

# Biotech-symp-UMS-2019

*by* Kholis Audah

---

**Submission date:** 07-Jan-2021 10:06AM (UTC+0700)

**Submission ID:** 1483939720

**File name:** full\_paper-Kholis\_Abdurachim\_Audah-Biotech\_Sym-UMS-2019.doc (477K)

**Word count:** 3338

**Character count:** 17435

# Antibacterial Screening of Mangrove Extract Library: Accelerating Drug Discovery from Indonesian Biodiversity

Razethy Batubara<sup>a</sup>, Julkipli Amsyir<sup>a</sup>, Evi Kurniawaty<sup>b</sup>, Irmanida Batubara<sup>c,d</sup> and Kholis Abdurachim Audah<sup>a,e\*</sup>

<sup>a</sup>Department of Biomedical Engineering, Faculty of Life Sciences and Technology, Swiss German University, Tangerang 15143, Indonesia

<sup>b</sup>Faculty of Medicine, University of Lampung, Lampung Province, Indonesia

<sup>c</sup>Biopharmaca Tropica Research Center, Bogor Agricultural University, Bogor 16128, Indonesia

<sup>d</sup>Department of Chemistry, Faculty of Mathematics and Natural Sciences, Bogor Agricultural University, 166812 Indonesia

<sup>e</sup>Academic Research and Community Services, Swiss German University, Tangerang 15143, Indonesia

\*Corresponding author e-mail: audahka@gmail.com

**Keywords:** Antimicrobial, drug discovery, drug resistant, extract library, Indonesian biodiversity.

**Abstract:** Humans are at a continuous battle against different types of diseases, so that extraordinary effort to accelerate drug discovery has become a necessity. Indonesian biodiversity is abundant natural resources that can be utilized as potential drug sources. Mangroves are among potential plant medicine that grow nearly at all Indonesian coastlines. The aim of this study was to evaluate the potential of mangrove extracts (extract library) as antibacterial agents. In this study, eight mangroves species were used. There were 16 samples collected from different parts of the plants such as leaf, bark or root. Four types of solvents with different polarity were used producing 64 extracts. Disk diffusion method was used for antibacterial screening using five bacterial strains. There were 37 extracts showed antibacterial potential with the lowest and the highest recorded inhibition index were 0.0283 and 1.8983, respectively. The highest inhibition index was recorded for ethyl acetate extract of root of *Bruguiera gymnorrhiza* (77 Ea) screened against *Escherichia coli*. The second highest inhibition index was 0.7867 recorded for leaf of water extract of *Avicennia marina* (84 A) screened against *Staphylococcus aureus*. Phytochemical analysis of the extracts were also evaluated. The majority of samples showed saponin and tannin in considerable amount. This supported the data that mangrove extracts were potential as antibacterial agents.

## Introduction

Drug discovery is a lengthy and expensive process. On the other hand, different types of diseases or drug resistant pathogens are increasing in numbers from time to time. The World Health Organization once reported that as many as 30 new diseases could emerge in 20 years period of time [1]. Therefore, finding alternatives for drug sources is urgently required. Drug discovery through screening process utilizing natural products can become a solution of the slow and expensive drug discovery process using conventional way.

Indonesia is well known as one of the richest country in the world in biodiversity [2]. The country possesses approximately 14000 islands, located between Indian and Pacific Oceans. According to Fauna and Flora International (FFI), Indonesia is home of approximately 11% or more than 30000 of the world's flowering plants and other biota both in land and marine with significant figures [3].

One of potential plants as medicinal sources and widely spread along Indonesian coastline is Mangrove. Mangrove and mangrove associates are very potential plants as medicinal sources [4]. Along roughly 90000 kilometer coastline, Indonesia is home of about 20 families with hundreds

species of mangroves and their associates. Indonesia has the largest mangrove forest or about 23% of total world mangrove forests [5].

The aim of this study was to evaluate the potential of mangrove extracts (extracts library) as antibacterial agents. Since long time ago different parts of mangrove trees either roots, branches, leaves, flowers and the fruits had been utilized as food and medicinal sources.

