

Conference Program & Extended Abstract

The Natural Pigments Conference for South-East Asia
In Conjunction with: LCMS WORKSHOP from SHIMADZU

RESEARCH AND DEVELOPMENT

OF PIGMENT-BASED INNOVATION AND TECHNOLOGY

22-23 AUGUST 2016

The Core R&D Center, Universitas Ma Chung

Malang, East Java, Indonesia

Organized by:



SHIMADZU
Excellence in Science

Partners:



Supported by:



DAAD
Deutscher Akademischer Austausch Dienst



PT DITEK JAYA
Analytical & Measuring Instruments

its

np-sea.machung.ac.id

PREFACE

Opening Remark from The Chairman of The 3th-NPSEA

Dear researchers and friends,

On behalf of the organizing committee, I would like to give you a warm welcome in the 3rd Natural Pigments Conference for South-East Asia (NP-SEA) 2016.

Natural pigments are the most obvious and eye-catching substances that can be found in flowers, leaves, bird feather, algae, photosynthetic bacteria, and many more. These pigments have been used as bountiful colorants for food, cosmetics, and textiles and very close connected to the culture of South-East Asia. If we look closely, pigments such as chlorophylls and carotenoids play importance role as key pigments, which capture radiant of energy from the Sun in the process called photosynthesis – a process that convert solar energy into fuels. In agriculture, the natural pigments are important photosensors and indicators for health status. There are many applications that have been revealed through the study of structure and function of natural pigments.

We are looking forward of your active participation during the Natural Pigment Conference for South-East Asia to present your works, to raise questions, and triggers discussion on the recent research and development of pigment-based innovation and technology. We are inviting high profile scientists and practitioner in the industry as the keynote and plenary speakers. We wish that their presence would be a great encouragement and motivation for students and young researchers in the South-East Asia to take part in the research and development of natural pigments.

We are very happy to have 125 participants including the keynote speaker, plenary speakers, invited speakers, poster speakers, students and other participants from Germany, Switzerland, France, US, the Philippines, Singapore, and Indonesia. In this event, we would like to extend our acknowledgement to our partners, who support us financially, i.e. Kemenristekdikti, DAAD, ITS Scientific as well as PT Ditek Jaya and Shimadzu (Asia Pacific) Pte Ltd. We thanks to the Indonesian Society Pigment Researchers (Himpunan Peneliti Pigmen Indonesia, HP2I) for cooperation as steering committee, the Indonesia Pharmacist Association (Ikatan Apoteker Indonesia, IAI) for certifying this event with 6 credit points, the Indonesian Chemical Society (Himpunan Kimia Indonesia, HKI) and Indonesian-German Network (IGN) for disseminating this event to their members. We thanks also to Universitas Ma Chung for having this venue with superb facilities and supports from the staffs.

I do hope that you will find your time here enjoyable and a source of many insights that will help to advance the understanding of natural pigments and to encourage the collaborations and friendship, scientific exchange, the development of joint interests and project that are of scientific and economic importance in order to exploit the natural pigments and their importance in the most aspect of living, e.g. food and health, fashion, agriculture and advanced technologies.

Thank you very much and please enjoy this event.

Yours sincerely,

Tatas H.P. Brotosudarmo, Dipl.Chem., Ph.D

Chair of the NP-SEA 2016

Opening Remark from The Rector of Universitas Ma Chung

Dear Friends, participants of the Natural Pigments Conference for South East Asia 2016.

Welcome to Universitas Ma Chung, welcome to Malang, a beautiful city in Indonesia. We are happy that natural pigments experts from several countries, Indonesia, German, Switzerland, USA, France, the Philippines and Singapore gathered together here to share their knowledge and research results. We hold the NP Conference South East Asia this year in Universitas Ma Chung, Malang. It is not by chance that the international conference is holding here, because Universitas Ma Chung has an expertise in Natural Pigments which is institutionally embodied as Ma Chung Research Center for Photosynthetic Pigments (MRCPP). MRCPP is not only supported by Universitas Ma Chung but also by Indonesian government by recognizing MRCPP as one of the national scientific center of excellence.

Indonesia is one of the countries with a rich biodiversity, and consequently rich of natural pigments source. However, natural pigments industry in Indonesia and South East Asia is still lag behind the developed countries, whereas it is expected that the demands of natural pigments in various industries will increasing in the future. Therefore the research on natural pigments is one of the important research field. Indonesian government is also promoting the dissemination of research results to be applied in industry, not only finish in scientific publication.

