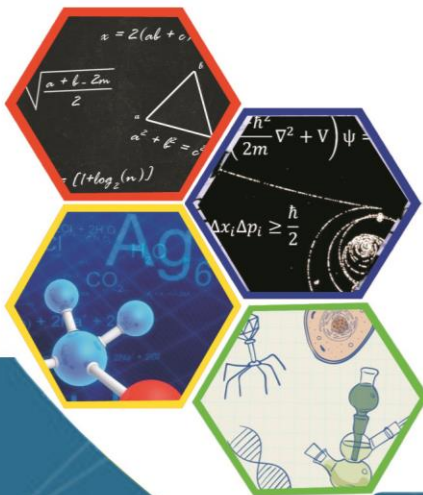




# PROCEEDING

The 2<sup>nd</sup> International Seminar of Basic Science  
Natural Science For Exploration The Sea-Island Resources  
Ambon, May 31<sup>st</sup> 2016



Organized by  
Faculty of Mathematics and Natural Science  
Pattimura University



# PROCEEDINGS

The 2<sup>nd</sup> International Seminar of Basic Science

*“Natural Science for Exploration The Sea-Island Resources”*

Poka-Ambon, 31<sup>st</sup> May 2016

**Mathematic and Natural Science Faculty  
Universitas Pattimura  
Ambon  
2016**

# PROCEEDINGS

The 2<sup>nd</sup> International Seminar of Basic Science

May, 31<sup>st</sup> 2016

---

**ISBN : 978-602-97522-2-9**

- Organizing Committee : PANITIA DIES NATALIES XVIII  
Fakultas Matematika dan Ilmu Pengetahuan Alam  
Universitas Pattimura
- Advisory : Prof . Dr. Pieter Kakisina, S.Pd., M.Si  
Scientific Comitte : Prof. Dr. Th. Pentury, M.Si (Matematika)  
Prof. Dr. Pieter Kakisina, M.Si (Biologi)  
Dr. Yusthinus T. Male, M.Si (Kimia)  
Dr. Catherina M. Bijang, M.Si (Kimia)  
Dr. A. N. Siahaya, S.Pd., M.Si (Kimia)  
R. R. Lakollo, S.Si., M.Si (Fisika)  
Grace Loupatty, S.Si., M.Si (Fisika)  
M. W. Talakua, S.Pd., M.Si (Matematika)  
E. R. Persulesy, S.Si., M.Si (Matematika)
- Steering Committee : Dr. La Eddy, M.Si  
D. L. Rahakbauw, S.Si., M.Si
- Editors : Y. A. Lesnussa, S.Si., M.Si  
Nelson Gaspersz, S.Si., M.Si  
Lady Diana Tetelepta, S.Si., M.Si  
L. D. Patty, S.Si., M.Si  
A. Y. Huwae, S.Si
- Cover Design : Lexy Janzen Sinay, S.Si., M.Si  
V. Silahooy, S.Si., M.Si  
Idham Olong, S.Si

Mathematic and Natural Science Faculty  
Universitas Pattimura  
Ir. M. Putuhena St.  
Kampus Poka-Ambon  
Pos Code 97233  
Email:fmipa\_unpatti@gmail.com

2<sup>nd</sup> edition

© 2016 Mathematic and Natural Science Faculty, Universitas Pattimura

All rights reserved

Republication of an article or portions thereof in original form or in translation, as well as other types of reuse require formal permission from publisher.

# PROCEEDINGS

The 2<sup>nd</sup> International Seminar of Basic Science

May, 31<sup>st</sup> 2016

---

## Welcoming Address By The Organizing Committee

Today, We have to thank the The Almighty Allah SWT for the implementation of this international seminar. This is the second seminar about Basic Science in The Faculty of MIPA Pattimura University. The seminar under the title “Natural Sciences for Exploration the Sea-Island Resources” will be carried out on May 31<sup>st</sup> 2016 at Rectorate Building, Pattimura University. There are 200 participants from lecturers, research institute, students, and also there are 34 papers will be presented.

My special thanks refer to the rector of Pattimura University and the Dean of MIPA Faculty, Prof. Dr. Pieter Kakissina, S.Pd., M.Si. I also would like to express my deepest gratitude to Prof. Amanda Reichelt-Brushett, M.Sc., Ph.D. ; Kazuhiko Ishikawa, Ph.D. ; Nicolas Hubert, Ph.D. ; Prof. Dr. Kirbani Sri Brotopuspito ; Prof. Dr. Marjono, M.Phil. ; Gino V. Limon, M.Sc., Ph.D. as the keynote speakers.

The last, We hope this international seminar usefull for all of us, especially Mollucas People and very sorry if any mistake. Thank you very much.