Previous qualitative phytochemical studies showed that leaf extract of *Rhizophora stylosa* and *Avicenna marina* contain flavonoid, terpenoid, alkaloid, flavonoid and glycosidic phenolic [6]. Bioactivity of mangrove extracts against other types of diseases had also been reported.

## Materials and Methods

### Plant materials

Mangroves plants were collected from the Eastern Coastline of Lampung Province, Indonesia in May 2017. There were 13 different species of mangroves used in this study with the total of 16 samples collected from different parts of plants such as leaves, barks and roots (Tabel 1). The eight species were identified for confirmation at the Herbarium of the Center for Biological Research of the Indonesian Institute of Sciences, Bogor, Indonesia.

Tabel 1. Mangroves species and part of the plants used in this study\*.

Name of Plants	Part of Plants	Samples Code
<i>Rhizophora apiculata</i>	Leaf	72
	Bark	73
	Root	74
<i>Bruguiera gymnorhiza</i>	Leaf	75
	Bark	76
	Root	77
<i>Rhizophora mucronata</i>	Leaf	79
	Bark	80
	Root	81
<i>Thespesia populnea</i>	Leaf	82
	Fruit	83
<i>Avicennia marina</i>	Leaf	84
	Root	85
<i>Xylocarpus granatum</i>	Leaf	86
<i>Ceriops tagal</i>	Leaf	87
<i>Sonneratia alba</i>	Leaf	88

\*Part of plants collected were based upon the nature of the plants.

### Solvents and chemicals

Distilled water, ethanol, n-hexane, ethyl acetate were obtained from Brata Chem. Concentrated HCl, n-amyl alcohol, acetone, dichloromethane, Liebermann-Burchard reagent, chloroform-ammonia, H<sub>2</sub>SO<sub>4</sub> 2 M, Mayer, Dragendorf and Wagner reagents, Magnesium powder, FeCl<sub>3</sub> 1%, NaOH 10% and DMSO 20% were obtained from Sigma-Aldrich.

### Bacterial strains, media and antibiotic

*Escherichia coli*, *Staphylococcus aureus*, *Propionibacterium acnes*, *Pseudomonas mosselii* and *Rhodococcus equi* bacterial strains were all purchased from the Indonesia Culture Collection (InaCC), nutrient agar (NA), Tryptic Soy Broth (TSB), Whatmann filter (6.02 ± 0.02mm) and tetracycline.

### Simplisia Preparations and Analyses

#### Simplisia Water Content

Water content analyses of simplisia was performed according to the Association of Official Analytical Chemist (AOAC) [7] Empty porcelain dish was dried in the oven at 105 °C in 30 minutes and cooled in desiccator in 30 minutes and weighed. One gram of sample was weighed into a dish, heated in the oven at 105 °C for certain period of time. The steps were redone until constant weight was obtained. Water content was determined by using the following equation:

$$\text{Water content} = \frac{B-A}{B} \times 100\%; \text{ A = dry sample weight (g), B = sample weight (g)}$$

### Maceration Extraction

Extraction method used was gradient maceration [8]. Four different solvents were used, which were n-hexane, ethyl acetate, ethanol and water. Ratio between solvent and simplisia was 5:1 with overnight maceration, 3:1 with maceration for 17 and 7 hours. Extracts separated from their residues was concentrated with rotary evaporator. The yields were then determined based on the ratio of concentrated extract weight with initial sample weight. Extractions were performed triplicate.

Antibacterial activity: Disk diffusion method was used to determine antibacterial activity of mangrove extracts [9]. Media used for Escherichia coli strain was Nutrient Agar (NA). Media used for Staphylococcus aureus, Propionibacterium acnes, Pseudomonas mosselii and Rhodococcus equi strains was Tryptone Soya Agar. All bacterial strains were subcultured in Triptic Soy Broth and incubated at 37 °C overnight. Sterilized agar media was prepared. Bacterial suspension was mixed with the agar and solidified for 5 minutes. Disk paper with the size of 6 mm in diameter was placed on the solid agar medium with tweezers and was dropped with 20 µL of 1% extract in 20% DMSO solvent. Tetracycline was used as positive control. Bacterial cultures were incubated at 37 °C overnight. Inhibition zone diameter formed was measured in millimeter (mm). Bacterial inhibition index value was calculated by using the following equation:

$$\text{Inhibition index} = \frac{d_{\text{inhibition zone}} - d_{\text{disk}}}{d_{\text{disk}}}; \text{ d = diameter}$$