Many kind of natural pigments in Indonesia and their properties are still unknown, they are remains to be investigated to provide benefit for human welfare. The international research cooperation in natural pigments will accelerate the rate of discovery and innovation in applying the knowledge for human welfare. Therefore, this conference is an important conference not only for the pigments research society but also for other research field and industry.

Besides the conference I hope the participants can also enjoy the natural beauty of Malang and its historic heritage.

I hope you enjoy staying in Malang, obtain a great benefit from the conference, and develop cooperation framework with other conference participants.

I wish to thank the speakers, poster presenters, students, and other attenders for attending the conference also partners who supported the conference.

Malang, August 18, 2016

Rector of Universitas Ma Chung

CONTENTS

Preface	1
Opening Remark from The Chairman of The 3 th -NPSEA	2
Opening Remark from The Rector of Universitas Ma Chung	3
Content	5
Organizing Committee	7
Scientific Program	11
General Schedule	12
Schedule of Oral Presentation	14
Schedule of Poster Presentation	16
Extended Abstracts of Keynote & Plenary Speaker	19
Extended Abstracts of Oral Presentation	29
Extended Abstracts of Poster Presentation	75
List of Workshop Participants	131

International Scientific Committee

1. Ferry F. Karwur, Ph.D. (Satya Wacana Christian University, Indonesia)
2. Prof. Dr. Hideki Hashimoto (Kwansei Gakuin University, Japan)
3. Prof. Dr. Hugo Scheer (Ludwig Maximilians University, Germany)
4. Leenawaty Limantara, M.Sc., Ph.D. (Universitas Pembangunan Jaya, Indonesia)
5. Prof. Dr. Ocky Karna Radjasa (Diponegoro University, Indonesia)
6. Tatas H.P. Brotosudarmo, Dipl.Chem., Ph.D. (Universitas Ma Chung, Indonesia)
7. Prof. Dr. Yuzo Shioi (Universitas Ma Chung, Indonesia)

Organizing Committee

- | | |
|---|--|
| 1. Chairman | : Tatas H. P. Brotosudarmo, Ph.D. |
| 2. Secretary | : Selvia Septa Rani
: Katarina Purnomo Salim, S.Gz., M.P.
: S. Alfisyah Nur Aziza, S.Si. |
| 3. Treasurer | : Rosita Dwi Chandra, S.TP., M.FoodSt(Adv)
: Amelia Myristi Lolita, A.Md. |
| 4. Public relation | : Tatas H. P. Brotosudarmo, Ph.D.
: Dr. Yuyun Yuniati, S.T., M.T. |
| 5. Program | : Tatas H. P. Brotosudarmo, Ph.D.
: Monika N. U. Prihastyanti, M.Nat.Sc.
: Novie Maria Setiawati, S.IP. |
| 6. Scientific program and poster | : Heriyanto, S.Si., M.Si., M.Sc.
: Dion Notaria, S.Farm., M.Sc., Apt.
: Rehmadata Sitepu, S.Farm., M.Si., Apt. |
| 7. Accommodation, equipment, and transportation | : Teddy Martono Jeremia, S.E.
: Marcelinus Alfasisurya Setya Adhiwibawa, S.P.
: Gigih Devy Rosalinda, S.IP. |

8. Documentation and publication : Marcelinus Alfasisurya Setya Adhiwibawa, S.P.
: Evan Hutomo Eka Putra, S.Kom.
: Dwi Endra Krisna
9. Food and beverages : Renny Indrawati, S.TP., M.Nat.Sc.
: Dr. Yuyun Yuniati, S.T., M.T.
10. Usher : Zuri Rismiarti, S.Si., M.Si.
: Martanty Aditya, M.Farm-Klin., Apt
11. Proofreader : Prof. Dr. Yuzo Shioi
: Prof. Eugenius Sadtono, Ph.D.

