第 49 卷 第 7 期
2022 年 7 月

湖南大学学报（自然科学版）
Journal of Hunan University (Natural Sciences)

Vol. 49 No. 7
July 2022

Open Access Article https://doi.org/10.55463/issn.1674-2974.49.7.13

Testing the Bioactive Compounds and Antioxidant Activity of the Ethanol Extract of Lantana Leaves (Lantana Camara L.) as an Alternative Medicine for Society

Jafriati*, Yusuf Sabilu, Jumakil, Fifi Nirmala

Public Health Study Program, Public Health Faculty, Halu Oleo University, Kendari, Indonesia

Abstract: Lantana (*Lantana camara* Linn.) is a wild plant whose leaves contain chemicals such as phenols, flavonoids, and alkaloids. Besides being used as an ornamental plant, lantana can also be used as a medicinal plant and a natural insecticide. This study aimed to determine the content of bioactive compounds based on the tests of phytochemistry and antioxidant activity on the leaves of *Lantana camara Linn*. using the DPPH method. The lantana leaves were extracted by the maceration method. The results showed that the ethanol extract of the *Lantana camara* L. leaves contained alkaloids, flavonoids, terpenoids, steroids, saponins, and tannins. Meanwhile, its antioxidant activity obtained an IC50 value of 316.8748 ppm, indicating that the antioxidant activity of the ethanol extract of *Lantana camara* L. leaves was not high. This research is a stage of scientific proof of the herbal benefits of *Lantana camara L*, which previously only had empirical data.

Keywords: Lantana, *Lantana camara* Linn., bioactive compounds, antioxidant activity.

叶乙醇提取物的生物活性化合物和抗氧化活性测试作为民间替代药物的药以作为民间替代药物

摘要：马德丹(马 丹.) 是一种野生植物,其叶子含有(类、类黄酮和生物碱等化学物质。 除了用作观赏植物外，马缨丹还可用作药用植物和天然杀虫剂。 本研究旨在通过对马来西亚丹叶片的植物化学和抗氧化活性测试来确定生物活性化合物的含量。 使用 DPPH 方法。 马 丹叶采用浸渍法提取。 结果表明,马 丹叶的乙醇提取物中含有生物碱、黄酮类、 生物碱、 同时,其抗氧化活性的我知道了 50 值为 316.8748 ppm,表明马 丹叶乙醇提取物的抗氧化活性不高。 这项研究是马 丹的草药益处的科学证明阶段,以前只有经验数据。

关键词：马 丹、马 丹卡马拉·林恩。、生物活性化合物、抗氧化活性.

1. Introduction

Indonesia has many plants that can be used as a source of medicinal ingredients. The use of plants as medicinal ingredients is being promoted in Indonesia. Traditional medicines have been used in society for a long time from generation to generation. One of the plants that can be used and efficacious as medicine is the lantana leaf (*Lantana camara* L.). *Lantana camara* L. is a shrub with a height of around 0.5 to 1.5 meters, woody stems, many branches, and rectangular, thorns, and hairy. The bark is brown with a rough surface. The leaves are green, oval, and with serrated leaf margins; the surfaces are rough because of the hairs. The position of the leaves is opposite, and the leaf bones are pinnate. The herbs are hairy with thorny stems, measuring about 2 meters. The flowers are in a racemic arrangement, with white, pink, and yellow-orange colors [1].

Indonesian people have long known West Indian Lantana (*Indonesian:* tembelekan), with many benefits, including as a reliever for fever, skin disease, pain, vaginal discharge, swelling, cough, tuberculosis, and

Received: April 18, 2022 / Revised: May 12, 2022 / Accepted: June 10, 2022 / Published: July 30, 2022

Fund Project: Institute for Research and Community Service, Faculty of Public Health, Halu Oleo University (Contract Number 1791/UN29.15/PG/2021)

About the authors: Jafriati, Yusuf Sabilu, Jumakil, Fifi Nirmala, Public Health Study Program, Public Health Faculty, Halu Oleo University, Kendari, Indonesia

Corresponding author Jafriati, jafriati.jazuli@gmail.com

asthma. As a wild plant, the West Indian Lantana has many chemical contents, including essential oils, phenols, flavonoids, carbohydrates, proteins, alkaloids, glycosides, iridoid glycosides, phenylethanoids, oligosaccharides, quinines, saponins, steroids, triterpenoids, sesquiterpenoids, and tannins [2]. Another benefit of this plant is a wild plant with colorful flowers and an unpleasant aroma. However, its toxic content can damage the digestive system of insects. Its content of toxic substances includes flavonoids, tannins, and saponins which are proven to have effectiveness against mosquito larvae and mortality. Its highest flavonoid content is 12.76%, and saponins are 66.22% [3]. As stated in [4], Lantana Camara extract contains flavonoids and alkaloids.

