinia mangostana), peanut (Arachis hypogaea L.), extract of soursop (Annona muricata) and sugar apple (Annona reticulata) fruit.

Keywords: :xanthine oxidase inhibitor, herbal anti gout, soursop, sugar apple

Structural and Dynamical Properties of Solvated Be(II) Ion in liquid ammonia: A Quantum Mechanical Charge Field Molecular Dynamics Simulation Study

Priyagung Dhemi Widiakongko, Bambang Setiaji and Ria Armunanto

Austrian-Indonesia Centre (AIC) for Computational Chemistry, Departement of Chemistry, Faculty of Mathematics and Natural Science, Gadjah Mada University, Sekip Utara, Yogyakarta 55281, Indonesia.

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A quantum mechanical charge field molecular dynamics simulation study of structural and dynamical properties of solvated Be(II) ion in liquid ammonia using was carried out. The first and second solvation shell were treated by quantum mechanics at Hartree-Fock level of theory, and the outer region of the system was described using coulombic potential. The structure was evaluated in terms of radial and angular distribution functions and coordination number distributions. Ligand exchange processes between coordination shells have been investigated and evaluated. A rigid structure was observed for the first solvation shell showing a tetrahedral coordinated $Be(NH_3)_4^{2+}$ complex with a Be-N averaged distance of 1.745 Å. The second solvation shell shows a labile structure with large number of successful ligand exchange. The simulation result has a good agreement with the experiments.

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Lipid Extraction Method From Microalgae *Botryococcus Braunii* As Raw Material To Make Biodiesel With *Soxhlet* Extraction

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Abstract. This research was a preliminary research that aimed to determine the number of lipid from microalgae *Botryococcus braunii* through the extraction process and to find out the potentiality of microalgae to be converted into biodiesel. In this research used n-hexane as solvent, then it was conducted a literature study for lipid extraction from *Botryococcus braunii* with *soxhlet* method as companion data result. In this research, lipid extraction was performed on a laboratory scale using 175 ml n-hexane. Microalgae *Botryococcus braunii* were cultivated for 10 days preceding the process of drying and it was followed by the process of lipid extraction with *soxhlet*. The results of this study showed that the extraction with *soxhlet* method had the percentage of lipid yield that was 24% with 45 cycles. The number of lipid yields obtained was affected by the number of solvent cycles during the extraction process. The extraction process run optimally since the number of solvent cycles increased more and more until there was no more lipids extract that could be dissolved by the solvent. Therefore, the best method of extraction was the *soxhlet* method because it had a dilution principle that occurred repeatedly.

Keywords : microalgae *Botryococcus braunii*, biodiesel, lipid

1. Introduction

The use of alternative energy from renewable energy sources can help in reducing the dependence on the use of fossil fuels whose reserves are depleting and their prices are increasing, as well as to safeguard the environment from global climate change and natural degradation resulting from the use of fossil fuels as an energy source [1]. Microalgae can be converted into biodiesel which is one of the renewable alternative energy and is considered as a good alternative energy source when compared with other alternative energy sources such as corn, soybeans, sunflower, palm, coconut and others [2]. Microalgae can absorb CO_2 which comes from burning fossil fuels and other sources from the nature, so that it can reduce emissions [3]. Based on planting area base, the microalgae have the ability to produce oil as biodiesel feedstock 15 - 300 times more than other plants. Microalgae also have a fairly short harvest cycle of 1 day to 10 days depending on the process [4]. The comparison of potential utilization of microalgae into biodiesel with other raw materials can be seen in Table 1.

Microalgae consist of proteins, carbohydrates, and lipids [3]. Lipid in the microalgae can be used to produce biodiesel, while the carbohydrates and proteins can be used to produce bioethanol [6]. There are various types of microalgae that can be converted into biodiesel. Microalgae with high lipid content are *Botryococcus braunii* with lipid content of 25 - 75% (% dry weight biomass) [4]. The lipid content of some microalgae can be seen in Table 2.

