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*Mini-Review*

# Pharmacognosy, Phytochemical, and Pharmacology of Wijaya Kusuma (*Epiphyllum oxypetalum* (DC.) Haw.) – An Update Review

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## Abstract

In Indonesia, *Epiphyllum oxypetalum* (DC.) Haw. is known as Wijaya Kusuma. The plant is grown for home decorating and used widely as medicine in some areas. This narrative review discusses the pharmacognosy, phytochemical, and pharmacology aspects of *E. oxypetalum*. The review is limited to original articles and abstracts available in Science Direct, PubMed, and Google Scholar. The keyword used to search the articles was "*Epiphyllum oxypetalum*". The plant contains proteins, amino acids, alkaloids, saponins, terpenoids, steroids, flavonoids, tannins, glycosides, and resins. The plant has pharmacological activities such as anti-inflammatory, antimicrobials, antidiabetic, and antioxidant properties. Researchers interested in developing *E. oxypetalum* as a medicinal plant might use this review as a reference.

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## INTRODUCTION

Indonesia has a lot of biodiversity and plants that can be used as a source of traditional medicine. Plants used as a source of medicine have existed since ancient times, both hereditary and scientifically proven. Plants have been an integral part of pharmacotherapy throughout history. Medicinal plants have an essential role in the discovery of bioactive molecules[1]. One of the plants that have the potential to be developed as a medicinal plant is *Epiphyllum oxypetalum* (DC.) Haw. or Wijaya Kusuma (family: Cactaceae).

*Epiphyllum oxypetalum* is an ornamental with much history and is widely used to decorate homes. The plant has the potential to be employed as a medicine. *Epiphyllum oxypetalum* is a plant native to Southern Mexico, but it can also be found in North America and Southeast Asia. The plant is also known as night-blooming cereus because of its likeness to a lotus flower. In Indonesia, *E. oxypetalum* has a story that is particularly popular in Central Java. It is said, if someone sees the flowers blooming, then his wishes will come true and achieve success. Another popular myth in the culture is that the *E. oxypetalum* flower does not always bloom, depending on the planter. Many people plant this flower, hoping that it will bring them luck[2].

*Epiphyllum oxypetalum* may reach a height of 2-6 m, are ancient with a green hue, and have dark green leaves. The trunks and shoots of these plants can reach a diameter of 2 cm or more, are woody, and have many branches. The leaves on these plants are low sideways and lancet-shaped. Glossy green leaves on the upper surface and underside of sharp-pointed leaves, thinning, wavy, and serrated leaves, the top of narrow leaves in a linear fashion with the interest of 1.6 to 1.8 mm, nocturnal (bloom at night) funnel-shaped, and scented[3]. The growth of flowers is heavily influenced by light and wind[4]. *Epiphyllum oxypetalum* is growing in an area with no light, and only a tiny breeze does not blossom until it is fully mature. The temperature has a significant impact on the growth of plant germination[5].

Many *E. oxypetalum* research articles have been published, but there is no review of this plant's pharmacognosy, phytochemical, and pharmacological aspects. In an era with more scientific publications than ever, article reviews are an essential type of scientific writing. Article reviews were intended to highlight key aspects of contemporary research and compare them to prior studies on related subjects[6]. Based on this, we highlight the potential of this plant from pharmacognosy, phytochemical, and pharmacological aspects through a narrative review. This review is aimed to provide researchers with a summary of information on *E. oxypetalum's* potential as a medicinal plant.

## PLANT CLASSIFICATION

**Table I** shows the classification of *E. oxypetalum*. Species information is essential for the identification stage of medicinal plants. This is useful to prevent errors in collecting and using plant samples[7].