SCIENTIFIC PROGRAM

GENERAL SCHEDULE

THE 3RD NATURAL PIGMENTS CONFERENCE FOR SOUTH-EAST ASIA (NP-SEA) 2016

August 22, R&D Center Universitas Ma Chung

Monday, August 22, 2014		
The 3rd Natural Pigments Conference for South-East Asia (NP-SEA) 2016		
Time	Program	Room
07:00 – 08:00	Registration	R&D Center 1 st floor
08:00 – 08:10	Opening Remark by Conference Chairman by Tatas H. P. Brotosudarmo, Ph.D.	R&D Center Hall 6 th floor
08:10 – 08:45	Keynote Speaker : <i>[Chlorophylls: From Photosynthesis to Photodynamic Therapy]</i> by Prof. Dr. Hugo Scheer (Moderator : Leenawaty Limantara, Ph.D.)	R&D Center Hall 6 th floor
08:45 – 09:10	Plenary Speaker : <i>[Chlorophyll Breakdown During Leaf Senescence: A Novel Role for TIC55 as a Hydroxylase of Phyllobilins, the Products of Chlorophyll Breakdown]</i> by Prof. Stefan Hörtensteiner (Moderator : Leenawaty Limantara, Ph.D.)	R&D Center Hall 6 th floor
09:10 – 09:35	Plenary Speaker : <i>[The Untapped Richness of Pigment-producing Marine Organisms and Their Associates]</i> by Prof. Ocky Karna Radjasa (Moderator : Leenawaty Limantara, Ph.D.)	R&D Center Hall 6 th floor
09:35 – 10:00	Plenary Speaker : <i>[Marine Fungal Pigments Diversity and Potential Use]</i> by Dr. Kustiariyah Tarman (Moderator : Leenawaty Limantara, Ph.D.)	R&D Center Hall 6 th floor
10:00 – 10:15	Coffee break	R&D Center Hall 4 th floor
10:15 – 10:50	Keynote Speaker : <i>[Potential Market of Pigments in Daily Life: Food, Health and Fashion in Indonesia]</i> by Ir. Thomas Darmawan (Moderator : Ferry F. Karwur, Ph.D.)	R&D Center Hall 6 th floor
10:50 – 11:15	Plenary Speaker : <i>[Review on the Metabolites of Monascus]</i> by Dr. Philippe J. Blanc (Moderator : Ferry F. Karwur, Ph.D.)	R&D Center Hall 6 th floor
11:15 – 11:40	Plenary Speaker : <i>[Nexera UC, New Concept On-pine SFE-SFC-MS: Principles and Applications of SFE-SFC-MS/MS]</i> by Dr. Xing Jie (Moderator : Ferry F. Karwur, Ph.D.)	R&D Center Hall 6 th floor
11:40 – 12:05	Plenary Speaker : by Prof. Sherry A. Tanumihardjo, Ph.D. (Moderator : Ferry F. Karwur, Ph.D.)	R&D Center Hall 6 th floor
12:05 – 13:30	Lunch	R&D Center Hall 4 th floor

Time	Program	Room
13:30 – 14:45	Invited speaker – Session 1	R&D Center 6 th floor (Class A)
		R&D Center 6 th floor (Class B)
14:45 – 15:45	Coffee Break Poster Session	R&D Center Hall 4 th floor
15:45 – 16:45	Invited speaker – Session 2	R&D Center 6 th floor (Class A)
		R&D Center 6 th floor (Class B)
16:45 – 17:15	3 rd NP-SEA Awards for Best Poster and Closing Remark	R&D Center Hall 6 th floor
17:15 – 18:00	Preparation for Gala dinner	-
18:00 – 20:00	Gala dinner	Balai Pertiwi
Tuesday, August 23, 2014		
Shimadzu Advance Liquid Chromatography Mass Spectrometry (LCMS/MS) Technologies and Applications Workshop in Junction with The Natural Pigments Conference for South-East Asia		
Time	Program	Room
07:00 – 8:00	Registration	MRCPP R&D Center Hall 3rd floor
08:00 – 09:00	Session 1 : Introduction of LCMS/MS and Application	
09:00 – 12:00	Session 2 : Technical Workshop (I)	
12:00 – 13:00	Lunch	
13:00 – 16:00	Session 3 : Technical Workshop (II)	
16:00 – 16:15	Closing	