Lantana leaves contain lantadene A and B, lantanolic acid, lantic acid, humulene (found in essential oils), caryophyllene, terpidene, pinene, and cymene [5]. In addition, according to [6], lantana leaves contain saponins, flavonoids, and essential oils. Flavonoid compounds have anti-inflammatory and antipyretic effects that work as cyclooxygenase (COX) inhibitors triggering prostaglandin formation. Prostaglandins play a role in the inflammatory process and increase body temperature. Therefore, if prostaglandins are not inhibited, body temperature will increase, resulting in fever.

Lantana camara contains steroids, saponins, and tannins [7]. Steroid-type saponins are one of the ingredients that can function as anti-feeding against insects. Saponins inhibit the work of enzymes that cause a decrease in the work of the digestive apparatus and the use of protein [8]. The saponin-typed steroid is an ingredient that can function as an anti-feeding against insects; saponins function to inhibit the work of enzymes, decreasing the digestive tract and the use of protein [9]. Furthermore, as stated in [10], *Lantana camara* L. extract also contains flavonoids and alkaloids. Secondary metabolite compounds in plants are the result of synthesis that occurs within the plant itself. Complex organic compounds are synthesized in the plant body and produce a series of compounds with various structures.

In recent years, antioxidants have been a topic of great interest to nutritionists, medicine, and researchers in the health and food sectors. As is known, compounds with antioxidant properties can help protect the human body against cell damage caused by free radical compounds that enter the human body. The damage caused by free radicals is determined by the high reactivity of substances or compounds that enter the human body. Free radicals can cause damage to macromolecular cells, including proteins, carbohydrates, nucleic acids, and fats in the human body. Due to the earlier damage, the free radicals that enter the human body can cause several degenerative diseases and chronic diseases, such as cancer [11].

Several scientific studies have been carried out on the leaves and flowers of the lantana plant. It is proven that the leaves are very potent as a wound medicine that exceeds bioplacenton wound medicine, and the flowers are very strong antioxidants. The content of secondary metabolites of leaves and flowers is also very varied. It still allows other potentials in the pharmaceutical field. The development and utilization of the lantana plant (*Lantana camara* L.) as a traditional medicine that the community has widely used require researching the utilization of the potential of natural resources by testing the content of bioactive compounds and antioxidant activity of the ethanolic extract of lantana leaves.

Based on the description above, it is necessary to research for Testing the Bioactive Compounds and Antioxidant Activity of the Ethanol Extract of the Leaves of Lantana (*Lantana camara* L.) as an alternative medicine for society.

2. Research Method

2.1. Instruments and Ingredients

Instruments: Spatula, analytical balance, tube rack, tongs, coolbox, blender, 60 mesh sieve, aluminum tray, rotary vacuum evaporator, incubator, vacuum filter, UV-VIS spectrophotometer, Erlenmeyer flask, cuvette, test tube, beaker, measuring cup, flask, dropper, funnel, petri dish, spoon substance, volume pipette, and reagent bottle.

Ingredients: Test samples of *Lantana camara* L, ethanol, Wagner's reagent, Meyer's reagent, Dragendroff's reagent, magnesium powder (Mg), concentrated hydrochloric acid (HCl), chloroform ($CHCl_3$), acetic anhydride ($C_4H_6O_3$), sulfuric acid concentrated (H_2SO_4), 3% ferric chloride ($FeCl_3$), distilled water (H_2O), sodium hydroxide 1 N (NaOH), 7.5% sodium carbonate (Na_2CO_3), iron (III) chloride ($FeCl_3$), spirit, aluminum foil, and Pb $(CH_3COO)_2$.