**Dr. La Eddy, M.Si.**

Chairman of Organizing Committee

## Opening Remarks By Dean of Mathematic and Natural Sciences Faculty

I express my deepest gratitude to The Almighty God for every single blessing He provides us especially in the process of holding the seminar until publishing the proceeding of International Seminar in celebrating the 18<sup>th</sup> anniversary of MIPA Faculty, Pattimura University. The theme of the anniversary is under the title “Natural Sciences for Exploration the Sea-Island Resources”. The reason of choosing this theme is that Maluku is one of five areas in Techno Park Marine in Indonesia. Furthermore, it is expected that this development can be means where the process of innovation, it is the conversion of science and technology into economic value can be worthwhile for public welfare especially coastal communities.

Having the second big variety of biological resources in the world, Indonesia is rich of its marine flora and fauna. These potential resources can be treated as high value products that demand by international market. Basic science of MIPA plays important role in developing the management of sustainable marine biological resources.

The scientific articles in this proceeding are the results of research and they are analyzed scientifically. It is expected that this proceeding can be valuable information in terms of developing science and technology for public welfare, especially people in Maluku.

My special thanks refer to all researchers and reviewers for your brilliant ideas in completing and publishing this proceeding. I also would like to express my gratefulness to the dies committee-anniversary of MIPA Faculty for your creativity and hard working in finishing this proceeding, God Bless you all.

**Prof. Dr. Pieter Kakisina, S.Pd., M.Si.**

Dean of Mathematic and Natural Sciences Faculty

# PROCEEDINGS

The 2<sup>nd</sup> International Seminar of Basic Science

May, 31<sup>st</sup> 2016

---

## ACKNOWLEDGMENT

The following personal and organization are greatfully  
acknowledgment for supporting  
“The 2<sup>nd</sup> International Seminar of Basic Science 2016”

Hotel Mutiara Ambon

# PROCEEDINGS

The 2<sup>nd</sup> International Seminar of Basic Science

May, 31<sup>st</sup> 2016

---

## Contents

	<i>Page</i>
<b>Welcoming Address by The Organizing Committee</b> .....	ii
<b>Opening Remarks by Dean of Mathematic and Natural Science Faculty</b> ....	iii
<b>Acknowledgment</b> .....	iv
<b>Contents</b> .....	v–vii
<b>Papers</b>	
1. Hyperthermophilic Cellulase from Deep-Sea Microorganisms Surviving in Extreme Environment <i>Kazuhiko Ishikawa</i> .....	1–6
2. Challenges for Risk Assessment Associated with Waste Disposal and Mineral Activities in Deep Sea Environments <i>Amanda Reichelt-Brushett</i> .....	7–12
3. The Importance of Geophysics Education at The University of Pattimura, Ambon <i>Kirbani Sri Brotopuspito</i> .....	13–18
4. The Lost Paradise: Term Observation of Coral Reef in Ambon Bay <i>Gino V. Limmon</i> .....	19–24
5. Mathematical Model for The Sustainable Development in Exploring The Sea-Island Resources <i>Marjono</i> .....	25–36
6. Quality Characteristics of Redtail Scad ( <i>Decapterus kurroides</i> ) SMOKE Pressure Using Different Liquid Smoke and Mechanical Mixing <i>Joice P. M. Kolanus, Sugeng Hadinoto</i> .....	37–48
7. Antidiabetic and Antioxidant Activity of Endophytic Fungi From Sirih Hitam Plant ( <i>Piper betel</i> L) <i>Edward J. Dompeipen</i> .....	49–57
8. Influence Each Stages by Processed on Quality Dry Sea Cucumber ( <i>Holothuria scabra</i> ) <i>Voulda D. Loupatty, R. V. Tehubijuluw</i> .....	58–64
9. Exploration For Fishing Areas Through SPL ( <i>Suhu Permukaan Laut</i> ) <i>Pentarina Intan Laksmiawati</i> .....	65–68
10. Development of Algorithm Model for Estimating Chlorophyll-a Concentration Using <i>In Situ</i> Data and atmospherically corrected landsat-8 Image By 6SV (Case Study: Gili Iyang'S Waters) <i>Resti Limehuwey, Lalu Muhamad Jaelani</i> .....	69–77
11. Earthquake Epicenter Positioning With Inversion Method In Central Maluku District <i>R. R. Lokollo, J. R. Kelibulin</i> .....	78–83
12. Spatial Distribution Analysis of Oxygen (O <sub>2</sub> ) By Using <i>In Situ</i> Data and	