Schedule of Oral Presentation

Oral Presentation – Session 1			
Meeting Hall at 6 th Floor of The R&D Center (Class A)			
Moderator: Dr. Ir. Edia Rahayuningsih, M.S.			
Time	Authors	Title	Code
13:30-13:45	Delianis Pringgenies, Riyanda Idris, Muhammad Zainudin	The Antioxidant Activity of Carotenoid Pigments in the Bacterial Symbionts of Seagrass <i>Syringodium isoetifolium</i>	ON-01
13:45-14:00	Victor Aprilyanto, Andrea Putri Subroto, Chris Darmawan, Reno Tryono, Condro Utomo, and Tony Liwang	In Vitro Selection of single guide RNA for Effective Cleavage of Exon-3 VIRESCENS Gene in Oil Palm Using CRISPR/Cas9 System	ON-02
14:00-14:15	Abdullah Muzi Marpaung, Nuri Andarwulan, Purwiyatno Hariyadi and Didah Nur Faridah	The Color Stability of Butterfly Pea (<i>Clitoria ternatea</i> L.) Petal Extract at pH 6 to 8 are Highly Uncertain	ON-03
14:15-14:30	Mohammad Junus	Algae Cells Density in Various Planting Period and Liquid Sludge Biogas Unit Proportion	ON-04
14:30-14:45	Uun Yanuhar	The Involvement Fragment Pigment Protein (FPP) Microalga <i>Nanochloropsis oculata</i> of Response Heat Shock Protein 70 (HSP70) of Infection Nervous Necrotic Viral (NNV) on Grouper	ON-05
Room at 6 th floor of The R&D Center (Class B)			
Moderator: Prof. Erlinda A. Vasquez			
13:30-13:45	Windu Merdekawati	The Uniqueness of Seaweed Pigments	ON-06
13:45-14:00	Ermiziar, T., Saragih, R., Hanum, L.	Natural Pigment from Red Colour Melinjo Peels	ON-07
14:00-14:15	Pujiyanto, Muhammad Iqbal Prawira Atmadja and Dadan Rohdiana	Theaflavin, Natural Pigment on Black Tea and Its Pharmacological Activities	ON-08
14:15-14:30	Failisnur, Sofyan and Anwar Kasim	Dyeing of Cotton Fabric with Natural Dye from Gambier (<i>Uncaria gambir</i> Roxb.)	ON-09
14:30-14:45	Defri Yona and Park Mi Ok	Seasonal variation of phycoerythrin chromophores of <i>Synechococcus</i> spp. in the East Sea, Korea	ON-10

Oral Presentation – Session 2

Meeting Hall at 6th floor of The R&D Center (Class A)

Moderator: Mr. Victor Aprilyanto

15:45-16:00	Darda Efendi, H. Muthmainnah, T.S. Arzam, I. H. Sumiasih, R. Poerwanto, and Y.A. Purwanto, A. Agusta, and S. Yuliarni	Degradation of Chlorophyll and formation of β -cryptoxanthin and β -citraurin in Citrus Degreening	ON-11
16:00-16:15	Edia Rahayuningsih	The Sustainable Economic Development through Research, Production, and Application of Natural Dye	ON-12
16:15-16:30	Delicia Yunita Rahman, Dwi Susilaningsih and Marc J.E.C. van der Maarel	Heterotrophic growth of LIPI13-AD014 for Phycocyanin Production	ON-13
16:30-16:45	Muh. Thoyib, Catur Harsito, Suyitno, Syamsul Hadi	Simple Procedure for Reducing Cratering Defect of Water-Based Paint Using <i>Caesalpinia Sappan</i> Dye	ON-14

Room at 6th floor of The R&D Center (Class B)

Moderator: Dr. Dadan Rohdiana

15:45-16:00	Anna Yuliana, Marlia Singgih Wibowo, Elin Julianti	Toxicity Level of Monascus Pigments Using Ecosar Program	ON-15
16:00-16:15	Erlinda A. Vasquez, Candelario L. Calibo, Ronnel M. Godoy and Lady Fatima G. Palermo	Alteration of the Chlorophyll Content in Phytoplasma-Infected Cassava	ON-16
16:15-16:30	Rika Wahyuningtyas & Uun Yanuhar	The Expression of MHC Class 1 in <i>Cyprinus carpio</i> Infected Koi Herpes Virus through Induction of Crude Protein from Macroalgae <i>Halimeda</i> sp	ON-17
16:30-16:45	Mada Triandala Sibero, Kustiariyah Tarman, Rita Sahara	Exploration of Red Pigment from Coastal Endophyte Fungi Isolated from <i>Hydnophytum formicarum</i>	ON-18

