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Proceeding

International Seminar on Food & Agricultural Science

17 February 2010 Bukittinggi, Indor

*"Improving the quality of life
through food and agricultural sciences"*

EDITORS

- Novizar Nazir - Universitas Andalas, Indonesia
- Aisman - Universitas Andalas, Indonesia
- Nazaruddin Ramli - Universiti Kebangsaan Malaysia
- Wan Aida Wan Mustapha - Universiti Kebangsaan Malaysia
- Ayub Mohd Yatim - Universiti Kebangsaan Malaysia
- Mohamad Kassim - Universiti Kebangsaan Malaysia
- A. Ploeger - Kassel University Germany



PROCEEDING

INTERNATIONAL SEMINAR ON FOOD AND AGRICULTURAL SCIENCES-ISFAS2010

16-17 FEBRUARY 2010

HILL HOTEL AND CONVENTION, BUKITTINGGI-INDONESIA

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Improving the quality of life through food and agricultural sciences

Jointly organized by:

Faculty of Agricultural Technology,
Universitas Andalas, Padang-Indonesia.

and

School of Chemical Sciences and Food Technology
Faculty of Science and Technology,
Universiti Kebangsaan Malaysia.

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Preface

Bismillahir-Rahmanir-Rahim,

Andalas University (UNAND) Padang, Indonesia, and Universiti Kebangsaan Malaysia have signed a letter of Memorandum of Understanding (MOU) on the 7th of March 2008. Both parties are interested in entering an MOU on education, teaching, research, academic and student exchange program. A joint seminar is among one of the academic activities proposed to be carried out from this MOU.

As a follow-up to the MoU, the School of Chemical Sciences & Food Technology, Faculty of Science and Technology (FST), UKM and Faculty of Agricultural Technology, UNAND, have agreed to conduct the 1st joint International Seminar on Food and Agricultural Sciences 2010 (ISFAS2010) on 16-17 February 2010 at Universitas Andalas, Padang, Indonesia. The objectives of seminar are:

1. To exchange and share experiences, new ideas and research findings
2. To promote research collaboration in improving the quality of life through natural resources-based science and technology.
3. To establish a regional network on food and agricultural sciences

This proceeding was developed as a result of ISFAS2010 seminar held on February 16-17, 2010 at the Hotel Hill Convention Center, Bukittinggi, INDONESIA. There were 141 papers presented in this ISFAS2010, consisting of 5 plenary papers, 63 papers for oral presentation and 73 papers for poster presentation. The papers were divided into 4 major topics covering topics on sustainable agriculture, chemical sciences and chemical engineering, food science and technology; biomass, bioenergy sources and management and industrial engineering.

We hope this proceeding could contribute to the role of higher education in developing food and agricultural sciences to improve the quality of life and welfare of mankind.

Bukittinggi, 17 February 2010

Novizar Nazir

Head of Programme and Proceeding

Welcoming address by the Chairman



In order to exchange and share experiences, new ideas and research findings, to promote research collaboration and network especially on natural resources-based sciences and technology between Universiti Kebangsaan Malaysia (UKM) and Universitas Andalas (UNAND), Padang, the two universities had agreed to conduct an International Seminar on Food and Agricultural Sciences which was called *ISFAS 2010*. The seminar was held in Bukittinggi on February 16-18, 2010, featuring papers for oral presentation and poster presentation. This opportunity was also used to sign the letter of Memorandum of Understanding (MoU) between Faculty of Science and Technology (FST) University, Malaysia and Faculty of Agricultural Technology, Andalas University, Padang. The series of activities was completed with a social work in Nagari Sicincin, one area badly suffering from the last year earthquake.

This seminar was attended by participants coming from Malaysia, Yemen, Libya, Japan and Indonesia. The papers or posters covered topics on sustainable agriculture, chemical sciences and chemical engineering, food science and technology, biomass, bio-energy sources and management and industrial engineering. This seminar presented Director General of Higher Education of Republik Indonesia as Keynote speaker and four plenary papers.