# PROCEEDINGS

The 2<sup>nd</sup> International Seminar of Basic Science

May, 31<sup>st</sup> 2016

---

	Landsat 8 Imagery (Study Case: Gili Iyang, Sumenep) <i>Rovila Bin Tahir, Lalu Muhamad Jaelani</i> .....	84–90
13.	Interpretation of Geothermal Reservoir Temperature In The Nalahia Nusalaut, Central of Moluccas <i>Helda Andayany</i> .....	91–96
14.	Temporal Statistical Analysis of The Volcanic Eruption in Mt. Banda Api, Banda Islands, Moluccas <i>J. R Kelibulin, R.R Iokollo</i> .....	97–103
15.	FTIR Spectrum Interpretation of Vegetable That Contains Pesticide <i>Diana Julaidy Patty, Grace Loupatty, Lorenzya Mairuhu</i> .....	104–109
16.	Landslide Susceptibility Analysis using Weighted Linear Combination (WLC) Combined with The Analytical Hierarchy Process (AHP) <i>Romansah Wumu, Teguh Hariyanto</i> .....	110–116
17.	Application of Principal Component Analysis Based on Image for Face Recognition <i>Y. A. Lesnussa, N. A. Melsasail, Z. A. Leleury</i> .....	117–130
18.	Learning Mathematics By Involving The Left and The Right Brains In Processing Information <i>Magy Gaspersz</i> .....	131–139
19.	The Total Irregularity Strength of The Corona Product of A Path With A Wheel <i>Faldy Tita, F. Y. Rumlawang, M. I. Tilukay, D. L. Rahakbauw</i> .....	140–145
20.	Spectrum Analysis Near-Infrared Spectroscopy (NIRs) of Cajuput Oil <i>Gian Kirana Efruan, Martanto Martosupono, Ferdy S. Rondonuwu</i> .....	146–152
21.	Analysis Aromatic Compounds of Citronella Oil by Using Near Infrared Spectroscopy (NIRS) and Gas Chromatography-Mass Spectroscopy (GC-MS) <i>Welmince Bota, Martanto Martosupono, Ferdy S. Rondonuwu</i> .....	153–159
22.	The Study of Waters Quality at Rosenberg Strait, Tual City, Maluku <i>Marsya Jaqualine Rugebregt</i> .....	160–168
23.	The Relationship Between Physical-Chemical Factors and Diversity of Sea Urchin (Echinodea) in The Kampung Baru Coastal of Banda Island Central Moluccas <i>Deli Wakano, Mechiavel Moniharapon</i> .....	169–178
24.	Volume and Production of Bee Propolis on Various Media <i>Trigona Spp</i> Natural Nest in The Village Waesamu Kairatu West District District West Seram <i>Debby D. Moniharapon, Jacobus S. A. Lamerkabel, Thresya S. Kwalomine</i> .....	179–186
25.	The Effect of Essence Red Fruit (Pandanus Conoideus Lam) To Gastric Mucosa Rat ( <i>Rattus novergicus</i> ) Induced Type of Alcohol Drinks Sopi <i>Mechiavel Moniharapon, Pieter Kakisina, Jantje Wiliem Souhaly</i> .....	187–195



# PROCEEDINGS

The 2<sup>nd</sup> International Seminar of Basic Science

May, 31<sup>st</sup> 2016

---

26. Inventory of Medicinal Plants and Its Utilization Potential In Pombo Island, Central Moluccas  
*Adrien Jems Akiles Unity, Veince Benjamin Silahooy* ..... 196–199
27. Extraction of Timbal (Pb) from Sediment at Inside of Ambon Bay with Bioleaching Method by Using Bacteria *Thiobacillus ferrooxidans*  
*Yusthinus T. Male, Martha Kaihena, Rodrich R. Ralahalu* ..... 200–206
28. Histological of Haemocyte Infiltration Changes During Pearl Sac Formation in *Pinctada maxima* Host Oysters Reared at Different Depths  
*La Eddy, Ridwan Affandi, Nastiti Kusumorini, Wasmen Manalu, Yulvian Tsani, Abdul Rasyid Tolangara, Cornelia Pary* ..... 207–212
29. Isolation and Identification of Lipase Producing Thermophilic Bacteria From a Hot Spring at Seram Island, Moluccas  
*Edwin T. Apituley, Nisa Rachmania Mubarik, Antonius Suwanto* ..... 213–218
30. Effect of Ethanol Extract Gambir Laut Leaves (*Clerodendrum inerme* L) To Ovaries Weight of Mice  
*Chomsa Dintasari Umi Baszary, Feliks Pattinama* ..... 219–221
31. The Performance of Morphological and Physiological Effect of Three Accessions of Cowpea on Drought Stress  
*Helen Hetharie* ..... 222–230
32. Relationship of Length-Weight and Size Structure of Skipjack (*Katsuwonus pelamis*) In Marine Waters of Moluccas, Indonesia  
*Immanuel V. T. Soukotta, Azis N. Bambang, Lacmuddin Sya'rani, Suradi Wijaya Saputra* ..... 231–237

# PROCEEDINGS

The 2<sup>nd</sup> International Seminar of Basic Science

May, 31<sup>st</sup> 2016

---

## SPECTRUM ANALYSIS NEAR-INFRARED SPECTROSCOPY (NIRs) OF CAJUPUT OIL

Gian Kirana Efruan<sup>1</sup>, Martanto Martosupono<sup>1</sup>, Ferdy S. Rondonuwu<sup>1,2,\*</sup>

<sup>1</sup>Biology Magister Postgraduate Program – Satya Wacana Christian University Salatiga

<sup>2</sup>Physics Study Program – Mathematics and Science Faculty, Satya Wacana Christian University, Salatiga 50711 Indonesia, Correspondent Telp. +6281390000149

\*Email: [ferdy@staff.uksw.edu](mailto:ferdy@staff.uksw.edu)