Poster Presentation			
Room at 4 th floor of The R&D Center			
14:45 – 15:45			
No	Authors	Title	Code
1	Elfi Anis Saati, Sita Ayu Pangesti, Sri Winarsih and Moch. Wachid	Co-pigmentation Anthocyanins of Rose Pigment (varieties of Batu Local) with Catechin from Black Tea and Green Tea Extracts	PN-01
2	Andreas Lucky Effendy, Rollando	In silico screening study of potent human breast cancer drug from natural pigments	PN-02
3	Antonius Herry Cahyana, Kam Natania and Hong Fu Sheng	Study on Antioxidant Activity, Binding Capacity and Stability of Curcumin-Functionalized Fe ₃ O ₄ Magnetic Nanoparticles	PN-03
4	Ayda Krisnawati and M. Muchlish Adie	Consistency of Biomass Production from Several Soybean Genotypes in Various Agro Ecology of Indonesia	PN-04
5	Diah Mustika Lukitasari, Rosita Dwi Chandra, Heriyanto, Renny Indrawati	Stability and Antioxidant Activity of Microencapsulated Pigment from Red Spinach (<i>Amaranthus tricolor</i>) for Food Colourants	PN-05
6	Elin Julianti, Laida Neti Mulyani, Marlia Singgih Wibowo, Susanti	Comparison Different Extraction method of C-Phycocyanin, a Phycobiliprotein from Dry Biomass of <i>Spirulina platensis</i>	PN-06
7	Ervika Rahayu NH, Dini Ariani, Miftakhussolikah, Maharani P.E., Yudi P	The Effect of Yellow Natural Color from Turmeric on Physical and Sensory Properties of Arenga Starch- <i>Colocasia Esculenta</i> L. Noodle	PN-07
8	Giacinta Mutiara Beta Maharani, Filiana Santoso, and Abdullah Muzi Marpaung	Stability Improvement of Anthocyanin from Various Local Plants using Metal Complexation	PN-08
9	Kam Natania, Antonius Herry Cahyana, Melanie Cornelia dan Edison Sutiyono	Microencapsulation of Soursop (<i>Annona muricata</i> Linn.) Leaf Tea Extract Using Natural Mucilages	PN-09

Poster Presentation			
Room at 4 th floor of The R&D Center 14:45 – 15:45			
No	Authors	Title	Code
10	M. Muchlish Adie and Ayda Krisnawati	Identification and Clustering Soybean Genotypes with High Biomass Production as a Source of Renewable Energy	PN-10
11	Melanie Cornelia and Oktafielia Putri	Application of Goji Berry Fruit (<i>Lycium barbarum</i> L.) extract as Food colorant in Dried Noodle	PN-11
12	Miftakhussolikah, Dini Ariani, Ervika RNH, Azkia Nastiti, Yudi Pranoto	Effect of Additional Suji Leaves and Turmeric Extract on Physicochemical Characteristic and Antioxidant Activity of Arenga-Canna Noodle	PN-12
13	Selfina Gala, Dhaniar Rulandri Widoretno, Delita Kunhermanti, Lailatul Qadariyah, Sumarno and Mahfud	Microwave-assisted Extraction of Natural Dyes from Jackfruit Wood Waste (<i>Artocarpus heterophyllus</i> Lamk)	PN-13
14	Renny Indrawati, Gita, Kristine, Melissa, Yuyun Yuniati, Leenawaty Limantara	How extensive does the artificial dye color our food?	PN-14
15	Swanty Rahmazania Mustika and Abdullah Muzi Marpaung M.P	Color properties and Stabilizing Effect of Metal ion on Blue Anthocyanin Color from Buni (<i>Antidesma bunius</i>) Fruit	PN-15
16	Rosita Dwi Chandra, Renny Indrawati, Mario Sent Anugrah, Jodiawan, Ricky Santoso, Tatas H. P. Brotosudarmo, Leenawaty Limantara	Uncovering the Availability of Products Enriched with Vitamin A in Local Supermarket	PN-16