**Table I.** Classification of *E. oxypetalum*[2]

| Classification | Identity |
|---|---|
| Kingdom | Plantae |
| Subkingdom | Tracheobionta |
| Phylum | Magnoliophyta |
| Class | Magnoliopsida |
| Sub Class | Hamamelidae |
| Order | Caryophyllales |
| Family | Cactaceae |
| Genus | *Epiphyllum* |
| Species | *Epiphyllum oxypetalum* |
| Synonims | *Cereus oxypetalum, Epiphyllum purpusii, Phyllocactus oxypetalus, Phyllocactus purpursii, Cactus oxypetalus, Epiphyllum acuminatum, Phyllocactus acuminatus, Phyllocactus guyanensis, Phyllocactus grandis, Cereus latifrons* Pfeiffer, *Epiphyllum latifrons* |
| Local Name | Wijaya Kusuma (Indonesia); tan hua (China); bakawali (Melayu); queen of the night; orchid cactus; beauty under the moon (International); brahma kamala, nishagandhi (India); kadupul (Sinhala). |

## PHARMACOGNOSY

The identification of a plant is critical for the advancement of traditional medicine. Observations at the microscopic and macroscopic levels help to achieve this objective[8]. Devi *et al.*[3] reported that the transverse section of *E. oxypetalum* leaf from Bangalore district, Karnataka, India showed the presence of upper epidermis, paracytic stoma, cystolith crystal, mesophyll with midrib vascular tissue, mesophyll with the upper epidermis, needle-shaped crystals, starch grains, xylem vessels, phloem, sclerenchyma of bundle sheath, and pith tissue, xylem vessels, phloem layer, sclerenchyma patches of bundle sheath. Meanwhile, the powder leaves of *E. oxypetalum* microscopically show the presence of star-shaped calcium oxalate crystals, tetracytic stoma, anisocytic stoma, starch grains, and xylem vessel with spiral wall thickening.

The epidermis is the cell layer that protects the surface of leaves, flowers, fruits, seeds, stems, and roots. The epidermis protects tissues from external effects and is a regulator of gas exchange in the leaves. Stomata and trichomes are formed from the epidermis[9]. Anisocytic stomata are observed in *E. oxypetalum* leaves. Anisocytic stomata have three adjacent cells of different sizes around each guard cell[10]. Stomata are involved in gas exchange by controlling water loss during transpiration and absorbing $CO_2$ during photosynthesis. Because of the importance of stomata in the photosynthesis process, it will impact the generation of metabolites in plants[11]. Mesophyll tissue contains chloroplasts in cells[12].

Non-specific characteristics like a loss of drying and ash content impact the quality of plant material. Loss in drying and total ash value of *E. oxypetalum* dried leaves was 2 ± 0.10% and 4.6 ± 0.4%[3]. Ingale and Mansoori[13] reported that the loss on drying in the stem extract was 22.6158 g/100 g, and the leaves extract was 10.4658 g/100 g. Meanwhile, the ash content of the stem extract was 2.0625 g/100 g, and the leaves extract was 2.6024 g/100 g.

The loss on drying aims to provide a maximum range linked to the number of compounds lost during the drying process, whereas the ash content intends to offer an overview of the internal and external mineral content from the starting process to the generation of the extract[14]. The location where the plant samples were gathered, and the extraction solvent might

impact the concentration of chemicals in the plant. Environmental elements such as nutrition supplies, pH, growth location, humidity, and light are the key factors that influence the concentration of chemicals in a plant[15]. *Epiphyllum oxypetalum* was sampled from several sites across India for this study. As a result, environmental factors significantly impact the concentration of chemicals in plants, resulting in a wide range of results in each research. Microbial contamination is caused by excess moisture, whereas microbial decomposition is suppressed by low water content[3].

