

# Toxicity Assay of *Baccaurea motleyana* Mull. Arg. Wood Extracts (Rambai) and Chemical Compounds Evaluation for the Most Active Fraction

*by* Erwin Erwin

---

**Submission date:** 10-Nov-2020 09:20AM (UTC+0700)

**Submission ID:** 1441456082

**File name:** 27\_RJPT\_13\_11\_2020.pdf (241.88K)

**Word count:** 2606

**Character count:** 14040

**RESEARCH ARTICLE**

**Toxicity Assay of *Baccaurea motleyana* Mull. Arg. Wood Extracts (Rambai) and Chemical Compounds Evaluation for the Most Active Fraction**

Erwin<sup>1\*</sup>, Zenthise Gandi Tonapa<sup>1</sup>, Alimuddin<sup>2</sup>

<sup>1</sup>Organic Chemistry Laboratory of Chemistry Department of Mulawarman University, Samarinda, Indonesia

<sup>2</sup>Analytical Chemistry Laboratory of Chemistry Department of Mulawarman University, Samarinda Indonesia

\*Corresponding Author E-mail: [winulica@yahoo.co.id](mailto:winulica@yahoo.co.id)

**ABSTRACT:**

*Baccaurea motleyana* Müll. Arg. (known locally as Rambai), as an edible fruit plant, is one of the plants native to tropical rain forest of East Kalimantan. This plant is spread in several Asian regions such as Malaysia, Thailand and Indonesia. Traditionally Rambai is used to treat stomach and eye diseases and this plant has anticancer potential. The purpose of this study was to conduct initial screening for bioactivity by the Brine Shrimp Lethality Test (BSLT) method and to determine chemical composition of the most active fraction from the extracts of Rambai woods by the GC-MS analysis. The toxicity test against *Artemia salina* larvae showed that n-hexane, ethyl acetate and methanol fraction has LC<sub>50</sub> values of 39.62, 11.29 and 661.39 ppm, respectively. Furthermore, the acetate fraction as the most active fraction was further fractionated using flash column chromatography and eight fractions were obtained E1, E2, E3, E4, E5, E6, E7, and E8 with LC<sub>50</sub> values of 1000 >, 1000 >, 159.52, 138.10, 80.36, 46.06, 47.96 and 72.49 ppm, respectively. The results of GC-MS spectrum characterization of E6 (the most active fraction) showed the presence of alkanes (45.57%), alkenes (27.02%), aromatic compounds (20.90%), fatty acid/fatty acid esters (5.71%), and alcohol (0.78%). Eugenol, 4-ethyl-2-methoxy-phenol, and di-n-octyl phthalate are aromatic compounds that have potential as anticancer drugs.

**KEYWORDS:** *Baccaurea motleyana*, Rambai, Toxicity, bioactivity, Flash column chromatography, anticancer.

**INTRODUCTION:**

Plants are actually a source of natural medicines to support healthy human life. The use of plants by the community in traditional medicine has been going on for a long time<sup>1,2</sup>. *Baccaurea* is a fairly large genus of plants. Approximately 43 known species of this genus have spread from India, Indonesia (Borneo, Sumatra, Java) Peninsular, Malaysia, Thailand, the Philippines, to the Pacific island<sup>3</sup>. *Baccaurea motleyana* Müll. Arg, known locally as Rambai is one of the genus *baccaurea* that grows in the tropical rain forests of East Kalimantan.

Traditionally, Rambai is used to treat stomach and eye diseases<sup>4</sup>. In addition, *B. motleyana* fruit can be sold and become additional income for people in Sanggau district and Malawi district, West Kalimantan<sup>5,6</sup>.

Previous studies have shown that this plant extract contains phenolic compounds. Phenolic compounds from plants found many that are bioactive and be a good drug candidate based on the nature of its activities<sup>4,7</sup>. Anticancer activity test on *B. motleyana* skin extract potentially inhibit the growth of colon cancer cell line (HT-29)<sup>4</sup>. In the present study we will report the toxicity of wood extracts and their fractions and the chemical composition of the most toxic fraction by GC-MS analysis.

**MATERIAL AND METHODS:**

**Sample collection:**

Sample of *B. motleyana* wood was collected from Lubuh Sawah, Mugirejo 13<sup>th</sup> age, Samarinda City. The sample was identified in the Plant Anatomy and Systematics Laboratory, Faculty of Mathematics and Natural Sciences, Mulawarman University.