Table 1. Comparison of Biodiesel Raw Material Potentiality [5]

Raw Material	Produced Lipid Yield (L/Ha)	Required Area Width (M ha)
Corn	172	1,540
Soybean	446	594
Canola	1,190	223
Jatropha	1,892	140
Coconut	2,689	99
Palm	5,950	45
Microalgae[a]	58,700	4.5
Microalgae[b]	136,900	2

Table 2. Lipid Content of Some Microalgae [4]

Mikroalgae	Lipid Content (% dry weight biomass)
Botryococcus braunii	25 – 75
Chlorella sp.	28 – 32
Crypthecodinium cohnii	20
Cylindrotheca sp.	16 – 37
Dunaliella primolecta	23
Isochrysis sp.	25 – 33
Monallanthus salina	>20
Nannochloris sp.	20 – 35
Nannochloropsis sp.	31 – 68
Neochloris oleoabundans	35 – 54
Nitzschia sp.	45 – 47
Phaeodactylum tricornutum	20 – 30
Schizochytrium sp.	50 – 77
Tetraselmis sueica	15 – 23

Microalgae *Botryococcus braunii* (Figure 1) is a green single-celled microalgae of the *Chlorophyta* microalgae division, these microalgae can be found in lake waters, brackish waters or ponds, and sea. Microalgae *Botryococcus braunii* can be a source of long-chain liquid hydrocarbons (C21 - C33) which can be further processed into alternative feedstock of renewable energy sources replacing fossil energy [7,8].

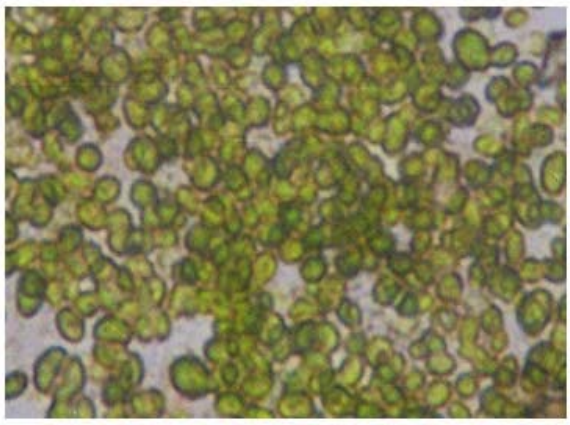

Figure 1. Microscopic Picture of The Mikroalgae *Botryococcus braunii* [9]

Biodiesel from microalgae production process includes cultivation, harvesting, biomass processing, lipid extraction, and transesterification processes. Amongst all the stages, the stages of lipid extraction are important and costly process. The production of microalgae biodiesel mainly depends on the type of lipid extraction process used [10].
This article was a preliminary research that described the effect of lipid extraction with *soxhlet* extraction method on lipid number of microalgae *Botryococcus braunii* from cultivation results within 10 days, then it was conducted a study of previous literature study related to microbial lipid extraction of *Botryococcus braunii* with *soxhlet* extraction method as supporting data for the results of conducted research and the potentiality of microalgae as a source of biodiesel raw materials.

2. Material and Methods

2.1. Microalgae Cultivation Stage

Stages of cultivation, determination of cell number, lipid extraction, and determination of lipid number were done for ± 2 months in Chemical Engineering Processing Unit Laboratory of Politeknik Negeri Sriwijaya. The research was conducted on the laboratory scale. Microalgae *Botryococcus braunii* seeds were obtained from Balai Besar Pengembangan Budidaya Air Payau (BBPBAP) of Jepara, Central Java.
The cultivation stage of microalgae *Botryococcus braunii* was carried out for 10 days in aerated culture bottles. Microalgae *Botryococcus braunii* of 100 ml were cultivated on cultivation medium in the form of 500 ml sea water with 25 - 35 ppt salinity, and nutrition medium of walne was used as much as 1 ml. The lighting process was done by using TL lamp 20 watts for 12 hours daylight and 12 hours dark. During the cultivation stage, the determination of the cell number of microalgae *Botryococcus braunii* with the aid of hemocytometer and microscope was done every day. It was calculated using equation below (1) [11].

$$\text{Number of cells (cell/ml)} = \left(\frac{\text{cell number}}{\text{box number}}\right) \times 25 \times 10^4 \quad (1)$$

2.2. Microalgae Extraction Stage

After cultivation stage, microalgae *Botryococcus braunii* was harvested and dried. The dried *Botryococcus braunii* were extracted by the *soxhlet* extraction method. The solvent used in this extraction was a dry 10% n-hexane. Dry microalgae *Botryococcus braunii* as much as 10 gram was extracted with 175 ml of n-hexane for 4 hours of heating. After the extraction process finished, the resulted lipids were distilled to separate the lipids and n-hexane solvent for 3 hours at 80°C. After that, the lipid was weighed and calculated by using equation (2) [11]:

$$\% \text{ Yield} = \frac{\text{Extracted lipid weight}}{\text{Initial sample weight}} \times 100\% \quad (2)$$