On this occasion, we would like to express our best gratitude to all members of organizing committee for working very hard in making this seminar happen. We also would like to praise the presenters for responding very enthusiastically to our call for paper. Last but not least, we would like to pay our best gratitude to the Rector of University of Andalas, the Vice Chancellor of Universiti of Kebangsaan Malaysia and Walikota Bukittinggi for supporting this seminar. We wish you all the best and hope you enjoy the seminar!

Thank you,

Prof. Dr. Anwar Kasim

Chairman of ISFAS2010

Kata Pembuka dari Dekan Fakultas Teknologi Pertanian Universitas Andalas



Seminar Internasional On Food and Agricultural Sciences 2010 (ISFAS 2010) adalah bagian dari tahapan kerjasama yang sudah dirintis antara Universitas Andalas (Unand) dengan Universiti Kebangsaan Malaysia (UKM). Pelaksanaan Seminar ini dimotori oleh Fakultas Teknologi Pertanian Unand bersama dengan Fakultas Sains dan Teknologi UKM. Bagi Fakultas Teknologi Pertanian Unand sendiri, seminar yang kita selenggarakan hari ini merupakan kado istimewa menjelang pelaksanaan Ulang Tahun ke dua fakultas ini.

Kami telah membaca dengan seksama bahwa makalah yang disampaikan dalam seminar ini adalah hasil penelitian yang dilakukan oleh para akademisi dan peneliti dari beberapa negara yang antara lain; Indonesia, Malaysia, Jepang dan Thailand. Disamping itu cakupan materi yang disampaikan juga sangat kompleks yang mencakup; Chemical Sciences and chemical Engineering, Food Sciences and Technology, Biomass, Bioenergy Sources and Management. Engineering and Industrial Process Engineering; Sustainable Agriculture. Dengan demikian apa yang disampaikan dalam seminar ini tentu akan menjadi inspirasi yang sangat besar terutama dalam mengkaji lebih dalam, mengembangkan serta memanfaatkan sumberdaya pertanian guna mensejahterkan kehidupan masyarakat di muka bumi ini.

Kami patut bersyukur melihat besarnya perhatian dan keinginan Bapak, Ibu serta Saudara para akademisi, peneliti dan praktisi untuk ikut serta berpartisipasi baik sebagai pemakalah maupun sebagai peserta pada seminar ini. Hal ini menunjukkan kesamaan persepsi dan keinginan kita untuk bertukar pikiran, menyampaikan hasil penelitian yang sudah dilakukan untuk dapat dimanfaatkan oleh orang banyak guna mensejahterkan kehidupan manusia. Lebih dari itu pertemuan banyak pihak dalam seminar ini diharapkan juga akan melahirkan jaringan kejasama yang lebih luas dengan melibatkan banyak pihak. Dengan demikian pekerjaan yang semula menjadi tugas masing-masing akan dapat dikolaborasikan menjadi tugas bersama, sehingga memberikan hasil dan manfaat yang lebih besar.

Akhirnya izinkanlah kami menyampaikan terima kasih yang sebesar-sebesarannya kepada yang mulia Rektor Universiti Kebangsaan Malaysia, Rektor Universitas Andalas, Dekan Fakultas Sains dan Teknologi UKM, Wali Kota Bukittinggi, Dinas dan Instansi Pemerintah dan swasta serta semua pihak yang tidak dapat kami sebutkan satu persatu yang telah berpartisipasi hingga terselenggaranya seminar ini dengan baik.

Kami menyadari sepenuhnya bahwa tidak ada kesempurnaan yang dapat kita capai, sehingga kekurangan masih akan kita temui disana sini. Untuk itu atas nama pimpinan fakultas kami menyampaikan maaf yang sebesar-besarnya atas segala kesalahan dan kekhilafan, wassalam.