**Extraction and partitioning:**

4000grams of dry wood powder macerated using methanol for 2 times 24 hours. The filtrate obtained was separated by solvent using a rotary evaporator at 40°C

and a pressure of 377 mbar until a crude extract was obtained. The crude extract was redissolved in methanol and then it was partitioned using n-hexane then with ethyl acetate. Then fractionated using column chromatography press performed on the active fraction.

**Biological assay:**

Bioactivity <sup>15</sup> crude extract and their fractions are determined using the Brine Shrimp Lethality Test (BSLT) method against *Artemia salina* larvae. 1mg of extract was put in the micro plate, dissolved in a few drops of DMSO then added aquades to make various variations of the concentration (500, 250, 125, 62, 5, 31, 25, 15, 625 and 7.81ppm). Then 10 shrimp larvae were added into each extract solution. Calculation of LC<sub>50</sub> was carried out using the SAS program after 24 hours<sup>8,9,10,11</sup>.

The most active fraction is characterized its chemical compounds using GCMS QP2010S SHIMADZU, Column: Rtx 5 MS, Column length: 30 meters, ID: 0.25 mm, Film: 0.25um, Carrier gas: Helium, and Ionizing: EI 70 Ev. The compounds will be identified by comparing the NIST data base.

**RESULTS AND DISCUSSION:**

**Extraction and Fractionation:**

The crude extract (20grams) was partitioned with n-hexane and ethyl acetate to yield fractions of n-hexane (5.85grams), ethyl acetate (2.99grams) and methanol (0.77grams). Ethyl acetate fraction as the most active fraction (LC<sub>50</sub>=11.29µg/ml) was further fractionated by flash column chromatography with the gradient polarity elution method to give 34 fractions. The fractions are combined into 8 fractions based on the profile of thin layer chromatography as shown in figure 1.

**GC-MS analysis:**

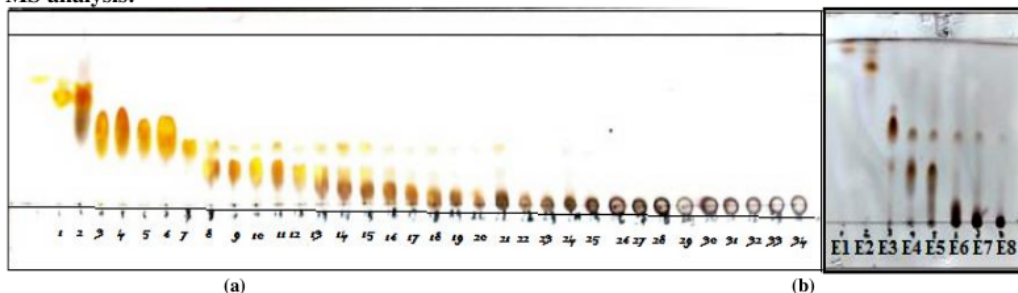


Fig.1: Chromatogram (a) fractions of flash column chromatography results, (b) The combined fractions flash column chromatography results of the ethyl acetate fraction

Table 1. Weight and LC<sub>50</sub> values of extract and their fractions

S. No	Extract/Factions	LC <sub>50</sub> (µg/ml)	Level of toxicity
1	Crude	27.35	Very toxic
2	n-hexane	39.62	toxic
3	Ethyl acetate	11.29	Very toxic
4	Methanol	661.39	Toxic
5	E1	1000 >	Not toxic
6	E2	1000 >	Not toxic
7	E 3	159.52	Toxic
8	E 4	138.10	Toxic
9	E 5	80.36	Toxic
10	E 6	46.06	Toxic
11	E 7	47.96	Toxic
12	E 8	72.49	Toxic

**Biological assay:**

The extract toxicity test againsts *Artemia salina* larvae was carried out as a preliminary cytotoxicity assessment tool to determine the potential <sup>17</sup> or activity as an anticancer<sup>8,9</sup>. The results showed that the crude extract, n-hexane fraction, ethyl acetate fraction and methanol fraction obtained LC<sub>50</sub> values of 27.35, 39.62, 11.29 and 661.39ppm, respectively. Crude extracts and ethyl acetate fractions are very toxic, while n-hexane and methanol fractions are toxic<sup>8</sup>. The results of the toxicity

test for the E1-E8 fractions obtained LC<sub>50</sub> values were 1000 >, 1000 >, 159.52, 138.10, 80.36, 46.06, 47.96, 72.49 ppm, respectively. Only E1da E2 belongs to the non-toxic category while E6 is the most toxic compared to the other fractions as contained in table 1.