### ABSTRACT

Cajuput oil is produced by the distillation of leaves and twigs of the *Melaleuca leucadendra* trees which grow wild and are cultivated in Indonesia. It is important to identify the substance of cajuput oil used, and it is conventionally measured using Gas Chromatography Mass Spectroscopy (GC-MS) method. This method is time consuming, leaves chemical residual, relatively expensive, and has not supported the need of quick measurement as well as provided online service in essential oil industry yet. One of potential methods to fulfill those needs is Near Infrared/NIR Spectroscopy. The result of this study shows specific NIRS spectrum pattern of cajuput oil, and the result of the overall identification shows that the cajuput oil consists of two major groups: the hydrocarbon and oxygenated hydrocarbon. The NIRs spectrum result is supported by the result of GC-MS which shows that the main compound of this oil is 1,8 Cineol which reach 72.11% of oxygenated hydrocarbon. Therefore, it can be concluded that the component compound in cajuput oil can be analyzed using NIRs method in a short period, accurate, and can be made as finger print in detecting the substance in cajuput oil products.

**Keywords:** Cajuput oil, GC-MS, NIRS, 1,8 Cineol

### INTRODUCTION

Cajuput oil is one of essential oil which is produced by the distillation of leaves and twigs of *Melaleuca leucadendra* trees which has particular and nutritious scent, and it also one of forestry products that has widely known by societies. The main compound of cajuput oil is 1,8 Cineole (C<sub>10</sub>H<sub>18</sub>O), as well as the alcohol's occurrence from terpineol (C<sub>10</sub>H<sub>17</sub>O), and several kinds of terpenes such as 1-pinene, valerate and aldehyde benzoate [1]. In Indonesia, the oil that its 1.8 cineole concentrate is above 55% is considered as the first quality, and under this concentrate is considered as the standard quality [2]. It is also supported by Department of Standard National Indonesia that requires cajuput oil containing 50-65% 1,8 Cineole (SNI-Indonesian National Standard 06-3954-2006). The benefits of Cineole are can reduce headache, toothache, rheumatics, convulsions, anti-mosquito [3], cockroach (*Periplaneta americana*) repellent [4], as fumigant [5], stimulate blood circulation without irritating air circulation on the skin [6], anti-microbe [7;8], analgesic and anti-inflammation [9; 10], as cytotoxic and anti-tumor [6], relief coughs in acute bronchitis patients in their four-day treatment [11].

The quality and the compound of cajuput oil are highly significant to the benefit of cajuput oil used by the consumers. Therefore, it is important to analyze the compound of the

# PROCEEDINGS

The 2<sup>nd</sup> International Seminar of Basic Science

May, 31<sup>st</sup> 2016

---

cajuput oil used. The most commonly used test to determine the chemical composition in cajuput oil using Gas Chromatography mass Spectroscopy (GC-MS). It is the conventional method used to detect the components of essential oil. This method is time consuming, leaves chemical residual, relatively expensive, and has not supported the need of quick measurement as well as provided online service in essential oil industry yet. Therefore, one of the potential methods to fulfill those needs is Near Infrared Spectroscopy (NIRs). The NIR spectra read both the organic and inorganic compounds which have specific absorption bands which is different from one another every time infra red wavelength is given to it. Thus, it offers non-destructive testing (NDT) method to evaluate its physical, mechanical and chemicals characteristics. The NIR spectroscopy principle relies on the harmonic and anharmonic absorptions from the molecular motions which caused molecular vibrations in wavelength transitions in the infrared region where the overtone and combination vibrations are in near infrared intervals [12]. Bunning-Pfaue & Kehraus [13] are also stated that NIRs method is reliable, relatively not expensive, and fast and can give distinctive mark on the compounds' products. Therefore, the contents of cajuput oil expected can be analyzed using NIR spectroscopy to ease the future testing method and to save the cost. On the other hand, the contents of cajuput oil will also be measured using Gas Chromatography Mass Spectroscopy (GC-MS)

## MATERIALS AND METHODS

### Material

The cajuput oil, branded name Eriwakang, distilled from *Melaleuca leucadendra* leaves which was acquired from citizens' distillation in Suli Village, Salahutu Subdistrict, Central Maluku Regency was provided as the sample.

### The Refining of Cajuput Oil

The cajuput oil was refined using chemical method with anhydrous sodium sulfate ( $\text{Na}_2\text{SO}_4$ ) and if the color of essential oil is brighter than before, it shows that the distillation process is done.

### NIR Spectroscopy Analysis

Near Infrared Spectrometer NIRFLEX solid N-500 made by BUCHI was used to measure the component contents of pure cajuput oil's compound. The transreflectance measurement was used to measure, where 2 ml samples were put on a petri dish and covered by a reflector. The sample under the reflector has 0.3 mm thickness. This sample was scanned for 21 times in wavelength interval  $4000\text{-}6300\text{ cm}^{-1}$  then it was averaged to get the good signal/noise ratio (s/n ratio). The spectra reflection in this measurement was  $4\text{ cm}^{-1}$ . The baseline was corrected using the first derivative while the acceleration of power split using the second derivative. Every derivative number is started with spectrum smoothing using Savitzky-Golay polynomial order 3 windows 11.