Bukittinggi, 17 Februari 2010

Prof. Dr. Ir. H. Isril Berd, SU
Dekan Fakultas Teknologi Pertanian
Universitas Andalas

Kata-kata Aluan Pengerusi Pusat Pengajian Sains Kimia & Teknologi Makanan, Fakulti Sains Teknologi-UKM



Dengan nama Allah yang Maha Pengasih & Penyayang
Selawat dan salam ke atas junjungan Rasulullah saw

Assalamualaikum & selamat sejahtera

Saya ingin mengucapkan terima kasih kepada JK Penganjur kerana memberi kesempatan kepada saya untuk menyampikan sepatah dua kata di dalam Buku Program dan Abstrak ISFAS 2010. Tahniah diucapkan kepada Jawatankuasa Penganjur antara UKM dengan UNAND di atas kejayaan menganjurkan International Seminar on Food and Agricultural Sciences (ISFAS 2010) di Bukittinggi, Indonesia.

Penganjuran ISFAS 2010 bertujuan untuk menyediakan satu platform untuk memperkenalkan PPSKTM di peringkat antarabangsa. Melalui ISFAS ini, jaringan penyelidikan dan pertukaran idea dalam ilmu-ilmu terkini dalam bidang makanan dan teknologi pertanian dapat dilakukan dengan jayanya melalui pembentangan hasil penyelidikan yang telah dilakukan. Negara Malaysia dan Indonesia merupakan Negara yang kaya dengan hasil semulajadi dan pertanian. Oleh itu, amatlah wajar kedua-dua institusi UKM dan UNAND mengambil peluang ini untuk memperkembangkan aktiviti penyelidikan supaya jaringan dan kerjasama yang dibina.

Saya yakin ISFAS 2010 akan menjadi suatu medan pertukaran ilmu, kemahiran dan kepakaran yang boleh dogunakan untuk mempertingkatkan lagi kualiti penyelidikan para peserta khususnya dalam bidangn yang berasaskan makanan dan pertanian.

Akhir kata, saya ingin merakamkan setinggi-tinggi penghargaan kepada Jawatankuasa Penganjur ISFAS 2010 yang telah berkerja keras dan berdedikasi di dalam menjalankan tanggungjawab untuk menganjurkan seminar kali pertama ini. TAHNIAH.

Sekian, terima kasih.

Prof. Dr Jumat Salimon

Pengerusi, Pusat Pengajian Sains Kimia Dan Teknologi Makanan

Kata-kata aluan Dekan FST-Universiti Kebangsaan Malaysia



Dengan nama Allah yang Maha Pengasih & Penyayang
Selawat dan salam ke atas junjungan Rasulullah saw

Assalamualaikum & selamat sejahtera

Saya ingin mengambil kesempatan ini untuk mengucapkan tahniah kepada Pusat Pengajian Sains Kimia dan Teknologi Makanan (PPSKTM), Fakulti Sains & Teknologi bersama Fakulti Teknologi Pertanian, Universitas Andalas yang telah mengambil inisiatif untuk mengadakan International Seminar on Food and Agricultural Sciences 2010 buat kali pertamanya ini. Seminar seperti ini sangat penting untuk memfokuskan penyelidikan yang dilakukan dalam bidang Sains Makanan, Pertanian dan yang berkaitan dengannya di samping dapat mengoptimumkan pengemblingan tenaga penyelidik agar penyelidikan dapat dilakukan secara terstruktur dan tidak berlaku pertindihan. Saya yakin dengan kepakaran yang ada di PPSKTM dan FST amnya, penyelidikan dalam disiplin ini dapat dilakukan dengan lebih agresif dan terfokus serta mampu menghasilkan banyak KPI yang berkualiti, yang berupaya memberikan impak yang tinggi kepada perkembangan ilmu dalam bidang ini, bukan sahaja dalam negara tetapi juga di luar negara. Ini adalah sejajar dengan aspirasi Universiti Kebangsaan Malaysia (UKM) sebagai Universiti Penyelidikan yang menyimpan hasrat untuk menjadi universiti terbilang di dunia menjelang tahun 2018. Dengan semangat kerja berpasukan yang tinggi, saya yakin penyelidikan yang dilakukan dalam disiplin Sains Makanan ini mampu melonjakkan bukan sahaja nama Fakulti tetapi juga nama UKM di persada antarabangsa. Saya juga mengharapkan agar Seminar Bersama yang dijalankan akan mengeratkan hubungan silaturrahim antara kakitangan akademik FST dan FTP melalui kerjasama penyelidikan yang telah dirancang. Saya juga berharap pemetraian Surat Hasrat (LoI) antara FST, UKM dan FTP, Unand sempena seminar ini akan membuka lembaran baru untuk pelbagai aktiviti kerjasama di antara kedua-dua institusi.