**GC-MS Analysis:**

GC-MS chromatogram of E-6 showed 32 compounds consisting of alkanes, alkenes, fatty acids/fatty acid esters, aromatic and alcohol compounds.

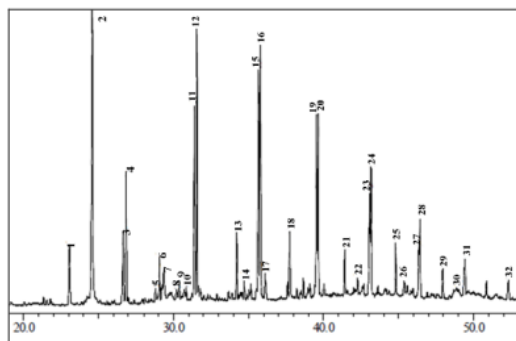
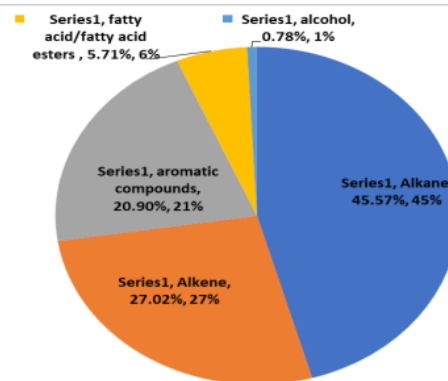


Fig. 2: GC-MS Chromatogram of E6

**Table 2. Profile of chemical compounds of E6 based on GC-MS spectrum**

Peak	Retention Time (minutes)	Percent Area (%)	Molecular Formula	Molecular Weight	Compound
1	23.059	2.82	C <sub>10</sub> H <sub>12</sub> O <sub>2</sub>	164	Eugenol
2	24.590	14.37	C <sub>14</sub> H <sub>22</sub> O <sub>20</sub>	206	3,5-Bis (1,1-dimethylethyl)-phenol
3	26.644	2.80	C <sub>14</sub> H <sub>28</sub>	196	1-tetradecene
4	26.840	3.81	C <sub>16</sub> H <sub>34</sub>	226	n-tetradecane
5	28.823	0.74	C <sub>8</sub> H <sub>12</sub> O <sub>2</sub>	152	4-ethyl-2-methoxy-phenol
6	29.069	1.46	C <sub>11</sub> H <sub>20</sub> O <sub>2</sub>	184	2-propenoic acid
7	29.357	2.15	C <sub>11</sub> H <sub>14</sub> O <sub>3</sub>	194	2,6-dimethoxy-4-(2-propenyl)-phenol
8	30.217	0.75	C <sub>15</sub> H <sub>32</sub>	212	n-Pentadecane
9	30.383	0.99	C <sub>16</sub> H <sub>34</sub>	226	5-methyl-Pentadecane
10	30.710	0.78	C <sub>12</sub> H <sub>26</sub> O	186	2-butyl-1-octanol
11	31.398	6.36	C <sub>16</sub> H <sub>32</sub>	224	1-Hexadecene/ 1-Cetene
12	31.569	8.69	C <sub>17</sub> H <sub>36</sub>	240	n-Heptadecane
13	34.220	2.10	C <sub>11</sub> H <sub>22</sub> O <sub>2</sub>	186	Octadecanoid acid, methyl ester
14	34.720	0.71	C <sub>23</sub> H <sub>28</sub>	184	Undecane, 3,7-dimethyl-
15	35.671	7.78	C <sub>18</sub> H <sub>36</sub>	252	1-octadecene
16	35.808	7.86	C <sub>20</sub> H <sub>42</sub>	282	Eicosane
17	36.119	1.41	C <sub>16</sub> H <sub>33</sub> Cl	260	1-chloro-hexadecane
18	37.741	2.15	C <sub>18</sub> H <sub>36</sub> O <sub>2</sub>	296	11-Octadecenoic acid, methyl ester
19	39.548	6.16	C <sub>22</sub> H <sub>44</sub>	308	1-Docosene
20	39.656	5.00	C <sub>16</sub> H <sub>34</sub>	226	Isocetane
21	41.426	1.54	C <sub>20</sub> H <sub>42</sub>	282	Nonadecane, 2-methyl-
22	42.276	0.68	C <sub>24</sub> H <sub>50</sub>	338	2-methyl-tricosane
23	43.093	3.92	C <sub>19</sub> H <sub>38</sub>	266	9-Nonadecene
24	43.186	3.74	C <sub>16</sub> H <sub>34</sub>	226	n-Hexadecane
25	44.826	1.89	C <sub>26</sub> H <sub>54</sub>	366	n-Hexacosane
26	45.375	0.82	C <sub>24</sub> H <sub>38</sub> O <sub>4</sub>	390	Di-n-octyl phthalate
27	46.361	1.72	C <sub>14</sub> H <sub>28</sub>	196	Cyclotridecane
28	46.431	2.12	C <sub>18</sub> H <sub>38</sub>	254	n-octadecane
29	47.962	0.99	C <sub>21</sub> H <sub>44</sub>	296	Eicosane, 2-mehtyl
30	49.042	0.75	C <sub>19</sub> H <sub>40</sub>	268	6-methyl-octadecane
31	49.445	2.00	C <sub>36</sub> H <sub>74</sub>	507	Hexatriacontane
32	52.332	0.92	C <sub>44</sub> H <sub>90</sub>	619	n-Tetratetracontane