### Qualitative Phytochemical Analysis

Qualitative Phytochemical Analyses were performed according to Harborne, JB [10]. Alkaloids test was performed by mixing 4 ml of chloroform-ammonia mixture with 0.1 gram crude extract and was then filtered. Few drops of H<sub>2</sub>SO<sub>4</sub> 2 M was added into the filtrate and mixed until two layers formed. Transparent layer (acidic layer) was divided into 3 reaction tubes. Mayer, Wagner and Dragendorf reagents were added into each tubes. Positive alkaloids test results indicated by the formation of white, brown or red precipitation by addition of Mayer, Wagner or Dragendorf reagents, respectively.

Triterpenoid and steroid tests were performed by heating mixture of 0.1 gram crude extract with 5 ml ethanol at 50 °C and then filtered. The filtrate was then concentrated and dissolved with ether. The ether layer was dropped on a drop plate and air-dried. Few drops of Liebermann-Burchard reagent (concentrated H<sub>2</sub>SO<sub>4</sub> and CH<sub>3</sub>COOH anhydrate) was added onto the drop plate. Positive triterpenoid test result indicated by the formation of red color and positive steroid test results indicated by the formation of green or blue color.

Phenolic and flavonoid tests were performed by mixing 0.1 gram of crude extract with 5 ml of distilled water and then boiled for 2 minutes and filtered. NaOH 10% was added into 2 ml of filtrate for phenolic test. Red color indicates that phenolic compounds are present in sample. The presence of flavonoid compounds can be detected by mixing 0.1 gram magnesium powder, 1 ml of concentrated HCl and 1 ml of amyl alcohol with 2 ml of the filtrated. The formation of red, yellow or orange color indicate a positive result.

Saponin and tannin tests were performed by mixing 0.1 gram of crude extract with 5 ml distilled water and then boiled and filtered. Filtrate was divided into 2 reaction tubes. Saponin test was done by cooling the filtrated and mixed until foam formed. Positive result indicated by the formation of foam that lasts for about 10 minutes. Tannin test was done by mixing the filtrate with FeCl<sub>3</sub> 10% solution. Positive result indicated by the formation of dark blue or blackish green color.

## Results and Discussions

### Water Content

Water content of simplisia (Tabel 2) showed that 15 out of 16 samples were kept below 10% which is a suitable percentage for simplisia analysis according to Indonesian Herbal Pharmacopeia [8]. Only one sample with sample code 83 which was originated from fruit of *Thespesia populnea* showed a slightly higher water content than 10% (10.06%) (highlighted in grey).

Table 2. Water content of simplisia\*

Samples code	Water content (%)	Samples code	Water content (%)
72	8.60	81	7.56
73	2.30	82	7.54
74	7.36	83	10.06
75	5.34	84	9.43
76	3.57	85	8.55
77	8.23	86	8.98
79	4.78	87	9.45
80	4.85	88	7.23

\*Water content of simplisia should be below 10% suitable for analysis.

### Yield Percentage

The yield of extracts of the 16 samples were between 0.14% (highlighted in green) to 26.23% (highlighted yellow) that belonged to n-hexane extract of root of *Rhizophora mucronata* and water extract of leaf of *Avicennia marina*, respectively as shown in Table 3. The data clearly showed that root extract using non polar solvent (n-hexane) resulted in lower yield percentage compared to more polar solvents (samples 74, 77, 81 and 85). This indicated that root sample contains less nonpolar constituents compared to other parts of plants.