Saya turut ingin mengucapkan tahniah kepada JK Penganjur yang telah bekerja keras di belakang tabir sehingga penganjuran seminar ini dapat direalisasikan. Harapan saya, semoga seminar seumpama ini akan terus dianjurkan secara berkala selepas ini, untuk mengekalkan sinergi dalam penyelidikan berkaitan Sains Makanan dan yang berkaitan, bukan setakat antara UKM dan Unand tetapi juga universiti lain.

Selamat berseminar !

Sekian terima kasih.

Prof. Dr. Musa Ahmad
Dekan Fakulti Sains & Teknologi

Kata-kata Aluan NAIB CANSELOR Universiti Kebangsaan Malaysia

Dengan nama Allah yang Maha Pengasih & Penyayang
Selawat dan salam ke atas junjungan Rasulullah saw

Assalamualaikum & selamat sejahtera

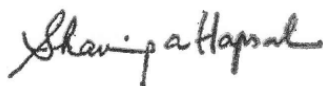
Tahniah diucapkan kepada Jawatankuasa Penganjur antara UKM dengan UNAND di atas kejayaan menganjurkan International Seminar on Food and Agricultural Sciences (ISFAS 2010) di Bukittinggi, Indonesia. Saya juga ingin mengucapkan terima kasih kepada JK Penganjur kerana memberi kesempatan kepada saya untuk menyampikan sepatah dua kata di dalam Buku Program dan Abstrak ISFAS 2010.

Seminar ini bertujuan untuk mengukuhkan karyawan-karyawan ilmu antara UKM dan UNAND melalui pembentangan dan pertukaran idea semasa seminar ini berlangsung. Kerjasama penyelidikan (LOI) yang di meterai melalui seminar ini akan mengeratkan serta mengukuhkan jaringan penyeliidkan antara kedua-dua pihak. Kesenambungan kerja-kerja penyelidikan harus dikekalkan serta di utuhkan lagi melalui seminar yang dirancang ini khususnya dalam ilmu makanan, kimia, pertanian dan bahan semulajadi. Selaras dengan pengumuman UKM sebagai Universiti Penyelidikan, maka sewajarnya kepakaran yang sedia ada di UKM patut dikembangkan serta di perluaskan hingga keperingkat antarabangsa.

Saya merasa gembira dengan sambutan yang menggalakkan daripada para penyelidik dan pelajar siswazah daripada pelbagai institusi pengajian tinggi khususnya UKM dan UNAND. Adalah diharapkan dengan aktiviti seperti ini akan meningkatkan mutu serta mengembangkan skop penyelidikan di mana segala maklumat dan ilmu pengetahuan yang diperolehi boleh dikongsi bersama demi kelestarian industri berasaskan makanan dan teknologi pertanian.

Akhir kata, saya ingin merakamkan setinggi-tinggi penghargaan kepada Jawatankuasa Penganjur ISFAS 2010 kerana telah Berjaya menganjurkan seminar kali pertama ini. Penganjuran ini tidak akan Berjaya tanpa kerja keras dan dedikasi daripada setiap ahli dalam jawatankuasa ini. Saya berdoa agar ISFAS 2010 akan mencapai matlamat penganjurannya.

Sekian.