The percentage of alkanes group were 45.57% consisting of n-tetradecane (3.81%), n-Pentadecane (0.75%), 5-methyl-Pentadecane (0.99%), n-Heptadecane (8.69%), Undecane, 3,7 -dimethyl- (0.71%), Eicosane (7.86%), 1-chloro-hexadecane (1.41) Isocetane (5%), Nonadecane, 2-methyl- (1.54%), 2-methyl-tricosane (0.68%), n -Hexadecane (3.74%), n-Hexacosane (1.89%), Cyclotridecane (1.72%), n-octadecane (2.12%), Eicosane, 2-mehtyl (0.99%), 6-methyl-octadecane (0.75%), Hexatriacontane (2.00%), n-Tetratetracontane (0.92%). The alkenes group were 27.02% consisting of 1-tetradecene (2.80%), 1-Hexadecene (6.36%), 1-octadecene (7.78%), 1-Docosene (6.16%), 9-Nonadecene (3.92%). 20.90% aromatic compounds consisting of eugenol (2.82%), 3,5-bis (1,1-dimethylethyl) -phenol (14.37%), 4-ethyl-2-methoxy-phenol (0.74%), 2,6-dimethoxy-4- (2-propenyl) -phenol (2.15%) and di-n-octyl phthalate (0.82%). 5.71% for fatty acids and fatty acid esters consisting of 2-propenoic acid (1.46%), octadecanoid acid, methyl esters (2.10%), 11-octadecenoic acid, methyl esters (2.15%). There is only one alcohol compound, namely 2-butyl-1-octanol (0.78%).



**Fig. 3: Diagram percentage phytochemical group identified in E-6.**

Many natural aromatic compositions have the potential to be used as medicinal raw materials<sup>12,13,14</sup>. Eugenol (1) can be used to treat or prevent cancer, oxidative stress, inflammation, hyperglycemia, cholesterol, and nerve disorders<sup>15,16</sup>. Eugenol is also used as a tropical analgesic agent used in dental clinic, inhibited aflatoxin production by *Aspergillus parasiticus* NRRL 2999, and antibacterial activity<sup>17,18,19</sup>.

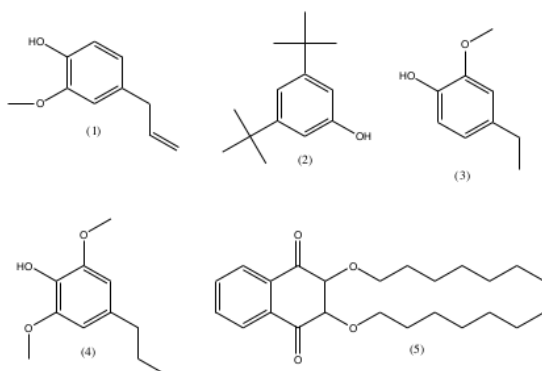


Fig. 4: Aromatic compounds identified in E-6.