2.2. Preparation and Extraction of the Raw Ingredients

The leaves of *Lantana camara* L. were collected in the Kapontori District of Buton Regency of Kendari City. The preparation of *Lantana camara* L. leaves was started with the washing process. First, the fresh *Lantana camara* L. plants were washed under running water. The sample was then dried and mashed using a blender. The sample that had been refined was then weighed with an analytical balance. Then the extraction process was carried out. The next stage was the extraction of the active ingredients. The extraction method used was the maceration method with ethanol as a solvent. The mashed sample weighed as much as 150 grams and was macerated with 1100 mL of ethanol solvent for 48 hours. The result of maceration in a solution was filtered with filter paper to obtain the

filtrate and residue. The filtrate was then evaporated using a Rotary Vacuum Evaporator at a temperature of less than 50°C until the solvent separated from the extract. This extract was formulated by adding diluent or aquadest (distilled water) as the solvent. Finally, the extraction results were evaporated to obtain a thick sea urchin extract (Figure 1). Furthermore, the phytochemicals (bioactive compounds) and antioxidant activity tests of the ethanol extract of the *Lantana camara* L. leaves were carried out.

Fig. 1 The thick extract of the leaves of *Lantana camara* L. (*tembelekan* = lantana)

2.3. Testing the Bioactive Compounds [12]

2.3.1. Alkaloid

A sample of 3 mL was added with 3 mL of 1% HCl, then heated while stirring for about 10 minutes. After that, 1 mL was pipetted into two different tubes. The Tube-1 was added with a few drops of Dragendorff's reagent (the appearance of an orange precipitate indicated a positive test result). The Tube-2 was added with a few drops of Mayer's reagent (a positive test result was indicated by the appearance of a yellowish cream-colored precipitate).

2.3.2. Flavonoid

Tube-1 was filled with 1 mL of sample, and then a few drops of Pb $(CH_3COO)_2$ were added (the appearance of a yellow precipitate indicated a positive test result). The Tube-2 was filled with 1 mL of sample, and then a few drops of H_2SO_4 were added (the appearance of an orange precipitate indicated a positive test result).

2.3.3. Terpenoid

A sample of 5 mL was added with 2 mL of $CHCL_3$, then 3 mL of concentrated H_2SO_4 was added slowly through the tube wall (a positive test result was indicated by forming a red ring at the interface).

2.3.4. Steroid

A sample of 5 mL was added with 2 mL of acetic anhydride, and then 2 mL of concentrated H_2SO_4 was added slowly through the tube wall (a purple color change indicated positive test results to blue or green).

2.3.5. Saponin

A sample of 2.5 mL was added with a few drops of distilled water and then shaken vigorously. The foam formed remained stable for about 10 minutes, as high as 1 cm to 10 cm, with the addition of 1 drop of 2 N HCl (a positive test result was indicated by the appearance of foam that lasted more than 30 seconds).

2.3.6. Tannin

A 2 mL sample was added with 2 mL of distilled water, and then a few drops of $FeCl_3$ were added (the appearance of a green precipitate indicated a positive test result).

2.4. Testing the Antioxidant Activity (IC50) by DPPH Method

The ethanol extract of the *Lantana camara* L. leaves was dissolved in methanol p.a with concentrations of 5, 10, 20, 40, and 80 g/mL. A total of 2 mL of 30 ppm DPPH solution was put into the vial, then 1 mL of each extract and fraction were added with various concentrations. The mixture of DPPH solution and the sample was incubated in the dark for the optimum/operating time (OT) of 30 minutes. The absorption of the mixture was read at the maximum wavelength, which was 516 nm. The inhibition power was calculated in percent attenuation (% inhibition) against DPPH radicals using the formula: The data obtained from the percent inhibition of DPPH free radicals at various concentrations were then used to determine the IC50 value of the sample. The results of the calculation of antioxidant activity were input into the line equation y = a + bx, with the concentration (µg/mL) as abscissa (x-axis) and the value of % antioxidant activity as the ordinate (y-axis). The IC50 value from the calculation when the % antioxidant activity was 50% would be obtained from the line equation [13].