## PHYTOCHEMICAL

*Epiphyllum oxypetalum* leaf powder has a carbohydrate content of 0.0237 ± 0.001 mg/0.5 mL[3], protein content was 14 mg/g, lipids content was 4.6 mg/g, and niacin content was 0.18 mg/g[16]. While, the levels of phenolics, flavonoids, tannins are 19.09 ± 0.08 g/0.6 mL, 8.728 ± 0.02 g/mL, and 31.32 ± 0.08%, respectively[3]. The leaves and flowers of *E. oxypetalum* have been extensively studied in the research, as well as the development of pharmaceuticals. Several studies on the chemical composition of this plant have been published. **Table II** summarizes the chemical composition of *E. oxypetalum*.

Plant chemicals are selectively soluble in suitable solvents. The extraction method used and the sample at various sites in each study can impact compound results. Maceration and soxhlet are two typical procedures researchers use to extract chemical components of *E. oxypetalum*. Maceration does not go through a heating process, so it is unlikely that the compounds contained are damaged[17]. The long maceration process allows the compound to be extracted completely. Soxhlet extraction is a highly effective hot extraction process. However, it should be noted that hot extraction can damage the samples' compounds for thermolabile compounds[18].

The choice of solvents considerably impacts the extraction efficiency of any traditional technique. The polarity of the substance to be studied is the most significant consideration when selecting a solvent. In choosing a solvent for bioactive component extraction, consider molecular affinity between the solvent and the solute, mass transfer, the use of a co-solvent, environmental safety, human toxicity, and financial feasibility[19].

Based on **Table II**, flowers and leaves of *E. oxypetalum* are reported to have metabolites that play a role in pharmacological activity. Alkaloids play a role in activities such as anticancer, antimalarial, and antihyperglycemic. Saponins play a role in antibacterial and antioxidant activities. Tannins play a role in antibacterial activity. Flavonoids have antioxidant properties[20]. Most of these compounds can be dissolved in either methanol, ethanol, or water[19].

**Table II.** Chemical composition of *E. oxypetalum*

| Part of plant | Sample location | Extraction method and type of extract | Chemical component |
|---|---|---|---|
| Flowers | Hosur, Krishnagiri district, Tamil Nadu, India | Maceration, hexane extract | Alkaloids, saponins, terpenoids[20] |
| | | Maceration, chloroform Extract | Proteins and amino acids, terpenoids[20] |
| | | Maceration, ethanol extract | Alkaloids, terpenoids[20] |
| | | Maceration, water extract | Steroids, flavonoids, tannins[20] |
| | Denpasar and Badung, Bali, Indonesia | Fractionation, petroleum ether fraction | Alkaloids, triterpenoids and saponins[21] |
| Leaves | Bangalore district, Karnataka, India | Soxhlet extraction, methanol Extract | Carbohydrates, proteins, tannins, phenols, alkaloids, flavonoids, sterols, saponins[3] |
| | | Soxhlet extraction, water extract | Carbohydrates, proteins, tannins, alkaloids, sterols, saponins[3] |
| | | Soxhlet extraction, petroleum ether extract | Carbohydrates, tannins, sterols, alkaloids[3] |
| | | Soxhlet extraction, ethanol extract | Carbohydrates, proteins, tannins, phenols, alkaloids, sterols, saponins[3] |
| | Bangalore district, Karnataka, India | Soxhlet extraction, sequentially ethanol extract | Carbohydrates, proteins, tannins, phenols, alkaloids, saponins, glycosides, steroids, terpenoids, resins[16] |
| | | Soxhlet extraction, sequentially acetone extract | Saponins, glycosides, proteins, steroids, terpenoids, phenols, resins, tannins[16] |
| | | Soxhlet extraction, sequentially petroleum ether extract | Glycosides, proteins, steroids, terpenoids, resins[16] |

Several chemical constituents of *E. oxypetalum* were identified using the gas chromatography-mass spectroscopy (GC-MS) method[20,22,23]. The summary can be seen in **Table III**. Hexadecanoic acid was detected in leaves and flowers. This compound

is reported to have potential as an antioxidant, flavor, pesticide, hemolytic, and other. Ethanol extract of *E. oxypetalum* leaves also contains flavonoids ([7- hydroxy-3(1,1-dimethyl prop-2enyl) coumarin) and fatty acids (oleic acid, nonadecanoic acid, and hexadecanoic acid)[20].