Table 3. Yield of extracts (%)\*

Samples code	Yield	Samples code	Yield	Samples code	Yield	Samples code	Yield
72H	1.28	76H	0.26	81H	0.14	85H	0.5
72Ea	3.22	76Ea	0.27	81Ea	0.15	85Ea	0.89
72Et	6.54	76Et	2.3	81Et	3.6	85Et	1.98
72A	16.2	76A	5.45	81A	2.53	85A	10.31
73H	0.42	77H	0.29	82H	2.46	86H	0.76
73Ea	0.43	77Ea	0.32	82Ea	2.73	86Ea	1.79
73Et	3.3	77Et	8.95	82Et	3.55	86Et	6.94
73A	1.84	77A	4.14	82A	15.1	86A	21.18
74H	0.25	79H	1.04	83H	3.08	87H	2.41
74Ea	0.25	79Ea	2.36	83Ea	3.64	87Ea	2.27
74Et	11.92	79Et	2.48	83Et	2.99	87Et	10.86
74A	6.31	79A	13.26	83A	13.41	87A	19.58
75H	2.6	80H	0.26	84H	1.7	88H	1.52
75Ea	1.34	80Ea	0.23	84Ea	1.4	88Ea	1.43
75Et	7.09	80Et	4.88	84Et	7.42	88Et	9.46
75A	20.32	80A	3.72	84A	26.23	88A	7.06

\*Solvents abbreviation: H = n-hexane, Ea = ethyl acetate, Et = ethanol, A = water.

### Antibacterial Zone of Inhibition

Antibacterial screening of mangrove extracts in this study were targeted against gram positive bacteria represented by *Staphylococcus aureus*, *Propionibacterium acnes* and *Rhodococcus equi* and against gram negative bacteria represented by *Pseudomonas mosselii* dan *Escherichia coli*. There were 37 out of 64 extracts that showed antibacterial activity as indicated by clear (inhibition) zone around the disk dropped with extract (Tabel 4). Only extracts that produced inhibition zone mentioned in the Table. Based upon inhibition index value obtained, root of *R. apiculata* (sample code 74) showed inhibition zone on agar media with gram positive bacteria *P. acnes* for all four solvents (74H, 74Ea, 74Et dan 74A) and extracts 74Ea and 74Et on media with *R. equi*. Sample 76Et also produced inhibition zone on agar media with *P. acnes* and *R. equi* bacterial strains.



Table 4. Bacterial inhibition zone (mm) and inhibition index of extracts.