2.5. Data Analysis

The descriptive statistical technique analyzed the research data. The descriptive statistics were carried out to describe the data on the content of bioactive compounds and antioxidant activity, which were presented through tables and graphs using the Microsoft Excel program.

3. Results and Discussion

3.1. Testing the Bioactive Compounds

The results of the bioactive compound test (phytochemical test) for the ethanol extract of the leaves of lantana (*Lantana camara* L.) can be seen in Table 1.

Table 1 Phytochemical screening test results of the ethanol extract of *Lantana camara* L. leaves

No.	Qualitative test	Reactant	Results
1	Alkaloid	Dragendorff Mayer	(+) Orange-colored precipitate (+) Yellow-colored precipitate
2	Flavonoid	Pb(CH3COO)2 + H2SO4	(+) Reddish yellow
3	Terpenoid	CHCL3 + H2SO4	(+) A reddish ring was formed
5	Steroid	CH_3COOH glacial + $H_2SO_{4\ (p)}$	(+) Blue or green
6	Saponin	Aquadest + HCl 2 N	(+) Foam as high as 1 cm
7	Tannin	Aquadest + FeCl3	(+) Green solution

The table above shows the results of phytochemical tests (bioactive compounds) of the ethanol extract of *Lantana camara* L. leaves which contained alkaloid, flavonoid, terpenoid, steroid, saponin, and tannin. As a wild plant, lantana turns out to have many chemical constituents such as essential oils, phenols, flavonoids, carbohydrates, proteins, alkaloids, glycosides, iridoid glycosides, phenylethanoids, oligosaccharides, quinines, saponins, steroids, triterpenoids, sesquiterpenoids, and tannins [14-17]. This finding is in line with [18] and [19], which showed that lantana leaves and flowers contain alkaloids, flavonoids, saponins, tannins, and quinones. According to [20], phytochemical screening of lantana leaves contains flavonoids, saponins, and essential oils. Lantana leaves studied using the qualitative phytochemical method contain phenolic compounds, saponins, and steroids (triterpenoids). As shown in [7], the phytochemical content of lantana leaves (steroids, saponins, and tannins) has the potential as a natural insecticide to reduce insect pests and disease incidence in plants.

Flavonoids are the largest group of phenolic compounds found in nature, which have biochemical and pharmacological effects, such as antioxidant, anti-inflammatory, antiplatelet, and antithrombotic. In addition, flavonoids are known to have hemostatic effects, namely accelerating the increase in the number of platelets. Compounds of the flavonoid group can cause damage to the permeability of bacterial cell walls, microsomes, and lysosomes due to the interaction between flavonoids and bacterial DNA [21]. The flavonoid group of compounds is also lipophilic, damaging bacterial cell walls [22]. According to [23], secondary metabolites in the form of flavonoids are one of the compounds that play an important role in the hemostatic process.

This study provided empirical data that could scientifically support the presence of secondary metabolite compounds in the extract of *Lantana camara* L. leaves, which had the potential as basic ingredients for medicines that provided anti-infective and anti-inflammatory effects in various diseases.

3.2. Testing the Antioxidant Activity

The results of testing the antioxidant activity of the ethanol extract of the leaves of *Lantana camara* L. can be seen in Table 2 and Figure 2.

Table 2 Antioxidant activity test results of the ethanol extract of *Lantana camara* L. leaves

No.	Concentration (µg/mL)	Antioxidant Activity (%)	IC-50 Value (µg/mL)
1	5	4.50	316.8748
2	10	5.23	
3	20	7.21	
4	40	9.73	
5	80	15.50	

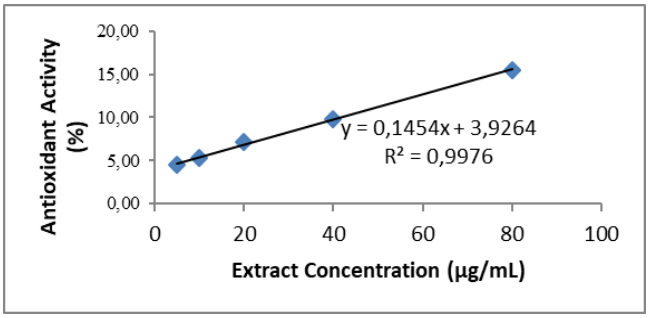

Fig. 2 The curve of the relationship between the antioxidant activity and the extract concentration of *Lantana camara* L. leaves