3. Results and Discussion

This research was begun with the cultivation stage. A total of 100 ml of microalgae *Botryococcus braunii* was cultivated for 10 days on a 500 ml sea water medium with 25 - 35 ppt salinity. Cultivation of microalgae *Botryococcus braunii* was carried out in a culture bottle equipped with an aerator. The cultivation process inside the culture bottle was done indoors with the help of 20 watt TL lamp lights or about 4000 lux with long lighting time for 12 hours of daylight and 12 hours of darkness. During the cultivation stage, the calculation of the number of cells was done every day during the cultivation period by calculating cell density by using chamber hemocytometer and microscope as a tool to see microalgae *Botryococcus braunii*. The result of cell calculation for 10 days cultivation period can be seen in Table 3.

Table 3. Number of Cell Density of Microalgae *Botryococcus braunii*

Days	Number of Cell Density (cell/ml)
0	0.694×10^4
1	2.257×10^4
2	2.430×10^4
3	3.125×10^4
4	3.993×10^4
5	4.340×10^4
6	4.861×10^4
7	5.208×10^4
8	3.645×10^4
9	3.472×10^4
10	2.604×10^4

The research results showed that the greatest number of cell density of microalgae *Botryococcus braunii* was obtained on the 7 day of cultivation which was 5.208×10^4 cells/ml. The calculation data of the number of cell density of microalgae *Botryococcus braunii* are depicted in a graph of Figure 2.

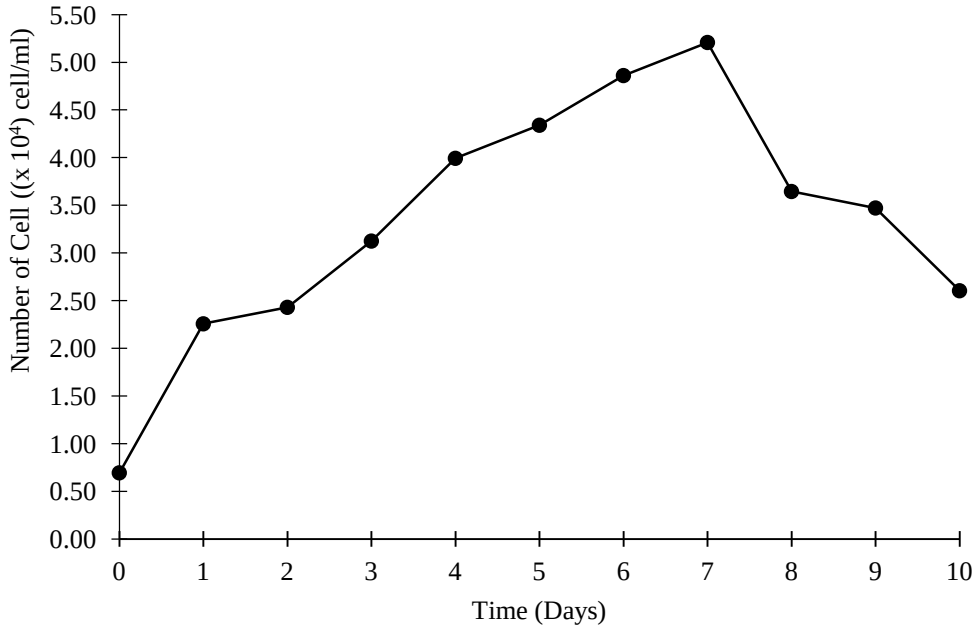

Figure 2. Graph of The Number of Cell Density of Microalgae *Botryococcus braunii*

The 10 day cultivated microalgae *Botryococcus braunii* was taken as 10 grams to be extracted to 175 ml of n-hexane. The extracted result was calculated in % yield which was the comparison between the extracted-lipid weight and the initial sample weight based on formula. After being extracted and distilled, the drying process within the oven was done and the obtained dried yield was as 2.4 grams and the calculation of % yield was done. The result was 24% lipid yield. During the 4 hour extraction, 45 solvent cycles were occurred.

The comparing data were obtained from the literature study of several previous studies. On the literature study, data was selecting by the highest result of % yield in each study. The results of lipid extraction from previous studies and direct study can be seen in Table 4 and Figure 3.