Poster Presentation			
Room at 4 th floor of The R&D Center			
14:45 – 15:45			
No	Authors	Title	Code
17	Yudi Purnomo, Fajar Audra Pratama, Nur Rohman	Hepatoprotector and Anti-Hemolysis Activity of Tommato (<i>Lycopersicon pimpinellifolium</i>) Juices In Rats Induced Alum	PN-17
18	Endang Kusdiyantini, Iffan Alif, Salma Fuadiyah, Dyah Wulandari, Anto Budiharjo	Identification of Red-Pigmented Thermophile Bacteria Isolated from Gedong Songo Hot Spring, Semarang – Central Jawa	PN-18
19	Setiyono, E., Pringgenies., Heriyanto, Prihastyanti, M.N.U, Shioi, Y., Brotosudarmo, T.H.P	Carotenoid Analysis from <i>Erythrobacter flavus</i> Symbiont of <i>Acropora nasuta</i>	PN-19
20	Husnatain, I.D., Salim, K.P., Heriyanto, Purwantiningrum, I., Harijono, Limantara, L.	Effect of Dried Fruit Processing on Lycopene Content and Pigment Composition of Tommato (<i>Lycopescicum esculentum</i> var Marta)	PN-20
21	Wibowo, A.A., Elim, P.E., Heriyanto, Prihastyanti, M.N.U, Shioi, Y., Brotosudarmo, T.H.P	Effect of Drying Treatments on the Concentration of Fucoxanthin and Chlorophyll <i>a</i> and Pigment composition of Three <i>Sargassum</i> Species	PN-21
22	Yuyun Yuniati, Renny Indrawati, Jovine, Tantiana, Wynona	Tracing the antioxidant-rich products in local groceries: naturalness, biofunctionality, and price	PN-22
23	Yuyun Yuniati, Juliana, Lidwina Angelica Soetantijo, and Ratna Yulianti Wijaya, Renny Indrawati	Preparation of Antioxidant Drinks from Mulberry <i>Morus nigra</i> L.	PN-23

Effect of Drying Treatments on the Composition and Concentration of Fucoxanthin and Chlorophyll *a* of Three *Sargassum* Species

Wibowo, A. A.^a, Elim, E. P.^a, Heriyanto^{a,b}, Prihastyanti, U. N. M.^b, Shioi, Y.^b, Limantara, L.^{a,b,c}
Brotosudarmo, T. H. P.^{a,b*}

^a Department of Chemistry, Faculty of Science and Technology, Universitas Ma Chung, Jl. Villa Puncak Tidar N-01, Malang – 65151, East Java, Indonesia

^b Ma Chung Research Center for Photosynthetic Pigments (MRCPP), Universitas Ma Chung, Jl. Villa Puncak Tidar N-01, Malang – 65151, East Java, Indonesia

^c Universitas Pembangunan Jaya, Jl. Cendrawasih Raya B7/P, South Tangerang-15413, Banten Indonesia

Abstract

Sargassum sp. is well known as a source of hydrocolloid and pigments. In the present preliminary study, the effect of two different drying treatments (oven and sun drying) on the pigments was evaluated and compared to the fresh one. Pigments composition from three species of *Sargassum* sp. collected from Teluk Awur beach was investigated using spectroscopic and chromatographic methods. The experimental results showed that concentration of fucoxanthin (fucox) and chlorophyll *a* (chl*a*) from the three species of *Sargassum* sp. (fresh and dried) were varied from 0.51 mg · g⁻¹ to 0.94 mg · g⁻¹ and from 0.47 mg · g⁻¹ to 2.68 mg · g⁻¹ dry weight (dw), respectively estimated by HPLC method. Oven was the best drying treatment to maintain the fucox while the sun drying was the best drying treatment to maintain chl*a*.

Keywords: *Sargassum* sp., fucoxanthin, chlorophyll *a*, drying treatments, pigments

*Corresponding author: E-mail Address : tatas.brotosudarmo@machung.ac.id

Telephone Number : 082141490052

1. Introduction

Brown seaweed is one of the edible seaweeds and has been widely used as the major commercial source of agar, alginate, and carrageenan. Besides hydrocolloid source, recently, brown seaweed has been reported for its industrial importance of potential pigments. *Sargassum* sp. is one of the edible brown seaweed and abundant in Indonesia. In fact, *Sargassum* sp. contains high amount of fucoxanthin (fucox) and chlorophyll *a* (chl*a*) [2]. Fucox is typical pigment component of *Sargassum* sp. that gives several health benefits to humans. Fucox act as anti-cancer and antiobesity [3,4].