Prof. Tan Sri Dato' Dr. Sharifah Hapsah Syed Hasan Shahabudin
Naib Canselor
Universiti Kebangsaan Malaysia

Opening Remarks by the Rector of the Universitas of Andalas



Bismillahirrahmanirrahim,
Assalamualaikum dan selamat sejahtera

First of all, thank to Allah, the Almighty, for blessing us good health that we all could come to this seminar. I would like to congratulate the Faculty of Agricultural Technology, Andalas University , which has taken the initiative to organize a joint seminar with Faculty of Science and Technology, Universiti Kebangsaan Malaysia, This International Seminar on Food and Agricultural Sciences (ISFAS2010) is part of collaborative activities between the two universities as the following up of the Memorandum of Understanding (MOU) signed on the 7th of March 2008.

As the oldest university outside Java, Universitas Andalas is committed to be excellent in research and teaching. Recently, we are preparing Universitas Andalas as one of the world class university.

The theme of the seminar, which is “improving the quality of life through food and agricultural sciences”, is a challenge for us, where the quality of life is closely linked with the quality of food which is produced from sustainable agriculture. It is expected that this seminar, would strengthen networking and cooperation among researchers at the two universities.

Last but not least, I would like to thank the organizing committee for the hard work and full commitment. I also would like to express my deep gratitude to the Director General of Higher Education of Republik Indonesia, the Vice Chancellor of Universiti of Kebangsaan Malaysia, The Dean of FST, UKM, Walikota Bukittinggi who welcomed us, key note speaker and participants for their valuable contributions on this seminar. I wish you all the best and hope Allah, the Almighty, supports all good efforts that we have been doing.

Thank you very much,

Prof. Dr. Musliar Kasim
Rector, Universitas Andalas

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SPIRULINA PRODUCTION IN FERTILIZER MEDIUM COMBINED BY TOFU AND LATEX LIQUID WASTES

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Abstract

Spirulina is one of microalgae that used in nutraceutical dan pharmaceutical industries. The biomass could produced in liquid waste of tofu and latex industries. The aims of this research were to know the influence tofu and latex liquid waste percentage in medium of cultivation for their maximum density and specific growth rate. This research was arranged in a factorial groups randomized design with two treatment factors (kinds of liquid wastes and their percentage in Spirulina medium) and three groups based on light intensities. Spirulina production could used tofu and latex liquid wastes. One hundred percent tofu liquid waste gave highest density and 75% tofu liquid wastes gave maximum specific growth rate as like as 100% fertilizer for Spirulina medium. Light intensity 1000 – 4000 lux could be given on the Spirulina cultivation if they were cultured in fertilizer medium was combined by tofu and latex liquid wastes.

Keywords

Spirulina, tofu, latex, liquid waste

INTRODUCTION

Spirulina platensis is a prokaryotic organism which contains a lot of bioactive compound in their biomass (Henrikson, 1989). Filamentous microalga *S. platensis* (cyanobacteria) has been produced commercially all over the world due to its high content of protein (up to 70%), pigments (especially the blue pigment phycocyanin), essential fatty acids (e.g., g-linolenic acid), vitamin B12 and minerals (Goksan, Zekerruyaolulu, 2007). In addition, it is successfully used in aquaculture and poultry industries as well. *Spirulina platensis* have been used for cosmetic, food, nutraceutical and pharmaceutical industry. *Spirulina platensis* has been cultured in serum latex medium that is skim effluent from latex industry, and used for reducing COD, total nitrogen, and ammonia nitrogen concentration of the medium optimally (Tri Panji *et al.*, 1995; El-Baky *et al.*, 2008). The microalgae cells that be cultured in this effluent can be bioremediator and a source of some bioactive compound for material industry.

Spirulina platensis is the most widely studied photosynthetic microorganism, only a few attempts have been made up to now to utilize it for removal of nutrients from wastewaters (Converti *et al.*, 2006). *Spirulina* biomass can cultivated in organic liquid waste such as tofu and latex industry. Tofu and latex liquid wastes have organic

matter which can be used for heterotroph cultivation of *Spirulina*. Composition of liquid waste in *Spirulina* medium needed optimalizing for biomass production. The aims of this research were to know the influence tofu and latex liquid waste percentage in medium of cultivation for their maximum density and specific growth rate.