The IC50 value in the ethanol extract of *Lantana camara* L. leaves can be seen from the simple linear regression equation in the graph above. Therefore, the IC50 value for the total ethanol extract of the lantana leaves (*Lantana camara* L.) was 316.8748 ppm. Specifically, a compound with the IC50 value of <10 ppm is a very strong antioxidant; strong activity for IC50 10-50 ppm, moderate activity for IC50 50-100 ppm, weak activity for IC50 100-250 ppm, and inactive for IC50 >250 ppm [24]. Based on this classification, it can be concluded that the antioxidant activity of the ethanolic extract of *Lantana camara* L. leaves was not active due to the IC50 value of >250 ppm, which was 316.8748 ppm. This result is different from the research on the antioxidant activity of *L. camara* from Brazil, where this plant has antioxidant activity with an IC50 value of 114.63±6.16 g/mL [25].

There are several studies of antioxidant activity in *L. camara* growing in various regions worldwide. For

example, the antioxidant activity of these four plant varieties from India showed that the leaf methanol extract provided inhibition against DPPH radicals with IC50 values ranging from 33.30 to 927.16 g/mL [26]. Meanwhile, the IC50 of methanol extract of *L. camara* leaves grown in Malaysia was 165 g/mL [27] and 16.02 g/mL [28].

Humans need antioxidant compounds since the human body has an antioxidant system to recognize the reactivity of free radicals continuously formed by the body. However, the body cannot handle it on its own under certain conditions; therefore, it requires antioxidant substances from outside the body to prevent these free radical reactive reactions from occurring. Antioxidants are compounds that can counteract or reduce the negative effects of oxidants in the body by donating one electron to oxidant compounds so that the activity of these oxidant compounds can be inhibited [29].

4. Conclusion

The test results of phytochemical compounds show that the ethanol extract of lantana (*Lantana camara* L.) leaves contains alkaloids, flavonoids, terpenoids, steroids, saponins, and tannins. Furthermore, the ethanol extract of the lantana leaves has antioxidant activity against DPPH free radicals with an IC50 value of 316,8748 g/mL. This IC50 value indicates that the antioxidant activity of the ethanol extract of lantana leaves is not active. The innovation lies in the drug discovery for various diseases by utilizing biodiversity, namely finding the content of bioactive compounds and antioxidant activity of *Lantana camara* L, which can then be used as primary ingredients for making herbal medicines for alternative medicine for various infectious diseases. It is a scientific contribution to the development of Indonesia's biodiversity to find the potential of herbs and active ingredients for drugs that the community can utilize.

Acknowledgment

The authors are thankful to Halu Oleo University through the Institute for Research and Community Service and Faculty of Public Health, who have funded this research in the work contract number 179l/UN29.15/PG/2021. The authors' gratitude is also conveyed to the Pharmacy Research Laboratory, Faculty of Pharmacy, Halu Oleo University, and the Biochemistry Laboratory, Department of Chemistry, Faculty of Mathematics and Natural Sciences (MIPA), Hasanuddin University of Makassar.

References

[1] MARINI & SITORUS H. Some of the Potential Plants as Repellents in Indonesia. *Spiracle*, 2019, 11(1): 24-33.

[2] VENKATACHALAM T, et al. Physicochemical and preliminary phytochemical studies on the Lantana camara (L.) fruits. *International Journal of Pharmacy and Pharmaceutical Sciences*, 2011, 3(1): 52-54.

[3] SAFITRI A R, & ASNGAD A. Effectiveness of Tembelekan Leaf Extract and Kaffir Jeruk Leaf Extract as Vegetable Insecticide Against Mosquito Larvae Mortality with Various Concentrations. *Parallel Papers Articles*, 2020: 491-495.

[4] HEMALATHA, PERIASWAMY, et al. Larvicidal activity of Lantana camara aculeata against three important mosquito species. *Journal of Entomology and Zoology Studies*, 2015, 3(1): 174-181.

[5] ANONIM. *1000 Efficacies and Benefits of Plants*. 2013. www.indonews.co.id. Accessed on 2 December 2015.