Many reports have been published for *Sargassum* sp. on its biochemical compounds, such as pigments and fatty acid. The growth depends on several environmental factors, such as light intensity, temperature, and nutrient levels [5]. To use *Sargassum* sp., either in fresh or dry conditions, as a raw material in pigment industry, pigment analysis is required to evaluate the effect of drying treatments on the pigment quality. In this study, we analyzed the pigment composition of the seaweed in the form of fresh seaweed and dry powders and determined the best drying treatment.

2. Material and Methods

2.1. Sample Preparation

Three *Sargassum* sp. were collected from several locations in Teluk Awur beach, Jepara, Central Java, Indonesia. The seaweeds were cleaned from any associated debris by rinsing with fresh water and then samples were put

into black plastic bags and placed in cooling box during the transportation to the laboratory. Seaweeds were dried using two different treatments, i.e. oven (50 °C, 30 h) and sun drying (30 °C, 36 h).

2.2. Extraction of Pigments

Initially fresh *Sargassum* sp. thali were frozen with liquid N₂ and followed by grinding into small particles. The pigment extraction was carried out homogenizing 0.5 g of the sample and ethanol (EtOH) in vortex, and followed by sonication to break the seaweed cells. The crude pigment extract was separated from its residue by centrifugation. The residue was continuously extracted with the same procedure until pigments were completely extracted. The crude extract was dried with the flow of N₂ gas. In the case of dry *Sargassum* sp thali powders, pretreatment by humidification was made before the pigment extraction according to the modified method of Ishihara *et al.* [6] Pigment from dry powder (0.1 g) was extracted with the same methods as fresh sample.

2.3. Pigment Determination

Absorption spectra of crude pigment extract in acetone were recorded by a UV-1700 spectrophotometer (Shimadzu) in the range of 300 nm to 800 nm. Chromatographic analysis was performed by RP-HPLC equipped with photodiode array detector (Shimadzu). A Shim-pack VP-ODS C18 column (250L × 4.6 mm; Shimadzu) was used for pigments separation according to the method of Hegazi *et al.* [7]. Chromatographic and spectroscopic properties of the

separated pigments were used for the identification. The modified standard curve of pigments from the linear equations was used for calculating concentration of fucox and chl *a* in mg g⁻¹ dry weight (dw) [2].

3. Results and discussion

Absorption spectra of pigment extract from fresh *Sargassum* sp. species 1 showed typical absorptions of carotenoids around 400 nm to 500 nm and also chl *a* at 431 nm and 662 nm which is partially overlapped with band of carotenoids (Fig. 1a). Absorption spectra of other fresh seaweed show similar pattern. On other hand, spectral shift from 431 nm to 412 nm was observed in dried seaweed. For the drying methods using oven showed that most of the chl *a* degraded into pheophytin. Moreover, absorption spectra of sun-dried seaweed show that the sorot has two peaks in 431 nm and 412 nm suggesting initial pheophytin formation. A decrease in absorbance was observed in Qy band of chl *a* due to the influence of drying process (Fig. 1a).

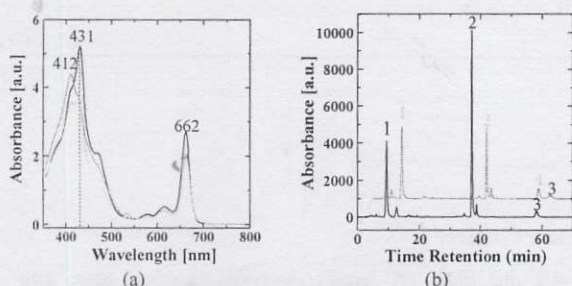


Fig. 1. (a). Absorption spectra of fresh seaweed (black), oven-dried seaweed (dark gray), and sun-dried seaweed (light gray). (b) Chromatogram of fresh (black) and dried seaweed (dark gray)

HPLC chromatogram of pigment extract from fresh and dried *Sargassum* sp. are shown in Fig. 1b. At least three main pigments were detected in fresh seaweed. On the other hand, at least four main pigments were detected in oven-dried seaweed. Moreover, there is a slight difference on fucox intensity which appeared at *t_R* 9.3 min between fresh and oven-dried seaweed.

On the contrary, significant decrease was observed on chl *a* peak (*t_R* 37.1 min) because most of chl *a* degraded into pheophytin. In Fig. 1b., pheophytin is shown at *t_R* 53.9 min. In addition, β-carotenoid was found in *t_R* 58.2 min. All pigment extract had similar chromatogram profile.