No.	Sample code	Bacterial strains	Disk diameter + inhibition zone (mm)		Inhibition index	
			Positive control	Samples	Positive control	Samples
1	72H	<i>P acne</i>	15.95	7.54	1.6583	0.2567
		<i>E coli</i>	25.88	7.26	3.133	0.2100
2	72A	<i>S aureus</i>	17.32	7.11	1.8875	0.1850
		<i>E coli</i>	25.88	6.94	3.3133	0.1567
3	72Et	<i>E coli</i>	25.88	6.94	3.3133	0.1567
4	73H	<i>R equi</i>	20.4	6.21	2.4	0.0350
5	73Ea	<i>R equi</i>	25.36	6.77	3.2275	0.1275
6	73Et	<i>P acne</i>	25.66	6.50	3.2767	0.0833
7	73A	<i>P acne</i>	25.66	6.99	3.2767	0.1650
8	74H	<i>P acne</i>	15.95	6.17	1.6583	0.0283
9	74Ea	<i>P acne</i>	11.25	6.29	0.8750	0.0483
		<i>R equi</i>	25.36	7.98	3.2275	0.3300
10	74Et	<i>P acne</i>	28.74	6.87	3.7892	0.1450
		<i>R equi</i>	23.48	7.91	2.9125	0.3183
11	74A	<i>P acne</i>	28.74	7.49	3.7892	0.2483
12	75Ea	<i>R equi</i>	25.36	6.44	3.2275	0.0733
13	75A	<i>S aureus</i>	16.90	6.43	1.8175	0.0717
14	76H	<i>P acne</i>	12.49	6.90	1.0817	0.1500
15	76Ea	<i>P acne</i>	17.88	6.89	1.9800	0.1483
		<i>P mosselii</i>	11.63	7.59	0.9383	0.2650
16	76Et	<i>P acne</i>	23.32	7.30	2.8858	0.2167
		<i>R equi</i>	25.41	6.52	3.2342	0.0867
17	77Ea	<i>S aureus</i>	31.6	7.74	4.2667	0.2900
		<i>E coli</i>	13.40	17.39	1.7325	1.8983
18	77Et	<i>P mosselii</i>	11.63	7.89	0.9383	0.3150
		<i>P acne</i>	31.6	7.02	4.2667	0.1700
19	77A	<i>P acne</i>	31.6	7.96	4.2667	0.3267
		<i>E coli</i>	34.40	7.71	4.7325	0.2850
20	79Ea	<i>R equi</i>	20.81	6.48	2.4683	0.0800
21	79A	<i>S aureus</i>	17.32	8.47	1.8875	0.4117
22	80H	<i>S aureus</i>	30.31	6.79	4.0517	0.1317
23	80Ea	<i>R equi</i>	20.81	7.25	2.4683	0.2083
24	81H	<i>R equi</i>	21.80	6.68	2.6325	0.1133
25	81Ea	<i>P mosselii</i>	11.88	6.25	0.9792	0.0417
26	82H	<i>P acne</i>	11.85	6.91	0.9750	0.1517
		<i>R equi</i>	21.80	7.13	2.6325	0.1883
27	83H	<i>E coli</i>	36.31	7.66	5.0517	0.2767
		<i>P mosselii</i>	10.46	7.60	0.7442	0.2667
28	83Ea	<i>R equi</i>	21.80	6.92	2.6325	0.1533
		<i>S aureus</i>	27.50	6.59	3.5825	0.0983
29	83Et	<i>E coli</i>	36.31	6.85	5.0517	0.1417
		<i>R equi</i>	23.40	7.80	2.8992	0.3000
30	84H	<i>P acne</i>	11.85	6.87	0.9750	0.1450
		<i>R equi</i>	21.80	6.80	2.6325	0.1333
31	84A	<i>S aureus</i>	16.90	10.72	1.8175	0.7867
32	85H	<i>P acne</i>	21.04	6.41	2.5067	0.0683
		<i>R equi</i>	19.37	7.78	2.2283	0.2967
33	86H	<i>R equi</i>	19.37	6.81	2.2283	0.1350
34	87H	<i>R equi</i>	19.37	6.49	2.2283	0.0817
35	88H	<i>R equi</i>	19.37	6.66	2.2283	0.1100
36	88Et	<i>P acne</i>	24.78	8.39	3.1292	0.3983
37	88A	<i>P acne</i>	24.78	7.58	3.1292	0.2633

Figure 1 showed an inhibition zone formed due to the addition of extract of root of *B. gymnorrhiza* (77Ea) on agar media with gram negative bacteria *E. coli*. The formed inhibition zone was the largest one with diameter 17.39 mm with inhibition index value of 1.8983. Extracts 77Ea also produced inhibition zone as large as 7.89 mm in diameter on agar media with *P. mosselii* and *S. aureus*. Extracts 76H, Ea and Et showed inhibition zone on agar media with *P. acnes*, *P. mosselii* and *R. equi*. The second highest inhibition index was 0.7867 recorded for leaf of water extract of *Avicennia marina* (84 A) screened against *Staphylococcus aureus*. Taken altogether, these data strongly suggested that mangrove extracts used in this study were potential as antibacterial agents with inhibition index value from the lowest to the highest were 0.0283 and 1.8983, respectively.

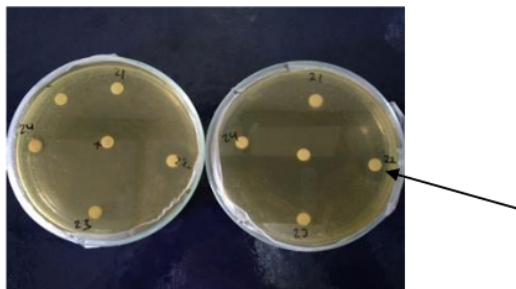


Figure 1: The largest inhibition zone formed due to the addition of extract of root of *B. gymnorrhiza* (77Ea) on agar media with gram negative bacteria *E. coli* with diameter 17.39 mm and inhibition index value of 1.8983 (as indicated by arrow).