MATERIALS AND METHODS

Spirulina platensis were obtained from Indonesian Biotechnology Research Institute for Estate Crops (Bogor, Indonesia). They was cultured in modified *Spirulina*'s technical medium (Wijayanti, 1999) during 60 days at Aquaculture Laboratory. Technical medium contain MgSO_4 0,2 g.l⁻¹, CaCl_2 0,04 g.l⁻¹, EDTA 0,08 g.l⁻¹, TSP 0,5 g.l⁻¹, Urea 0,3 g.l⁻¹, ZA 1,32 g.l⁻¹, NaHCO_3 8,5 g.l⁻¹, A₅ solution 0,1% v/v. Biomass was isolated in batch and non axenic system.

This research used tofu and latex liquid wastes from effluent waste water of tofu and latex industry at Palembang and Ogan Ilir, South Sumatra. The liquid wastes were preparated with 100°C boiling and filtering (plankton net mesh size 25µm). Liquid wastes and isolated composition were arranged in a factorial group randomized design with two treatment factors, kinds of liquid wastes (tofu and latex liquid medium) and their percentage in *Spirulina* medium (0, 25, 50,75,100% liquid waste in cultivation medium) and three groups based on light intensities consisted of low intensity 500-2500 lux, medium intensity 1000- 4000 lux and high intensity 2000-6000 lux approximately.

Density of biomass measured with Genesys-20 spectrophotometre in 560 nm wavelength at 0,1,2,3,7,14,21,25,26,27, 28 days cultivation. The absorbance was converted in gram of dry biomass per litre of cultivation medium. Specific growth rates (µ) were calculated as following equation (Becker,1996) :

$$\ln N_t - \ln N_0 = \mu \cdot t + C$$

Where N_0 is density of *Spirulina* biomass (g.l⁻¹) at zero time, N_t is density of *Spirulina* biomass (g.l⁻¹) at t days cultivation, t is time of days cultivation. Datas were calculated in logarithmic phase of growth.

Datas were analized by ANOVA (Analysis of Variance) and were followed with LSD (Least Significance Difference) test if f test showed difference number significantly

RESULT AND DISCUSSION

Table 1 shows maximum density of *Spirulina* biomass (g.l^{-1}) which were cultured in tofu and latex liquid wastes combined *Spirulina*'s technical medium. Maximum density of *Spirulina* biomass which cultivates in tofu liquid waste was higher ($3,36 \text{ g.l}^{-1}$) than in latex liquid waste medium ($2,70 \text{ g.l}^{-1}$). The nutrients from tofu liquid wastes were more adequate for *Spirulina* growth than from latex liquid waste. Composition 50% and 75% of liquid wastes in *Spirulina* medium gave highest average density of *Spirulina* biomass 2,97 and $3,23 \text{ g.l}^{-1}$. Interaction of treatment 50, 75, 100% tofu liquid wastes and control medium gave highest density of *Spirulina* between $3,48 - 3,89 \text{ g.l}^{-1}$.

Table 1. Maximum density of *Spirulina* biomass (g.l^{-1}) which were cultured in tofu and latex liquid wastes combined *Spirulina*'s technical medium.

Composition of liquid waste percentage	Kind of liquid waste influence		Percentage of waste influence
	Tofu	Latex	
0%	3,89 e	3,89 e	3,89 c
25%	2,06 ab	2,88 bcd	2,47 a
50%	3,48 cde	2,46 b	2,97 ab
75%	3,67 de	2,79 bc	3,23 b
100%	3,68 de	1,49 a	2,58 a
Kind of liquid waste influence	3,36 b	2,70 a	

Table 2 shows average of maximum density (g.l^{-1}) which were cultured in tofu and latex liquid wastes combined *Spirulina*'s technical medium at three groups based on light intensity. Heterotrophical cultivation of *Spirulina* grew optimally in medium of light intensity between 1000-4000 lux approximately. The average density of *Spirulina* biomass which cultivated with medium lightness was highest ($3,44 \text{ g.l}^{-1}$) as like as cultivation with high lightness.