**Table III.** Chemical constituents identified in *E. oxypetalum*

| Part of plant | Extraction method and type of extract | Chemical component |
|---|---|---|
| Flowers | Maceration; chloroform, ethanol, hexane and aqueous extracts | Hexadecanoic acid, ethyl ester<br>Nonadecanoic acid<br>Oleic acid<br>11-tridecen-1-ol<br>1-octadecyne<br>Hexadecanal,<br>Spiro[androdt-5-ene-17,1-cyclobutan]-2-1-3-hydroxy<br>1,6;3,4-dianhydro-2-deoxy-. beta.-DLyxo- hexopyranose<br>di-n-decylsulfone,<br>7-hydroxy-3(1,1-dimethyl prop-2enyl) coumarin<br>Pterin-6-carboxylic acid[20] |
| Leaves | Soxhlet extraction; ethanol extract | 4-hydroxy-2-methylacetophenone<br>Megastigmatrienone<br>4-((1E)-3-hydroxy-1-propenyl)-2 methoxyphenol<br>n-hexadecanoic acid<br>Octadecanoic acid<br>Phytol<br>Cholesta-22,24-dien-5-ol, 4,4-dimethyl<br>Stigmasterol<br>22-stigmasten-3-one<br>Heptacosane<br>Nonadecane, 2- methyl-<br>Spinasterone<br>4,22-stigmastadiene-3-one<br>Tetracosane<br>Hentriacontane<br>Stigmast-4-en-3-one<br>Testosterone cypionate[24] |
| | Cold percolation, methanol extract | 10-octadeconoic acid, methyl ester; 1,2-benzenedicarboxylic acid, butyl octyl ester; 1,2-benzenedicarboxylic acid, mono (2-ethylhexyl) ester; Cyclopropanebutanoic acid, 2-[(2-[(2 [(2pentylcyclopropyl)methyl]cyclopropyl)methyl]cyclopropyl)methyl]-, methyl ester; 17-(1,5-dimethylhexyl)-10,13-dimethyl-3 styrylhexadecahydrocyclopenta(a)phenanthren-2-one; Ergosteryl acetate; Ethanol, 2-(9-octadecenyloxy)-,(Z)-;<br>Glycine,N-[(3a,5a,7a,12a)-24-oxo-3,7,12 tris [(trimethylsilyl) oxy]cholan-24-yl] -, methyl ester; (5a) pregnane -3,20 a-diol, 14a, 18a-[4-methyl-3-oxo- (1-oxa-4-azabutane-1,4-diyl)]-, diacetate; and Rhodopin[23] |

Several structures of essential compounds in *E. oxypetalum* are presented in **Figure 1**. A molecular docking study reported that megastigmatrienone and testosterone cypionate found in *E. oxypetalum* leaves have the potential to be developed as an antiviral[22].

## PHARMACOLOGY

The summary of pharmacological activity from *E. oxypetalum* is shown in **Table IV**. Because animal tests are expensive, time-demanding, and susceptible to ethical controversy, *in vitro* procedures are frequently preferred over *in vivo* assays[25]. According to **Table IV**, most *E. oxypetalum* research has been done *in vitro*. The leaves are more studied than the flowers. Flowers may be more challenging to obtain because not all plants planted can produce flowers.