3,5-bis (1,1-dimethylethyl) -phenol (2) exhibit weak potency as anti-cancer<sup>20</sup>. However, 4-ethyl-2-methoxyphenol (3) has antioxidant and anticancer activity<sup>21,22</sup> while 2,6-dimethoxy-4-(2-propenyl) -phenol (4) has no report on its activities<sup>23</sup>. Bioactivity of di-n-octyl phthalate (5) in Dr. Duke's Phytochemical and Ethnobotanical Databases among others as an antitumor (nasopharynx), and inhibit Production of Tumor-Necrosis-Factor<sup>24</sup>.

#### 22 CONCLUSION:

Based on the results of the study showed that the E6 fraction was the most active fraction with the LC<sub>50</sub> value 46.06ppm. E6 consists of alkanes (20.9%), aromatic compounds (20.08%), alkenes (17.02%), fatty acids/fatty acid esters (5.71%), and alcohol (0.78%). Eugenol, 4-ethyl-2-methoxy-phenol and di-n-octyl phthalate are aromatic compounds that have potential as anticancer.

#### ACKNOWLEDGEMENT:

We would like acknowledgment to the Head of Plant Anatomy and Systematic Laboratory of Biology Department, Faculty of Mathematics and Natural Sciences of Mulawarman University for identification the specimen

#### REFERENCES:

1. Amin R, Nabi MN. Evaluation of Cytotoxic and Antioxidant Activity of Different Fractions of Methanolic Extract of *Baccaurea ramiflora* (Lour) Fruits. *International Current Pharmaceutical Journal*, 2015; 4: 386-389.
2. Uddin Md S, Asaduzzaman Md., Al Mamun A, Iqbal MA, Wahid F, Rony RK. Phytochemical analysis and antioxidant profile of methanolic extract of seed, pulp and peel of *Baccaurea ramiflora* Lour. *Asian Pacific Journal of Tropical Medicine*, 2018; 11(7): 443-450.
3. Haegens R. Taxonomy, phylogeny, and biogeography of *Baccaurea*, *Distichirhops*, and *Nothobaccaurea* (Euphorbiaceae). *Blumea Supplement*; 2000. 12(1): 1-218
4. Ismail M, Bagalkotkar, Iqbal S, Adamu HA. Anticancer Properties and Phenolic Contents of Sequentially Prepared Extracts from Different Parts of Selected Medicinal Plants Indigenous to Malaysia. *Molecules*; 2012, 17(5): 5745-5756
5. Iqbal M, Septina AD. Utilization of Non-Timber Forest Products (NTFPs) by Local People in Sanggau Regency, West Kalimantan. *Jurnal Penelitian Ekosistem Dipterokarpa*; 2018, 4 (1): 19-34.