[6] HIDAYATI DKK. *Chemical Content and Anti-Inflammatory Test of Ethanol Extract of Lantana camara on Male White Rats (Rattusnorvegicus L.)*. Surakarta. 2005.

[7] PURWATI S, LUMOWA S V T; SAMSURIANTO, SAMSURIANTO. *Phytochemical Screening of Lantana (Lantana camara L.) Leaves as Vegetable Pesticides to Suppress Pests and Disease Incidence in Horticultural Plants in East Kalimantan*. In: Chemistry Seminar Proceedings, 2017: 153-158.

[8] MUTA'ALI R, & PURWANI, K.I. *Effects of Pluchea indica Leaf Extract on Spodoptera litura F. Larva Mortality and Growth.* Journal of SCIENCE and ART.4(2). 2015. 1-4.

[9] MUTA'ALI R, & PURWANI K I. Effect of Beluntas Leaf Extract (Puchea indica) on Mortality and Larvae Development Spodoptera litura F. *Journal of SCIENCE and ART*, 2015, 4(2): 1-4.

[10] HEMALATHA P, ELUMALAI D, JANAKI A, et al. Larvicidal activity of Lantana camara aculeata Against Three Important Mosquito Species. *Journal of Entomology and Zoological Studies*, 2015, *3* (1): 174-181.

[11] TAPSELL, L. C, HEMPHILL, I, COBIAC, L, et al. Health benefits of herbs and spices: the past, the present, the future. *Medical Journal of Australia*, 2006, 185: 4-24.

[12] CHANWITHEESUK A, TEERAWUTGULRAG A, & RAKARIYATHAM N. Screening of antioxidant activity and antioxidant compounds of some edible plants of Thailand. *Food Chemistry*, 2005, 92(3): 491-497.

[13] MOSQUERA O M, CORREA Y M, BUITRAGO D C, & NINO J. Antioxidant Activity of Twenty-Five Plant from Colombian Biodiversity. *Memórias do Instituto Oswaldo Cruz, Rio de Janeiro*, 2007, 102(5): 631-634.

[14] VENKATACHALAM T, KUMAR V K, SELVI P K, MASKE A O, & KUMAR N S. Physicochemical and preliminary phytochemical studies on the Lantana Camara (L.) fruits. *International Journal of Pharmacy and Pharmaceutical Sciences*, 2011, 3(1): 52-54.

[15] KENSA V M. Studies on phytochemical screening and antibacterial activities of Lantana camara Linn. *Plant Sciences Feed*, 2011, 1(5): 74-79.

[16] KALITA S et al. Phytochemical composition and in vitro hemolytic activity of Lantana camara L. (Verbenaceae) leaves. *Pharmacology Online*, 2011, 1: 59-67.

[17] BHAKTA D & GANJEWALA D. Effect of leaf positions on total phenolics, flavonoids and proanthocyanidins content and antioxidant activities in Lantana camara (L). *Journal of Scientific Research*, 2009, 1(2): 363-369.

[18] GHISALBERTI E L. Lantana camara (Verbenaceae). *Fitoterapia*, 2000, 71: 462-487.