Previous studies reported that mangrove extracts had shown their activity against microbes or pathogen parasites in animals and plants [11,12] including HIV [13] and Hepatitis-B virus [14].

### Phytochemical Constituents

Phytochemical qualitative analysis showed that most if not all extracts contain saponin and tannin in considerable amount (Tabel 5). The two phytochemical constituents and flavonoid had shown their activity against some bacteria [15]. Samples collected contained flavonoid and steroid in less amount and no alkaloid detected in almost all samples.

It is important to note that chemical constituents and bioactivity of mangrove extracts and plants in general vary depend upon not only from species to species but also due to geographical conditions. This is also important to identify factors contributing to bioactivity, such as season, location and reproduction cycle stage [16]. Therefore, documentation of samples collection includes taxonomy, time and location, collector either individual or institution and species availability. This will be very helpful in tracing and sample monitoring during research process for accessibility purpose and benefit sharing and recollection.

Tabel 5. Phytochemical qualitative analysis of mangrove extracts.

Sample code	Alkaloid			Triterpenoid	Steroid	Quinon	Flavonoid	Saponin	Tanin
	Mayer	Wagner	Dragendof						
72	-	-	-	-	++	-	-	+	++
73	-	-	-	+	-	-	-	+++	++
74	-	-	-	-	-	-	+	+++	+++
75	-	-	-	-	++	-	+++	+++	+++
76	-	-	-	+	-	+	+	+++	++
77	-	-	-	-	-	-	-	+++	+++
79	-	-	-	-	++	-	+	+++	+++
80	-	-	-	-	-	+	-	+++	+++
81	-	-	-	-	-	+	+++	+++	++
82	-	-	-	-	+++	-	-	+++	+
83	-	-	-	-	+	-	-	-	+++
84	-	-	-	-	+	-	++	++	++
85	-	-	-	-	+	-	-	+	-
86	-	-	-	-	+	-	-	+++	+
87	+	+	+	-	+	-	+	+	++
88	-	-	-	-	+	-	++	-	+++

Considering the very large area covered by mangroves in Indonesia and worldwide, mangrove research, particularly for the purpose of drug discovery is still very limited. This opens up

opportunities for researches to start putting their efforts individually and collaboratively on mangrove research which also applies to mangrove's associates.

## References

- [1] World Health Organization Report. (1996).
- [2] Royal Botanical Garden Report 2016. (2017). State of the World's Plants.
- [3] Fauna Flora International Report. (2010).
- [4] Bandaranayake, W.M. (2002). Bioactive compounds and Chemicals Constituents of Mangrove Plants, *Wetland Ecology and Management*, 10:421-452.
- [5] Giri et al. (2011). Status and distribution of mangrove forests of the world using earth observation satellite data. *Global Ecology and Biogeography*, 20(1), 154–159.
- [6] Mouafi et al. (2014). Phytochemical Analysis and Antibacterial Activity of Mangrove Leaves (*Avicenna marina* and *Rhizophora stylosa*) Against Some Pathogens. *World Applied Sciences Journal*, 29(4), 547-554.
- [7] [AOAC] Association of Official Analytical Chemist. (2006). Official Methods of AOAC International. Edisi ke-14. Arlington (US): Association of Official Analytical Chemist.
- [8] Department of Health of the Republic of Indonesia. (2009). Indonesian Herbal Pharmacopeia. First Edition. Jakarta (ID): Depkes RI.
- [9] Ravikumar S, M. Syed Ali, A. Ramu, M. Ferosekhan. (2011). Antibacterial Activity of Chosen Mangrove Plants Against Bacterial Specified Pathogens. *World Applied Sciences Journal*. 14 (8): 1198-1202.
- [10] Harborne JB. (1987). *Metode Fitokimia*. Padmawinata K, Soediro I, translator; Niksolihin S, editor. Bandung (ID): Bandung Institute of Technology. Translation from: *Phytochemical Methods*.
- [11] Batubara I, Mitsunaga T. (2013). Use of Indonesian Medicinal Plant Products against Acne. *Reviews in Agricultural Science Vol 1*:11-30.
- [12] Audah, K A., J Amsyir, F Almasyur, A M Hapsari and H Sutanto. (2018). Development of extract library from Indonesian biodiversity: exploration of antibacterial activity of mangrove *Bruguiera cylindrica* leaf extracts. *IOP Conf. Ser.: Earth Environ. Sci.* 130 012025.
- [13] Rege, A.A., dan Chowdhary A. S. (2013). Evaluation of Mangrove Plants As Putative Hiv-Protease Inhibitors. *Indian Drugs*, 50(7), 41
- [14] Yi et al. (2015). Four New Cyclohexylideneacetonitrile Derivatives from the Hypocotyl of Mangrove (*Bruguiera gymnorhiza*). *Molecules*. 20(8), 14565-75.
- [15] T. Murugan, J. Albino Wins, M. Murugan. (2013). Antimicrobial Activity and Phytochemical Constituents of Leaf Extracts of *Cassia auriculata*. *Indian J Pharm Sci.* 75(1): 122–125.
- [16] Atanasov et al. (2015). Discovery and resupply of pharmacologically active plant-derived natural products: A review. *Biotechnology Advances* 33 (2015) 1582–1614.