6. Dasman Y, Oramahi, Sisillia, L. Source Food Plants that used By Community Forest Tembawang Village Nanga Kompi Melawi District. *Jurnal Hutan Lestari*; 2015, 3 (2): 332 – 336.
7. Khoo HE., Azlan A., Kong KW, Ismail A. *Review Article: Phytochemicals and Medicinal Properties of Indigenous Tropical Fruits with Potential for Commercial Development, Evidence-based Complementary and Alternative Medicine*; 2016:1-20.
8. Meyer BN, Ferrigni NR Putnam JE, Jacobsen, LB, Nichols DE, McLaughlin JL. Brine Shrimp: A Convenient General Bioassay for Active Plant Constituents". *Journal of Medicinal Plants Research*, 4: 82. 45, pp. 31-34.
9. McLaughlin JL. 1991. Bench-top bioassays for the discovery of bioactive compounds in higher plants. *Brenesia*; 34:1 – 14.
10. Karolina A, Pratiwi DR, Erwin. Phytochemical and Toxicity Test of Merung Extracts (*Coptosapelta tomentosa* (Blume), *Jurnal Atomik*; 2018, 03(2) :79-82
11. Supomo I, Syamsul, E. S., Apriliana, A., Saleh, C., Erwin and Lestari, D., *Rasayan J. Chem.*; 2019, 12(3): 1340-1346
12. Owen RW, Giacosa A., Hull WE, Haubner R, Spiegelhalter B, Bartscha H. The antioxidant/anticancer potential of phenolic compounds isolated from olive oil. *European Journal of Cancer*; 2000, 36 :1235-1247
13. Semzadeh A, Jaafar, H. ZE, Profiling of phenolic compounds and their antioxidant and anticancer activities in pandan (*Pandanus amaryllifolius* Roxb.) extracts from different locations of Malaysia. *BMC Complementary and Alternative Medicine*; 2013, 13 (341): 1-9
14. Galati G, O'Brien, PJ. Serial Review: Flavonoids and Isoflavones (Phytoestrogens): Absorption, Metabolism, and Bioactivity. *Free Radical Biology and Medicine*; 2004, 37 (3): 287 – 303
15. Khalil AA, Rahman U, Khan MR, Sahar A, Mehmoodac T, Khan M. Essential oil eugenol: sources, extraction techniques and nutraceutical perspective. *RSC Adv.*; 2017, 7: 32669–32681.
16. Arvis E, Kicar AY, Medine EI, Tekin V, Cosci B., Uygur, E., Muftuler, FZB. In Vitro Incorporation of Radioiodinated Eugenol on Adenocarcinoma Cell Lines (Caco2, MCF7 and PC3). *Cancer Therapy and Radiopharmaceuticals*; 2017, 32 (3), 1-7.
17. Lee, M.H., Yeon, K.Y., Park, C.K., Li, H.Y., Fang, Z., Kim, M.S., Lee, S.Y., Lee, S.J., S. Lee, Park, K., Lee, J.H., Kim J.S. and Oh, S.B. Eugenol Inhibits Calcium Currents in Dental Afferent Neurons. *J Dent Res*, 2005; 84 (9): 848-85.
18. Jayashree T, Subramanyam, Antiaflatoxic activity of eugenol is due to inhibition of lipid peroxidation. *Lett Appl Microbiol.*; 1999; 28(3): 179-83.
19. Mysinsky S, Davidson PM, Barry D, Bruce BD, Weiss, J. Growth Inhibition of *Escherichia coli* O157:H7 and *Listeria monocytogenes* by Carvacrol and Eugenol Encapsulated in Emulsified Micelles. *Journal of Food Protection*; 2005, 68 (12): 2559-2566.
20. Rizvi SMD, Shakil S, Zeeshan M, Khan MS, Shaikh S, Biswas D, Ahmad A, Kamal MA. An Enzoinformatics Study Targeting Polo-Like Kinases-1-Enzyme: Comparative Assessment of Anticancer Potential of Compounds Isolated Leaves of *Ageratum houstonianum*. *Pharmacognosy Magazine*; 20014, 10: 973-1296
21. Kim MK, Nam PW, Lee SJ, Lee, K.G. Antioxidant activities of volatile and non-volatile fractions of selected traditionally brewed Korean rice wines. *J. Inst. Brew*; 2014, 120: 537-542
22. Hase GJ, Deshmukh KK, Pokharkar RD, Gaje TR, Phatanagre ND. Phytochemical Studies on *Nerium oleander* L. Using GC-MS. *International Journal of Pharmacognosy and Phytochemical Research*; 2017, 9 (6): 885-891.
23. Rajeswari J, Rani S. GC-MS Analysis of Whole Plant of *Leptadenia Reticulata*. *Int. J. Pharm Tech Res.*; 2014, 6(7): 2043-2050.
24. Dr. Duke's Phytochemical and Ethnobotanical Databases. Available from: <https://phytochem.nal.usda.gov/phytochem/search/list>.

# Toxicity Assay of *Baccaurea motleyana* Mull. Arg. Wood Extracts (Rambai) and Chemical Compounds Evaluation for the Most Active Fraction

## ORIGINALITY REPORT

16%

SIMILARITY INDEX

12%

INTERNET SOURCES

15%

PUBLICATIONS

10%

STUDENT PAPERS

## PRIMARY SOURCES

1	<a href="http://innspub.net">innspub.net</a> Internet Source	2%
2	<a href="http://www.webmd.com">www.webmd.com</a> Internet Source	2%
3	<a href="http://jipbs.com">jipbs.com</a> Internet Source	1%
4	<a href="http://journals.sagepub.com">journals.sagepub.com</a> Internet Source	1%
5	Sombeer Sharma, Aakash Deep, Avtar C. Rana, Monu Yadav, Arun K. Sharma. "Possible Biomarkers and Therapeutic Targets for the Management of Cervical Cancer", <i>Current Cancer Therapy Reviews</i> , 2020 Publication	1%
6	<a href="http://res.mdpi.com">res.mdpi.com</a> Internet Source	1%
7	Submitted to University of Alabama, Huntsville	