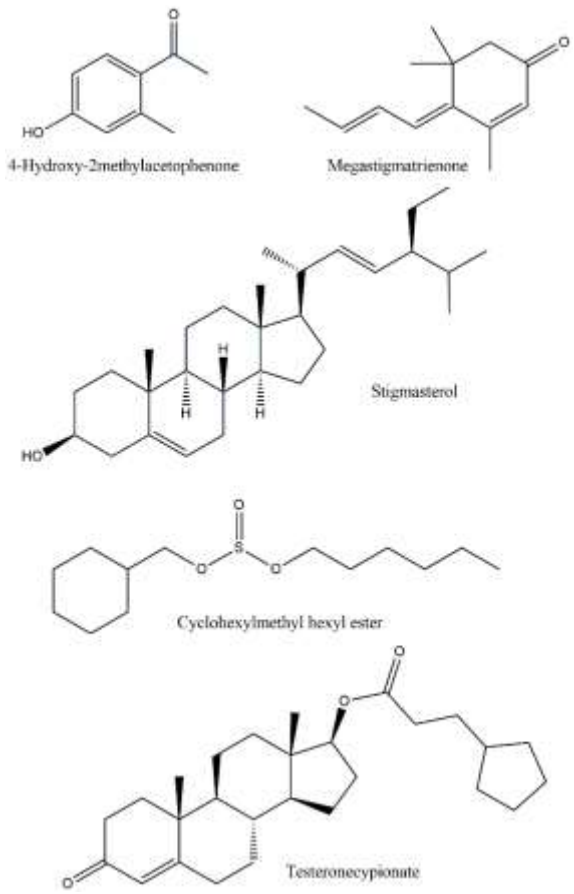


**Figure 1.** Several chemical structures identified in *E. oxypetalum*[20,22,23]

Alcohols, both ethanol and methanol, as polar solvents, are more often used in the test. This solvent can extract metabolites with a wider polarity, such as polyphenols, flavonoids, tannins, alkaloids, glycosides, terpenoids, and steroids[26]. The extraction methods that are widely used are maceration and soxhlet extraction. Both of these methods are commonly used in the extraction of medicinal plants[27]. However, currently, the use of non-conventional extraction techniques (such as ultrasonic-assisted extraction or microwave-assisted extraction) is auspicious to be applied in the development of this plant to produce effective, efficient extracts and environmentally friendly[28,29]. The plant metabolites play a role in the pharmacological effects of plants. Each pharmacological activity of the plant will be discussed at separate points.

### *Antioxidant*

Antioxidants are chemical substances that, when consumed sufficiently, can prevent damage produced by the oxidation process[30]. In other words, the body needs a substance such as an antioxidant that helps protect against free radical attack[31]. The method that has been used to test antioxidant activity is the DPPH method and hydrogen peroxide scavengers which were tested on samples of methanol extract, ethanol extract, water extract, and petroleum ether fraction. DPPH•, on the other hand, is not a natural radical, but its reaction mechanism with antioxidants is close to that of peroxyl radicals ROO•[32]. When the DPPH solution is mixed with a substrate that can donate a hydrogen atom, it gives rise to a reduced form with a loss of purple color[33]. In this test, ascorbic acid, Trolox, gallic acid, butylated hydroxytoluene (BHT), and butylated hydroxyanisole (BHA) are often used as references[34].

The secondary metabolites, such as flavonoids and saponins, contribute to this activity. Saponins can reduce superoxide by forming hydroperoxide intermediates to prevent damage by free radicals. The antioxidant mechanism of steroids is by scavenging reactive species, such as superoxide and chelating metals ($Fe^{2+}$ and $Cu^{2+}$)[35]. While flavonoids are polyphenols that can donate hydrogen atoms to free radicals, the antioxidant activity of polyphenolic compounds can be generated from a neutralization reaction or at the termination of a chain reaction[36].