# Biotech-symp-UMS-2019

---

## ORIGINALITY REPORT

---

6%

SIMILARITY INDEX

4%

INTERNET SOURCES

5%

PUBLICATIONS

2%

STUDENT PAPERS

---

## PRIMARY SOURCES

---

1

[worldwidescience.org](http://worldwidescience.org)

Internet Source

1%

---

2

Hanafi H, Candra Irawan, Septilina Melati Sirait, Lilis Sulistiawaty, Sri Redjeki Setyawati.

"Toxicity Test with BSLT (Brine Shrimp Lethality Test) Method on Methanol, Ethyl Acetate Extract, Hexane on Seeds and Rind of Matoa extract (*Pometia pinnata*)", *Oriental Journal Of Chemistry*, 2020

Publication

1%

---

3

Y. Kawamoto. "Genetic diversity of longtail macaques (*Macaca fascicularis*) on the island of Mauritius: an assessment of nuclear and mitochondrial DNA polymorphisms", *Journal of Medical Primatology*, 3/30/2007

Publication

1%

---

4

Submitted to New York Institute of Technology

Student Paper

1%

---

5

[pbbmi.org](http://pbbmi.org)

Internet Source

1%

---

6	Kim, D.S.. "Preparation and characterization of crosslinked PVA/SiO <sup>2</sup> hybrid membranes containing sulfonic acid groups for direct methanol fuel cell applications", Journal of Membrane Science, 20040901 Publication	<1%
7	Submitted to University of Leeds Student Paper	<1%
8	<a href="http://www.oasiskrasota.ru">www.oasiskrasota.ru</a> Internet Source	<1%
9	<a href="http://academicjournals.org">academicjournals.org</a> Internet Source	<1%
10	<a href="http://www.vetbact.org">www.vetbact.org</a> Internet Source	<1%
11	Sultan Akbar Toruntju, La Banudi, Purnomo Leksono, Mochammad Rahmat, Wa Ode Salma. "Identification of secondary metabolite contents on marine rabbit extract (dolabella auricularia)", IOP Conference Series: Earth and Environmental Science, 2020 Publication	<1%
12	<a href="http://aip.scitation.org">aip.scitation.org</a> Internet Source	<1%
13	Nabeelah Bibi, Fawzi, Gokhan, Rajesh, Nadeem, Kannan R.R., R.D.D.G., Pandian. "Ethnopharmacology, Phytochemistry, and	<1%

# Global Distribution of Mangroves—A Comprehensive Review", Marine Drugs, 2019

Publication

---

---

Exclude quotes      On

Exclude matches      Off

Exclude bibliography      On