1%

8

[meridian.allenpress.com](http://meridian.allenpress.com)

Internet Source

1%

9

[www.intechopen.com](http://www.intechopen.com)

Internet Source

1%

10

[www.ncbi.nlm.nih.gov](http://www.ncbi.nlm.nih.gov)

Internet Source

1%

11

Submitted to Management & Science University

Student Paper

1%

12

Musri Musman, Mauli Zakia, Ratu Fazlia Inda Rahmayani, Erlidawati Erlidawati, Safrida Safrida. "Pharmaceutical hit of anti type 2 Diabetes mellitus on the phenolic extract of Malaka (*Phyllanthus emblica* L.) flesh", *Clinical Phytoscience*, 2019

Publication

1%

13

Submitted to Program Pascasarjana Universitas Negeri Yogyakarta

Student Paper

1%

14

S.E. Atawodi. "Polyphenol Composition and Antioxidant Potential of *Hibiscus esculentus* L. Fruit Cultivated in Nigeria", *Journal of Medicinal Food*, 12/2009

Publication

<1%

15

[garuda.ristekbrin.go.id](http://garuda.ristekbrin.go.id)

Internet Source

&lt;1%

16

[www.tandfonline.com](http://www.tandfonline.com)

Internet Source

&lt;1%

17

[www.jabonline.in](http://www.jabonline.in)

Internet Source

&lt;1%

18

Arvind Kumar Goyal, Sushil Kumar Middha, Talambedu Usha. "Baccaurea ramiflora Lour.: a comprehensive review from traditional usage to pharmacological evidence", *Advances in Traditional Medicine*, 2020

Publication

&lt;1%

19

Tatiane M. Popiolski, Issei Otsuka, Sami Halila, Edvani C. Muniz, Valdir Soldi, Redouane Borsali. "Preparation of Polymeric Micelles of Poly(Ethylene Oxide-b-Lactic Acid) and their Encapsulation With Lavender Oil", *Materials Research*, 2016

Publication

&lt;1%

20

Andriati Ningrum, Nhut Nguyen Minh, Matthias Schreiner. " Carotenoids and Norisoprenoids as Carotenoid Degradation Products in Pandan Leaves ( Roxb.) ", *International Journal of Food Properties*, 2015

Publication

&lt;1%

21

Modestas Ruzauskas, Elena Bartkiene, Arunas



---

Stankevicius, Jurga Bernatoniene et al. "The Influence of Essential Oils on Gut Microbial Profiles in Pigs", *Animals*, 2020

Publication

<1%

---

22

[lib.dr.iastate.edu](http://lib.dr.iastate.edu)

Internet Source

<1%

---

23

Shazi Shakil, Mohammed F. Abuzinadah. "Putative Anti-Cancer Drug Candidate Targeting the 'PLK-1-Polo-Box Domain' by High Throughput Virtual Screening: A Computational Drug Design Study", *Critical Reviews in Eukaryotic Gene Expression*, 2019

Publication

<1%

---

24

"Anticancer plants: Properties and Application", Springer Science and Business Media LLC, 2018

Publication

<1%

---

25

Ali Ghasemzadeh, Hawa Z. E. Jaafar, Asmah Rahmat, Thiyagu Devarajan. " Evaluation of Bioactive Compounds, Pharmaceutical Quality, and Anticancer Activity of Curry Leaf ( *L.* ) ", *Evidence-Based Complementary and Alternative Medicine*, 2014

Publication

<1%

---

26

Sangita Debnath Puja, Choudhury Mahmood Hasan, Monira Ahsan. "*Baccaurea ramiflora*: Isolation of Aldehydes and in Vitro

<1%

# Biological Investigations", Pharmacology & Pharmacy, 2020

Publication

---

---

Exclude quotes      On

Exclude matches      Off

Exclude bibliography      On