### Gas Chromatography Mass Spectroscopy (GC-MS)

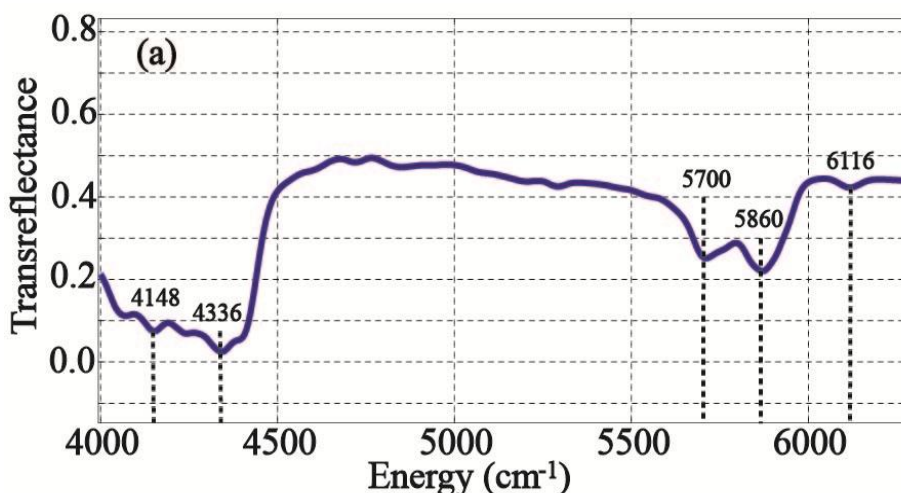
The component structures of pure cajuput oil were identified using GC-MS SHIMADZU QP-5000. The column used in this study was Rastek RXi-5MS, which length is 30 m, ID 0.25mm. Helium was used as the carrier gas (0.3 ml/min) and the column pressure is 13.7 kPa were used to operate the machine. The heating temperature in the column is  $70\text{ }^\circ\text{C}$  in injection split model. The total flow is 80 ml/min, column flow is 0.50 ml/min, and linier speed is 25.9 cm/s.

**RESULTS AND DISCUSSION**

**Cajuput Oil Analysis using NIR Method**

Before analyzing the cajuput oil using NIR Method, it was refined using chemical method with anhydrous sodium sulfate (Na<sub>2</sub>SO<sub>4</sub>) to turn its color into brighter color. Na<sub>2</sub>SO<sub>4</sub> was added in order refining and remove the dispersed water in the oil since the new distilled essential oil usually contains little amount of distilled water which can caused slow reaction between the water and the essential oil [1]. The water contained in the cajuput oil can caused hydrolysis process to create sodium which turns the cajuput oil color into darker color. If it happens, the distillation process has to be performed to improve the quality of the cajuput oil.

NIR spectrum was acquired using transreflectance measurement technique which the samples' geometric wavelength was twice of the samples' thickness. Since the sample thickness was 0.3 mm, therefore the geometric wavelength was 0.6 mm. transreflectance spectrum of the pure cajuput oil was shown in Figure 1(a). In this spectrum, absorption is shown by the valley. Where the lesser the value, the stronger the absorption is. From the measurement, it is shown that the lowest transreflectance is 0.02455, which means that this spectrum has not reached the saturation condition, so the samples' thickness is considered adequate. Just like the NIR spectrum in general, the absorption of overtone and combination vibrations which appear in NIR area always have wide absorption features as those vibrations are very close. Wide absorption which appears in the region around 4050-4400 cm<sup>-1</sup> and 5650-6000 cm<sup>-1</sup> were the characteristic of hydrocarbon chain in general. Apparently, there are several prominent typical absorptions, such as in 4148 cm<sup>-1</sup>, 4336 cm<sup>-1</sup>, 5700 cm<sup>-1</sup>, 5860 cm<sup>-1</sup>, and 6116 cm<sup>-1</sup>. Another structure form that spectrum is more difficult to be identified therefore two times of derivative process are needed. The second derivative spectrum of pure cajuput oil is shown in Figure 1(b). It is important to be noted that the second derivative spectrum will indicate the absorptions' position which have not been determined accurately (because it looks like a peak, not a valley) in transreflectance spectrum. In the second derivative spectrum, the valley position in transreflectance spectrum will be indicated by the peak position on the second derivative spectrum. The valley on the second derivative spectrum does not have any physical meaning.