[19] NUROCHMAN P S. *Antibacterial Test and Tracing*

Active Compounds of the Lantana camara L. Plant. JF FMIPA UNPAD, 1996.
[20] NUR A H, SHANTI L A, & AHMAD D. *Chemical Content and Anti-Inflammatory Test of the Ethanol Extract of Lantana camara L*. An Undergraduate Thesis of the Faculty of Mathematics and Natural Sciences of Universitas Sumatra Utara, 2005.
[21] SABIR A. Aktivitas antibakteri flavonoid propolis Trigona sp terhadap bakteri Streptococcus mutans (in vitro) (In vitro antibacterial activity of flavonoids Trigona sp propolis against Streptococcus mutans). *Dental Journal* (Majalah Kedokteran Gigi), 2005, 38(3): 135–141. https://doi.org/10.20473/j.djmkg.v38.i3.p135-141
[22] NAIM R. 2004. *Antimicrobial Compounds from Plants*. http://www2.kompas.com/kompas-cetak/0409/15/sorotan/1265265.htm. Accessed on July 2008.
[23] PAURAN M P, KARAUWAN F A, KANTER J. Hemostatic Effects of the Lantana camara L. Leaf Extract Against Cuts in White Rats Rattus norvegicus. *Biofarmasetikal Tropis*, 2019, 2(2): 34-39.
[24] PHONGPAICHIT S, NIKOM J, HUTADILOK T N, et al. Biological Activities of Extracts from Endophytic Fungi Isolated from Garcinia Plant. *Fems Immunology & Medical Microbiology*, 2007, 51(3): 517-525.
[25] GOMES DE MELO J, DE SOUSA ARAÚJO T. A, THIJAN NOBRE DE ALMEIDA E CASTRO V, et al. Antiproliferative Activity, Antioxidant Capacity and Tannin Content in Plants of Semi-Arid Northeastern Brazil. *Molecules*, 2010, 15(12): 8534–8542. https://doi.org/10.3390/molecules15 128534.
[26] KUMAR S, SANDHIR R, & OJHA S. Evaluation of antioxidant activity and total phenol in different varieties of Lantana camara leaves. *BMC Research Notes*, 2014, 7(1), 560. https://doi.org/10.1186/1756-0500- 7-560.
[27] SWAMY, MALLAPPA KUMARA, et al. In vitro pharmacological activities and GC-MS analysis of different solvent extracts of Lantana camara leaves collected from tropical region of Malaysia. *Evidence-Based Complementary and Alternative Medicine*, 2015, Special issue, Article ID 506413, https://doi.org/10.1155/2015/506413
[28] MAHDI-POUR B, JOTHY S L, LATHA L Y, et al. Antioxidant activity of methanol extracts of different parts of Lantana camara. Asian Pacific Journal of Tropical Biomedicine. 2012. 2(12), 960– 965. https://doi.org/10.1016/S2221- 1691(13)60007-6.
[29] TITTA H S, AHMAD N, & RESI A. Gel Mask Preparation Formulation from the Methanol Extracts of Green Tea (Camellia sinensis L.) Leaves and Black Honey (Apidorsata) as Antioxidant. *Kartika – Pharmaceutical Scientific Journal*, 2013, 1: 17-23.

参考文:

[1] MARINI 和 SITORUS H. 印度尼西亚有一些潜在的驱虫植物。尖顶，2019，11（1）：24-33。
[2] VENKATACHALAM T 等等。林丹 (大号.) 物理化学和初步植物化学研究。国际药学与药物科学杂志，2011，3(1)：52-54。
[3] SAFITRI A R, 和 ASNGAD A. 腾贝莱坎叶提取物和卡菲尔杰鲁克叶提取物作为蔬菜杀虫剂对各种浓度的蚊子幼虫死亡率的有效性。平行论文，2020：491-495。
[4] HEMALATHA、PERIASWAMY 等等。马德丹对三种重要的蚊子的杀幼虫活性。昆虫学与动物学研究杂志, 2015, 3(1): 174-181.
[5] 匿名。1000 种植物的功效和益处。2013. www.indonews.co.id。于 2015 年 12 月 2 日访问。
[6] HIDAYATI D K K。马 丹乙醇提取物对雄性白鼠(褐家鼠.)的化学成分和抗炎。苏拉加达。2005。
[7] PURWATI S，LUMOWA S V T, SAMSURIANTO, 和 SAMSURIANTO. 花丹(马 丹.)叶子的植物化学筛选作为蔬菜杀虫剂,以抑制东加里曼丹园艺植物的病虫害发病率。在:化学研讨会论文集，2017：153-158。
[8] MUTA'ALI R, 和 PURWANI, K.I. 水稻叶提取物对斜纹夜蛾幼虫死亡率和生长的影响。科学与艺术杂志 4(2)。2015. 1-4.
[9] MUTA'ALI R, 和 PURWANI K I. 贝伦塔斯叶提取物(水稻)对死亡率和幼虫发育的影响斜纹夜蛾 F.科学与艺术杂志, 2015, 4(2): 1-4.
[10] HEMALATHA P、ELUMALAI D、JANAKI A 等等。马德丹对三种重要的蚊子的杀幼虫活性。昆虫学与动物学研究杂志, 2015, 3 (1): 174-181.
[11] TAPSELL, L. C, HEMPHILL, I, COBIAC, L, 等等。草药和香料的健康益处:过去、现在、未来。澳大利亚医学杂志，2006, 185：4-24。
[12] CHANWITHEESUK A, TEERAWUTGULRAG A, 和 RAKARIYATHAM N. 筛选泰国部分食用植物的抗氧化活性和抗氧化化合物。食品化学, 2005, 92(3): 491-497。
[13] MOSQUERA O M、CORREA Y M、BUITRAGO D C 和 NINO J. 来自哥伦比亚生物多样性的 25 种植物的抗氧化活性。奥斯瓦尔多克鲁兹研究所纪念馆,里约热内卢, 2007, 102(5): 631-634。
[14] VENKATACHALAM T、KUMAR V K、SELVI P K、MASKE A O 和 KUMAR N S. 研究马 果实的物理化学和初步植物化学研究。国际药学与药物科学杂志，2011，3(1)：52-54。
[15] KENSA V M. 马 丹植物化学筛选和抗菌活性研究。植物科学饲料，2011，1（5）：74-79。
[16] KALITA S 等等。花丹(马鞭草科)叶子的植物化学成分和体外溶血活性。药理学在线，2011，1：59-67。
[17] BHAKTA D 和 GANJEWALA D. 叶位置对马缨丹(大号)中总酚、类黄酮和原花青素含量和抗氧化活性的影响