The dominant pigment in fresh *Sargassum* sp. were fucox and chl *a*. The concentration of fucox varied from 0.71 mg g⁻¹ to 0.87 mg g⁻¹. On other hand, chl *a* varied from 1.91 mg g⁻¹ to 2.68 mg g⁻¹. From three species *Sargassum* sp. (1) has the highest concentration of fucox and chl *a*. As the result of drying treatments, fucox and chl *a* concentrations decreased (Table 1). The degradation percentage of fucox with oven drying treatment varied from 12.64 % to 29.88%, thus oven drying is recommended as the best drying method that still can maintain fucox. Meanwhile, sun drying treatment gave larger degradation percentage of fucox, i.e.

36.78 % to 41.38 %. The properties of carotenoids as photoprotector enable fucox to minimize degradation on chl *a* due to high intensity of light during sun drying treatment, therefore fucox concentration decreased. However, oven-dried seaweed still had stable fucox under high temperature exposure. On the other hand, chl *a* is more stable in low temperature although it was exposed under high intensity light from the sun. The decrease percentage of chl *a* from oven-dried seaweed varied from 58.58 % to 75.39 %, while the degradation percentage in sun-dried seaweed varied from 31.93 % to 56.90 %.

Table 1. Spectrophotometric and chromatographic of the chl *a*, total carotenoid, and fucox from *Sargassum*

Species of <i>Sargassum</i>	Treatment	Concentration (mg · g ⁻¹)	
		Chl <i>a</i>	Fucox
<i>Sargassum</i> sp. (1)	Fresh	2.68	0.87
	Oven	1.11	0.76
	Sun drying	1.28	0.55
<i>Sargassum</i> sp. (2)	Fresh	2.39	0.87
	Oven	0.68	0.61
	Sun drying	1.03	0.51
<i>Sargassum</i> sp. (3)	Fresh	1.91	0.71
	Oven	0.47	0.94
	Sun drying	1.30	0.61

4. Conclusion

The dominant pigments for fresh *Sargassum* sp. were fucox and chl *a*. *Sargassum* sp. (1) has the highest concentration of fucox (0.87 mg g⁻¹) and chl *a* (2.68 mg g⁻¹). The best drying treatment to maintain the concentration or quality of fucox is oven drying with decrease percentage varied from 12.64 % to 29.88 %. In other hand the best drying treatment to maintain the concentration of chl *a* is sun drying with degradation percentage varied from 31.93 % to 56.90 %.

References

- [2] Heriyanto, Juliadiningtyas, A. D., Shioi, Y., Limantara, L., Brotosudarmo, T. H. P. (2016). Analysis of Pigment Composition of Brown Seaweeds Collected from Panjang Island, Central Java, Indonesia. *Pertanika J. Trop. Agri. Sci. in press*
- [3] Hosokawa, M., Kudo, M., Maeda, H., Kohno, H., Tanaka, T. & Miyashita, K. (2004). Fucoxanthin induces apoptosis and enhances the antiproliferative effect of the PPARγ ligand, troglitazone, on colon cancer cells. *Biochim. Biophys. Acta* 1675:113-9.
- [4] Maeda, H., Hosokawa, M., Sashima, T., Funayama, K. & Miyashita, K. (2005). Fucoxanthin from edible seaweed, *Undaria pinnatifida*, shows antiobesity effect through UGP1 expression in white adipose tissues. *Biochem. Biophys. Res. Commun.* 332:392-7.
- [5] Baghel, R., S., Kumari, P., Reddy, C., R., K., & Jha, B. (2014). Growth, pigments, and biochemical composition of marine red alga *Gracilaria Crassa*. *J. Appl. Phycol.* vol. 26, p. 2143-2150.
- [6] Ishihara, K., Oyamada, C., Sato, Y., Danno, H., & Kimiya, T. (2008). Relationships between quality parameters and content of glycerol galactoside and porphyrin-334 in dried laver nori *Porphyra yezoensis*. *Fish. Sci.*, vol. 74, p. 167-173.
- [7] Hegazi, M. M., Ruzafa, A. P., Almela, L., & Candela, M. E. (1998). Separation and identification of chlorophylls and carotenoids from *Caulerpa prolifera*, *Jania rubens* and *Padina Pavonica* by reversed phase high-performance liquid chromatography. *Journal of Chromatography, A* 829, 153-159.