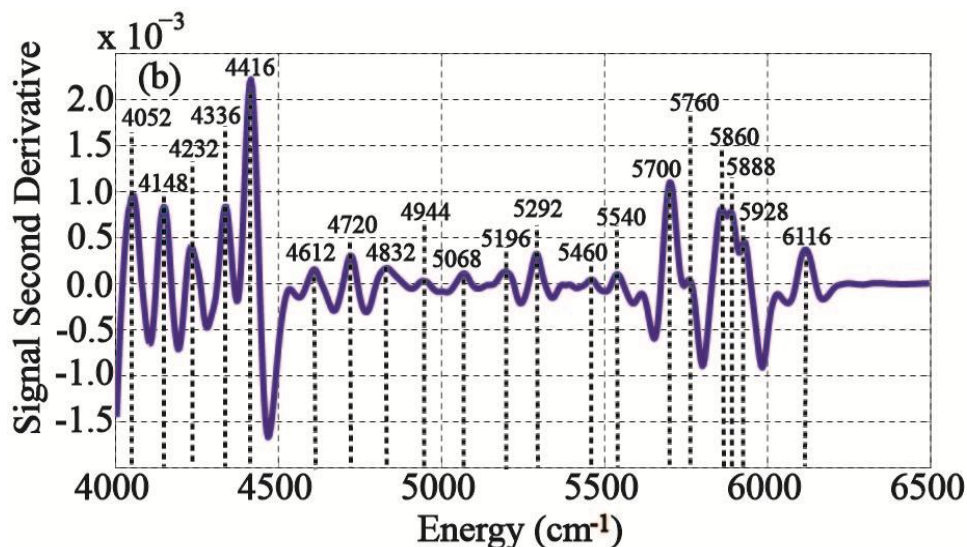


Figure 1. (a) The transreflectance spectrum of the pure cajuput oil, (b) The second derivative spectrum of the cajuput oil

Figure 1(b) the second derivative spectrum of the pure cajuput oil shows the variations in peaks which has specific absorption area on wave number 4052, 4148, 4612, 4832, 5068, 5928 and 6116 (aromatic compound C-H aryl); 4232, 4336 (aliphatic hydrocarbon compound); 4416, 5460, 5540, 5700 (volatile combination compound C, H, O); 4720 (methanol compound O-H); 4944 (ester compound); 5860, 5888 (ether compound), and 5196, 5192 (polyvinyl alcohol compound O-H).

The strongest signal in the second derivative of the cajuput oil was shown in wavenumber 4416  $\text{cm}^{-1}$  which is identified as chemical group combination of C-H-O. Therefore, it can be concluded that the major compositions of the cajuput oil is a chemical group combination of the aromatic compound C-H-O. This data is also supported by the result of data analysis using GC-MS in Table 2, which shows the highest composition in the cajuput oil is Cineole 72.11% with chemical compound  $\text{C}_{10}\text{H}_{18}\text{O}$ .

The previous study, carried out by Schimleck, *et al.* [14], showed the Cineole spectrum from the sample leaves producing cajuput oil (*Melaleuca cajuputi*) has absorption around wavenumber 1650-1800 and 2200-2400 nm (6060-5600 and 4545-4167  $\text{cm}^{-1}$ ), and it is also in line with the result of a study by Ebberts, *et al.* [15] that confirm the NIR spectrum data from pure 1,8 Cineole has the absorption wave number range of 1700-1800 and 2200-2300 nm (5882-5600 and 4545-4348  $\text{cm}^{-1}$ ). The absorptions shown on the wave number from the studies conducted by Schimleck, *et al.* [14] and Ebberts, *et al.* [15] were also shown in spectrum data of the distilled cajuput oil that it shows absorption in those wave number ranges too. In wave number range 1650-1800 (6060-5600  $\text{cm}^{-1}$ ) NIRs spectrum data of the cajuput oil shows the absorption in wave number 5700, 5760, 5860, 5888 and 5928  $\text{cm}^{-1}$ . Then, in the range wave number 2200-2400 nm (4545-4167  $\text{cm}^{-1}$ ) the NIRs spectrum data of the cajuput oil shows the absorption in wave number 4232, 4336, and 4416  $\text{cm}^{-1}$ .

The data tabulation from the absorption peaks identification in the second derivative spectrum of cajuput oil is provided in Table 1.

# PROCEEDINGS

The 2<sup>nd</sup> International Seminar of Basic Science

May, 31<sup>st</sup> 2016

Table 1. The absorption peaks identification in the second derivative spectrum of cajuput oil [16]

No.	Energy (cm <sup>-1</sup> )	Functional Group	Type of Material
1.	4052, 4148	C-H Aromatic C-H (aryl)	Aromatic compound
2.	4232, 4336	C-H Methylene C-H	Aliphatic compound C-H, hydrocarbon
3.	4416	O-H/C-H/C-H-O combination	Aromatic compound
4.	4612	C-H Aromatic C-H (aryl)	Aromatic compound
5.	4720	O-H/C-O combination from	Methanol compound O-H
6.	4832	methanol	Aromatic compound
7.	4944	C-H Aromatic C-H (aryl)	Esther compound
8.	5068	C=O esther & acid (C=OOR)	Aromatic compound
9.	5196, 5292	C-H Aromatic C-H (aryl)	Polyvinyl alcohol compound
10.	5460, 5540,	O-H hydrogen	OH
11.	5700	O-H/C-H/C-H-O/C-H=O	Aromatic compound
12.	5760	combination	Aromatic compound
13.	5860, 5888	C-H methyl, Aromatic (ArCH <sub>3</sub> )	Ether compound
	5928, 6116	C-H methyl C-H, ether (R-O-CH <sub>3</sub> )	Aromatic compound
		C-H Aromatic C-H (aryl)	

The data on table 1 describes that cajuput oil consists of 2 big groups, the hydrocarbon group which is formed from Hydrogen (H) and Carbon (C), and the oxygenated hydrocarbon group which is formed from Carbon (C), Hydrogen (H) and Oxygen (O).