Table 4. The Results of Microalgae *Botryococcus braunii* Lipid Extraction

Ref.	Lead Author	% Yield	Description
-	Research	24	10-day culture, 25-35 ppt salinity, 1 ml walne, 100 ml of microalgae seeds in 500 ml of culture media, 20 watt of TL exposure for 12 hours, 175 ml of n-hexane solvent.
[12]	Febriana (a)	58.23	7-day culture, 45 ppt salinity, 5,000 lux of exposure for 12 hours, 250 ml of n-hexane solvent, 200 ml of microalgae seeds in 800 ml culture media.
[13]	Sari (b)	67	7-day culture, 30 ppt salinity, 10,000 lux of exposure for 24 hours, 250 ml of n-hexane solvent, 200 ml of microalgae seeds in 800 ml of culture media, 5 ml of walne.
[14]	Nagaraja (c)	78	35-day culture, 0.15 molar of NaCl salinity, 12 hours of exposure, 250 ml of microalgae seeds, 250 ml of n-hexane solvent.

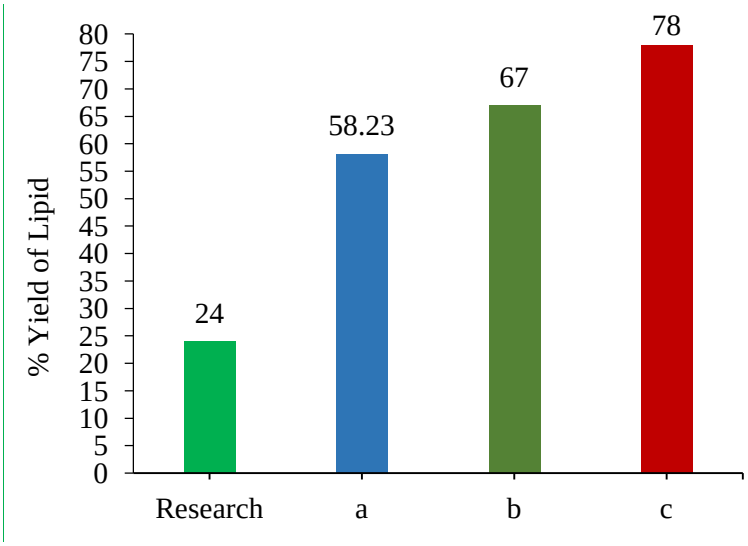

Figure 3. Graph of % Yield of Lipid Result of Direct Study and Literature Study

In the stage of cultivation of microalgae *Botryococcus braunii* in the direct study (Figure 2), the greatest number of cell density was occurred on the 7th day of cultivation period which was 5.028 x 10^4 cell/ml. It meant that on the 7th day, the exponential phase of *Botryococcus braunii* growth phase was occurred. The initial growth phase or lag phase was occurred on the 1st day of cultivation period with the additional nutrition of walne and the culture media which used to be increased frequently until the 6th day of cultivation period. The lowering phase of growth rate started to happen on the 8th day of cultivation period, then on the 9th day of cultivation period, the stationary phase was occurred, in which the number of microalgae *Botryococcus braunii* cells were constant as the number of new cell formation was offset by the number of cell deaths. On the 10th day, there was a decrease in the

number of cell density of microalgae *Botryococcus braunii* to 2.604 x 10^4 cell/ml which meant that there had been a death phase due to the decreasing number of microalgae *Botryococcus braunii* since nutrients in the culture medium was running out.

After the 10 day cultivation process, microalgae *Botryococcus braunii* was harvested and dried, then extracted using *soxhlet* extraction method. The *soxhlet* method was selected because this method is the best method used to get great numbers of yields with little amount of solvents, faster extraction period, and perfectly extracted samples as it was done in repetition [15]. N-hexane solvent was chosen since lipids are soluble in non-polar solvents only, n-hexane has also been extensively used throughout the world as a solvent for extracting vegetable oils such as lipid microalgae [17].

The results of the direct study extraction yielded 24% yield of lipid with 45 cycles of solvent by using 175 ml of n-hexane solvent. If compared to the literature study results of previous studies (Figure 3), the % yield lipid obtained was the lowest % yield, but this was influenced by several factors (Table 4). The results of the highest % yield of lipid yields were 78% done by (c) with 250 ml of cultivated microalgae *Botryococcus braunii* while the researchers only used 100 ml of it. Researcher (a) and (b) also cultivated with 200 ml of microalgae *Botryococcus braunii* seeds that resulted a lower % yield than researcher (c) did. The direct study used 175 ml of n-hexane solvent for extraction while the researchers (a), (b), and (c) used 250 ml of it.