**Table IV.** Pharmacological activities of *E. oxypetalum*

| Part of Plant | Type of extracts | Activities and methods | Results |
|---|---|---|---|
| Flowers | Methanol extract and petroleum ether fraction | Antioxidant, *in vitro*, diphenylpicrylhydrazine, DPPH method | The methanol extract and petroleum ether fraction (at 8000 ppm, 60 minute) was able to able to reduce DPPH free radicals by 70.00% and 155.1%, respectively[37]. |
| | Methanol extract | Antihyperuricemia; *in vivo* | The extract (400 mg/Kg BW) can reduce 63.50% of uric acid on mice induced by *melinjo* and chicken liver juice raw[37]. |
| Leaves | Ethanol extract and aqueous extract | Antioxidant, *in vitro*, DPPH and hydrogen peroxide scavenger methods | Both of extracts at 2000 and 500 µg/mL was able to inhibit DPPH radical and hydrogen peroxide scavenging[38]. |
| | Alcohol extract and water extract | Anti-inflammatory, *in vitro*, human red blood cell membrane stabilisation and inhibition of protein denaturation method | Using *in vitro* techniques, the percentage inhibition of alcohol and aqueous extract was highest at 300 µg/mL, but in animal studies, the percentage inhibition of alcohol and aqueous extract was highest at 600 and 200 mg/Kg BW, respectively[39]. |
| | Silver nano particles (AgNPs) synthesized from aqueous extract | Anti-bacteria, *in vitro*, tested using by Kirby-Bauer disc diffusion method | AgNP synthesized from aqueous extract of *E. oxypetalum* indicated the presence of anti-bacterial activity against *Propionibacterium acne, Pseudomonas aeruginosa,* and *Klebsiella pneumoniae*[40]. |
| | Extract | Wound healing and kidney hispathological, *in vivo* | The combination of *Catharanthus roseus* and *E. oxypetalum* leaf extract at a concentration of 15% (topically) provided the best wound healing in guinea pigs compared to the administration of each extract alone. Histopathological parameter showed that both extracts were safe for the kidneys[41]. |
| | Ethanol extract 96% | Anti-inflammatory, *in vivo* | In diabetic mice, topical treatment (ointment) of the extract of *E. oxypetalum* leaves accelerated wound healing time, with 20% *E. oxypetalum* extract displayed the highest effect[42]. |
| | Petroleum ether, acetone, and ethanol extracts | Antimicrobe, *in vitro,* disc diffusion method | The maximum inhibition zone was indicated by acetone and petroleum ether extracts against *Escherichia coli* (14 mm); acetone extract against *Staphylococcus aureus* (14 mm); acetone and ethanol extracts against *Klebsiella pneumonia* (10 mm and 10 mm, respectively); and petroleum ether extract against *Bacillus subtilis* (12 mm). All extracts were tested at a concentration of 100 µg/mL. All extracts showed no activity against fungal pathogen[16]. |
| | Methanol extract | Anti-inflammatory, *in vitro*, inhibition of albumin denaturation | The extract showed anti-inflammatory activity with a percent inhibition was 32%[37]. |
| | Methanol extract | Anti diabetic, *in vitro*, α-amylase inhibitory assay | The extract showed the percent inhibition of α-amylase was 26%[37]. |
| | Several active compounds (4-hydroxy-2-methylacetophenone, Stigmasterol, 6-octen-1-ol, 3,7-dimethyl, Megastigmatrienone, Cyclohexylmethyl hexyl ester, Testosterone cypionate | Antivirus, *in silico* study using molecular docking | Megastigmatrienone (5.02 kcal/mol) from *E. oxypetalum* leaves had higher binding interactions against *Treponema pallidum*, followed by megastigmatrienone (4.58 kcal/mol) with liver cirrhosis, and testosterone cypionate (7.084 kcal/mol) with Zika virus[22]. |

### *Antihyperuricemia*

Determination of uric acid levels was determined by the enzymatic method using uric acid reagent FS-TBHBA (2,4,6-tribromo-3-hydroxybenzoic acid). The mechanism in this method is that the enzyme uricase oxidizes uric acid with the help of $H_2O$ and $O_2$ into allantoin, $CO_2$, and $H_2O_2$. The $H_2O_2$ formed will react with 4-amino antipyrine and FS-TBHBA to form pink quinonimine; the peroxidase enzyme catalyzes the reaction[43]. Compounds that play a role in lowering uric acid levels are flavonoids. The flavonoid group of compounds inhibits the activity of xanthine oxidase and superoxidase, thereby reducing the formation of uric acid[44].