## Cajuput Oil Analysis Using GC-MS

The data tabulation of cajuput oil component measurement is shown in Table 2.

Table 2. The GC-MS data tabulation of cajuput oil component measurement

Peak	Compound	Molecule Chemical	Base Peak (%)
1	α-Pinene	C <sub>10</sub> H <sub>16</sub>	2.56
2	β-Pinene	C <sub>10</sub> H <sub>16</sub>	1.41
3	β-Myrcene	C <sub>10</sub> H <sub>16</sub>	1.15
4	γ-Terpinene	C <sub>10</sub> H <sub>16</sub>	0.38
5	Benzene	C <sub>10</sub> H <sub>14</sub>	0.39
6	1,8-Cineole	C <sub>10</sub> H <sub>18</sub> O	72.11
7	γ-Terpinene	C <sub>10</sub> H <sub>16</sub>	2.04
8	δ-4-carene	C <sub>10</sub> H <sub>16</sub>	1.03
9	3-Cyclohexen-1-	C <sub>10</sub> H <sub>18</sub> O	0.76
10	Methanol	C <sub>10</sub> H <sub>18</sub> O	7.66
11	β-fenchyl alcohol	C <sub>12</sub> H <sub>20</sub> O <sub>2</sub>	2.24
12	β-Terpinyl acetate	C <sub>15</sub> H <sub>24</sub>	5.06
13	trans-Caryophyllene	C <sub>15</sub> H <sub>24</sub>	1.95
14	α-Humulene	C <sub>15</sub> H <sub>24</sub>	0.68
15	δ-Guaiene	C <sub>15</sub> H <sub>24</sub>	0.59
	δ-Guaiene		

# PROCEEDINGS

The 2<sup>nd</sup> International Seminar of Basic Science

May, 31<sup>st</sup> 2016

---

From the GC-MS measurement it is found that cajuput oil consists of 15 compound contents and the highest content is 1,8 Cineole 72,11% which has met the Indonesia National Standard requirement. Therefore, the quality of the cajuput oil used in this study has the highest quality. The measurement result of the Cajuput Oil using GC-MS can be grouped into big 4 groups: Limonene (C<sub>10</sub>H<sub>16</sub>) 26.23%, Benzene (C<sub>10</sub>H<sub>14</sub>) 0.39%, Cineole (C<sub>10</sub>H<sub>18</sub>O) 72.87%,  $\beta$ -Terpinyl Acetate (C<sub>12</sub>H<sub>20</sub>O<sub>2</sub>) 2,24%, and Sesquiterpene (C<sub>15</sub>H<sub>24</sub>) 7.28%.

The previous study by Astuti & Aphari [17], showing gcms results cajuput leaves extracted using ethanol by maceration method produces 45 components and 10 components having the highest content are  $\alpha$ -selinene (9,07%), Guaiol (7,47%), 2-hexadecen-1-ol, 3,7,11,15-tetramethyl-, [R-[R\*,R\*-(E)]]- (CAS) Phytol (5,24%), Cyclopentanetrione (4,90%), trans-Caryophyllene (4,78%), 10-epi-gamma-eudesmol (4,69%), 1,8-cineole (4,66%), hexadecanoic acid (CAS) Palmitic acid (4,23%), 4-isopropyl-5-methyl-hexa-2,4-dien-1-ol (3,79%), dan 2-propen-1-on3, 1-(2,6-dihydroxy-4-methoxyphenyl)-3-phenyl-,(E)-(CAS) Pinostrobin (3,71%). Results of they study demonstrate the component with the highest concentration of  $\alpha$ -selinene 9,07% and 1,8 cineole is 4,66%. So, it can be said that the method of extraction can affect the outcome of ingredients extracted. Compared the results of research conducted by Astuti & Aphari [17], this research distillation methods produces 1,8- cineole content is 72.11 % higher than the results of research by Astuti & Aphari [17] which uses solvent ethanol by maceration extraction methods.

## CONCLUSION

The spectrum identification result from Near Infrared Spectroscopy (NIRs) shows that the strongest second derivative signal in cajuput oil is explained in wave number 4416 cm<sup>-1</sup> which is identified as the group combination of C-H-O aromaticity compound. The final result of the cajuput oil compounds in NIRs spectrum, which is also supported by GC-MS spectrum data, is divided into two groups of big compounds. Those are hydrocarbon and oxygenated hydrocarbon. Therefore, Near Infrared Spectroscopy (NIRs) can be used to analyze or find out the component compound of cajuput oil accurately in a short period and it also can be applied online and does not spend expensive cost. From the analysis of the structural component compound of the cajuput oil using GC-MS finds that there are 15 structural compounds, and the content of the major compound of this oil is 1,8 Cineole 72.11 % which produces particular scent of the cajuput oil. Extraction methods may affect the results of eucalyptus oil content extracted.