Researcher (c) conducted the cultivation process for 32 days while researcher (a) and (b) conducted the cultivation for 7 days and the direct study conducted 10 days of cultivation. Researcher (b) had a higher % yield compared to researcher (a) and the direct study since the number of walne as the nutrient during the cultivation process was greater, which was 5 ml. This could affect the yield as nutrients are needed during the growth period, if the intake of nutrients and medium is not sufficient, then the rate of growth will be obstructed.

Exposure in direct research was done with 4,000 lux of exposure, while for researcher (a) with 5,000 lux and researcher (b) with 10,000 lux which meant that the greater the exposure or intensity of light given, the greater the lipid content in microalgae *Botryococcus braunii* would be.

The salinity of culture media during the cultivation period may also affect the number of lipid of microalgae *Botryococcus braunii*. As in the direct study, salinity used during the cultivation period was 25 - 35 ppt which had lower % yield of lipid compared to researcher (a) who cultivated culture media with the salinity of 45 ppt. This suggested that the higher the salinity of culture media from microalgae *Botryococcus braunii* is, the higher the productivity of lipids of *Botryococcus braunii* microalgae during the cultivation would be.

Different conditions (Table 4) will determine the number of lipid to be obtained since the lipid productivity of microalgae *Botryococcus braunii* was influenced by the following factors: nutrition, temperature, light intensity and duration, salinity, nitrogen content in the growth medium and the influence of competitor organisms in culture [12].

The selection of the extraction and solvent methods to be used would also affect the number of lipid yields of the microalgae *Botryococcus braunii*. The inappropriate selection of extraction and solvent method could increase the cost [16]. Since this study was conducted on a laboratory scale, the selection of the *soxhlet* extraction method was considered appropriate as it could save time as well as maximize the extraction process by repeated dilution.

The researcher also extraction with other methods such as maceration, percolation, autoclave, and osmotic by using 75 ml of n-hexane. The extraction results can be seen in Figure 4.

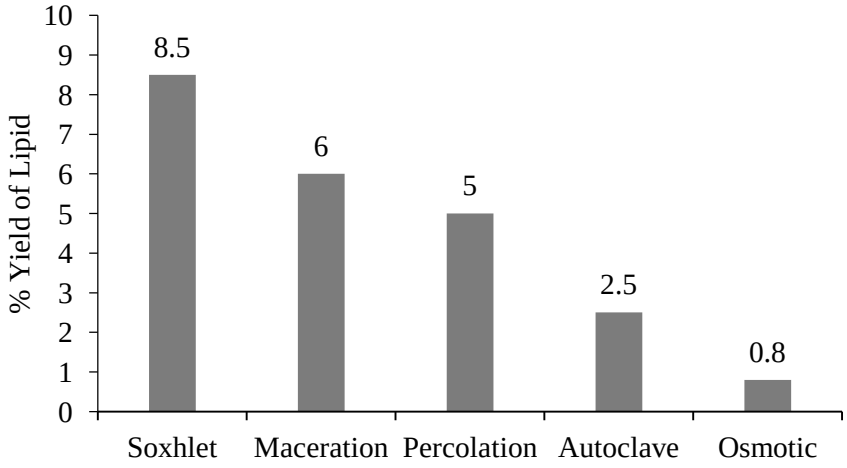

Figure 4. Graph of % Yield of Lipid Result with Various Extraction Methods

In Figure 4 it can be seen that the extraction results with *soxhlet* method yielded 8.5% lipid, maceration yielded 6% lipid, percolation yielded 5% lipid, autoclave yielded 2.5% lipid, and osmotic yielded 0.8% lipid. Then it can be concluded that the best extraction method is *soxhlet* which yields the highest % yield of lipid.

4. Conclusion

Based on research and literature study conducted, the best method of extraction is the soxhlet method because it had a dilution principle that occurs repeatedly. And based on literature studies, many researchers used the soxhlet extraction method to extract lipid from microalgae Botryococcus braunii. And n-hexane has also been extensively used throughout the world as because it is a non-polar organic solvent and this solvent can used for extracting vegetable oils such as lipid microalgae.

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