。科学研究杂志, 2009, 1(2): 363-369.

[18] GHISALBERTI E L. 马(马鞭草科)。鱼翅目，2000, 71: 462-487。

[19] NUROCHMAN P S. 马德植物的抗菌测试和示踪活性化合物。杰夫 FMIPA 联合国人口基金，1996。

[20] NUR A H, SHANTI L A, 和 AHMAD D. 马来西亚的化学成分和抗炎试验。苏门答腊北方大学数学与自然科学学院本科论文，2005。

[21] SABIR A. 蜂胶黄酮对变形链球菌的抗菌活性(体外)(蜂胶黄酮对变形链球菌的体外抗菌活性)。牙科杂志，2005, 38(3): 135–141 。https://doi.org/10.20473/j.djmkg.v38.i3.p135-141

[22] NAIM R. 植物中的抗菌化合物. 2004 。http://www2.kompas.com/kompas-cetak/0409/15/sorotan/1265265.htm。于 2008 年 7 月访问

[23] PAURAN M P, KARAUWAN F A, 和 KANTER J. 参照中,马和丹叶提取物对白鼠褐家鼠割伤的止血作用。热带生物制药, 2019, 2(2): 34-39。

[24] PHONGPAICHIT S、NIKOM J、HUTADILOK T N 等等。藤黄植物内生真菌提取物的生物活性。女性免疫学和医学微生物学，2007，51（3）：517-525。

[25] GOMES DE MELO J、DE SOUSA ARAÚJO T. A、THIJAN NOBRE DE ALMEIDA E CASTRO V 等等。巴西东北部半干旱植物的抗增殖活性、抗氧化能力和单宁含量。分子，2010，15（12）：8534-8542。https://doi.org/10.3390/molecules15 128534。

[26] KUMAR S, SANDHIR R, 和 OJHA S. 不同品种的马丹叶抗氧化活性和 总 的评价。BMC 研究笔记，2014 年，7(1)，560。https://doi.org/10.1186/1756-0500-7-560。

[27] SWAMY M K, SINNIAH U R, AKHTAR S。马来西亚热带地区马 由 体外药理活性和气相色谱-质谱分析。循证补充和替代医学，2015，特刊，文章 ID 506413，https://doi.org/10.1155/2015/506413

[28] MAHDI-POUR B、JOTHY S L、LATHA L Y 等等。甲醇提取物的抗氧化活性。亚太热带生物医学杂志。2012. 2(12), 960–965. https://doi.org/10.1016/S2221-1691(13)60007-6。

[29] TITTA H S、AHMAD N 和 RESI A. 绿茶(茶树.)叶子和黑蜂蜜(阿皮多尔萨塔)的甲醇提取物作为抗氧化剂的凝胶面膜制备配方。卡提卡– 制药科学杂志，2013，1：17-23。