## REFERENCES

- [1] Ketaren, Ir. S. (1985). *Pengantar Teknologi Minyak Atsiri*. Jakarta: PN Balai Pustaka..
- [2] Sekasegawa, M., Hori, K., & yatagai, M. (2003). Composition and anti-termite activities of essential oils from *Melaleuca* species. *Journal of Wood Science*, 49, pp. 181-187.
- [3] Ogata, K. (1969). Note on the tropical trees (in Japanese). *Tropical Forest Journal*, 14, pp. 49-50.
- [4] Scriven, R. & Meloan, C. E. (1984). Determining the active component in 1,3,3-trimethyl-2-oxabicyclo {2, 2, 2} octane (cineole) that repels the American cockroach, *Periplaneta Americana*. *The Ohio Journal of Science*, 84, pp. 85-88.
- [5] Lee, Byung-Ho., Annis, P. C., Tumaalii, F. (2003). The potential of 1,8-cineole as a fumigant for stored wheat. In: *Proceedings of the Australian Postharvest Technical conference*. Canberra.

# PROCEEDINGS

The 2<sup>nd</sup> International Seminar of Basic Science

May, 31<sup>st</sup> 2016

---

- [6] Agustina, E. (2010). Penentuan Kemurnian Minyak Kayu Putih dengan Teknik Analisis Perubahan Sudut Putar Polarisasi Cahaya Akibat Medan Listrik Luar. *Jurnal Neutrino*, 3(1), pp. 10-2010
- [7] Raandrianarivelo, R., Sarter, S., Odoux, E., Brat, P., Lebrun, M., Romestand, B., Menut, C., Andrianoelisoa, H. S., Raherimandimby, M., & Danthu, P. (2009). Composition and antimicrobial activity of essential oils of *Cinnamosma fragrans*. *Food Chemistry Journal*, 114, pp. 680-684.
- [8] Bosnic, T., Softic, D., & Grujic-Vasic, J. (2006). Antimicrobial activity of some essential oils and major constituents of essential oils. *Acta Medica Academica*, 35:19-22
- Asanova, Zh. K., Suleimenov, E. M., Atazhanova, G. A., Dembitskii, A. D., Pak, R. N., Dar, A., & Adekenov, S. M. (2003). Biological activity of 1,8 cineole from levant wormwood. *Pharmaceutical Chemistry Journal*, 37(1), pp. 30-32
- [10] Silva, J., Abebe, W., Sousa, S. M., Duarte, V. G., Machado, M. I. L., & Matos, F. J. A. (2003). Analgesic and anti-inflammatory effects of essential oils of *Eucalyptus*. *Journal of Ethnopharmacology*, 89, pp. 277-283.
- [11] Fischer, J. & Dethlefsen, U. (2013). Efficacy of cineole in patients suffering from acute bronchitis: a placebo-controlled double-blind trial. *Cough Journal*, 9, pp. 25.
- [12] Karlinasari, L., Sabed, M., Nyuman, I., Wistara, J., & Purwanto, Y. A. (2014). Near infrared (NIR) spectroscopy for estimating the chemical composition of (*Acacia mangium* Willd.) wood. *Journal of the Indian Academy of Wood Science*, 11(2), pp. 162-167
- [13] Bünning-Pfaue, H & S. Kehraus. (2001). Application of near infrared spectroscopy (NIRS) in the analysis of frying oils. *Eur. Journal Lipi Science Technoogy*, 103, pp. 793-797
- [14] Schimleck, L. R., John, C. D., & Anto, R. (2003). Near Infrared Spectroscopy for Cost Effective screening of Foliar Oil Characteristics in a *Melaleuca cajuputi* Breeding Population.
- [15] Ebberts, M. J. H., Wallis, I. R., Dury, S., Floyd, R., Foley, & W. J. (2002). Spectrometric predictions of secondary metabolites and nitrogen in fresh *Eucalyptus* foliage: towards remote sensing of the nutritional quality of foliage for leaf eating marsupials. *Aust. J. Bot*, 50, pp. 761-768.
- [16] Workman, I. Jr., & Weyer, L. (2007). Practical Guide to Interpretative Near-Infrared Spectroscopy. New York: CRC Press Taylor and Francis Group. 332p.
- [17] Astuti, F.L., & Aphari, I.M.. (2013). Ekstraksi Daun Kayu Putih (*Melaleuca leucadendra* (L)) menggunakan Pelarut Etanol dengan Metode Ekstraksi Maserasi. *Skripsi*. Cilegon-Banten: Jurusan teknik Kimia- Fakultas Teknik, Universitas Sultan Ageng Tirtayasa.