Table 2. Maximum density of *Spirulina* biomass (g.l^{-1}) at three groups based on light intensity.

Group of light intensity	Average maximum density	LSD (0,05)
High	3,06	ab
Medium	3,44	b
Low	2,59	a

Specific growth rate of *Spirulina* logarithmic growth phase showed adaptability in their cultivation medium. Table 3 shows specific growth rate of *Spirulina* biomass ($\%.\text{day}^{-1}$) which were cultured in tofu and latex liquid wastes combined *Spirulina*'s technical medium. Composition 0% waste gave highest of specific growth rate ($16,58\%.\text{day}^{-1}$). It is possible because they were cultivated in the same of medium when they were prepared before this research. In liquid waste, 50 and 70% composition were the best of liquid waste medium for the specific growth rate. Tofu liquid waste gave influence better than latex liquid wastes. Nutrient from tofu liquid waste

could be easier to be adsorbed by *Spirulina* cell than nutrient from latex waste. Interaction of kind and percentage of liquid wastes showed 50% and 75% tofu liquid wastes were not different with technical medium significantly.

Table 3. Specific growth rate of *Spirulina* biomass ($\%.\text{day}^{-1}$) which were cultured in tofu and latex liquid wastes combined *Spirulina*'s technical medium.

Composition of liquid waste percentage	Kind of liquid waste influence		Percentage of waste influence
	Tofu	Latex	
0%	16,58 d	16,58 d	16,58 c
25%	7,29 a	10,54 bc	8,92 a
50%	13,57 cd	9,08 ab	11,33 ab
75%	13,50 cd	10,97 bc	12,24 b
100%	11,47 bc	5,81 a	8,64 a
Kind of liquid waste influence	12,48 b	10,60 a	

Table 4. Specific growth rate of *Spirulina* biomass ($\%.\text{day}^{-1}$) at three groups based on light intensity.

Group of light intensity	Average maximum density	LSD (0,05)
High	11,62	ab
Medium	13,20	b
Low	9,81	a

Table 4 shows average of specific growth rate ($\%.\text{day}^{-1}$) which were cultured in tofu and latex liquid wastes combined *Spirulina*'s technical medium at three groups based on light intensity. In medium and high lightness (approximately 1000-6000 lux), heterotroph cultivation was more suitable for degradation of organic compound to be anorganic compound which was done by symbiont microbe in the medium.

Liquid wastes can contain metal ions, included heavy metals (Pb, Hg, Cd) that are hazardous for human consumption such as food, nutraceutical and pharmaceutical. Cyanophyta such as *Spirulina* have capability for metal adsorption 88-97% (da Costa and de Franca, 2003; Inthorn, *et.al.*,2002). Biosorptive capacity is influenced by many factors including: properties of metal ions in aqueous solution, biosorption conditions (such as pH, temperature, contact time, the presence of other ions in the solution, initial concentration of metal ions and the biomass) and algal species (Michalak *et al.*, 2007). Pre-treatment of liquid wastes is needed for safety. Heavy metal removal can be done by precipitation, filtration or growing aquatic plant for adsorption of metal ions and removal nitrogen and phosphor exceed in the organic liquid wastes. *Spirulina* have limiting factor for their growth. One of the limiting factors is maximum nitrogen concentration. maximum nitrogen concentration able to sustain the batch growth of this microalga without inhibition was 23,8 ppm (Converti *et al.*, 2006). Tofu and latex liquid wastes contains exceed nitrogen until 250 ppm (Wi-

jayanti and Jubaedah, 2009), so that is needed to remove nitrogen for optimizing *Spirulina* growth.

CONCLUSION

One hundred percent tofu liquid waste gave optimum density and 75% tofu liquid wastes gave maximum specific growth rate as like as 100% fertilizer for *Spirulina* medium. Light intensity 1000 – 4000 lux could be given on the *Spirulina* cultivation if they were cultured in fertilizer medium was combined by tofu and latex liquid wastes.

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