### *Anti-inflammatory*

*Epiphyllum oxypetalum* has pharmacological activity as an anti-inflammatory. In a study by Dwita *et al.*[42], *E. oxypetalum* leaf extract contains secondary metabolites such as alkaloids, flavonoids, tannins, saponins, and steroids. Several studies have demonstrated the mechanism of flavonoids in wound healing by modulating the expression of cytokines and nitric oxide in the inflammatory phase.

### *Antidiabetic*

The antidiabetic activity of methanol extract of *E. oxypetalum* leaf showed inhibition of α-amylase. α-amylase is helpful as a hypoglycemic agent to control hyperglycemia, especially in patients with type 2 diabetes mellitus. This enzyme delays carbohydrates and prolongs carbohydrate digestion time, causing a reduction in the rate of glucose absorption and consequently reducing the postprandial rise in plasma glucose[45]. Secondary metabolite compounds such as phenolics, flavonoids, alkaloids, and steroids have antidiabetic activity[46].

### *Antibacterial*

The chemical content of the *E. oxypetalum* leaf extract has the potential as an antibacterial, both against gram-negative and gram-positive bacteria, compared to antifungals[16]. When paired with antibiotics, nanoparticle technology using silver (silver nanoparticles, AgNPs) synthesized from an aqueous extract of *E. oxypetalum* is more effective. This formulation is both environmentally friendly and cost-effective and may be precious in biomedical applications[40].

AgNPs can be used effectively against many drug-resistant bacteria because their large surface area and small size make them easy to interact with substances and enhance their antibacterial efficacy. AgNPs can be a new generation of antimicrobial with broad-spectrum activity. Biological methods for the synthesis of nanoparticles have several advantages over chemical and physical methods because these methods do not involve chemical toxins, and sometimes reactions take place at very high temperatures. Using plants to synthesize nanoparticles can be an advantage over microorganisms because it eliminates the culture maintenance process[40].

The phenolic compounds contained in *E. oxypetalum* are one of the compounds suspected of having antibacterial activity[16]. Alkaloids are thought to have the ability as an antibacterial that can interfere with the peptidoglycan components of bacterial cells so that the cell wall layer is not formed completely. Terpenoids are other plant metabolites with antimicrobial, antifungal, antibacterial, and antiviral properties. The flavonoids act as an antibacterial agent by building complex molecules with proteins that damage the bacterial cell membrane's integrity. These substances can degrade cell walls and interfere with cell permeability. In addition to flavonoids, a type of polyphenolic compounds that have antibacterial action, particularly tannins[47].

### *Toxicity study*

Safety is a major consideration in the development of medicinal plants. Eleven compounds found in methanol extract of *E. oxypetalum* leaves, through GC-MS analysis, were evaluated for their toxicity using QSAR – Toxicity Estimation Software Tool (TEST). Some of them were predicted to possess high to extreme toxicity against Daphnia *magna*, *Tetrahymena pyriformis*, and *Pimephales promelas*, such as oleic acid, eicosyl ester; hexadecanoic acid, 1-(hydroxymethyl)-1,2- ethanediyl ester; 17-pentatriacontene; cyclopropanebutanoic acid,2-[(2-[(2-[(2-pentylcyclopropyl)methyl]cyclopropyl)methyl]cyclopropyl)methyl]-,methyl ester; 17-(1,5-dimethylhexyl)-10,13-dimethyl-3-styrylhexadeca hydrocyclopenta(a)phenanthren-2-one; and ergosteryl acetate[23].

Among the chemicals found in *E. oxypetalum*, 0-octadecenoic acid, methyl ester and ethanol, 2-(9-octadecenyloxy)-, (Z) were harmless to development. Meanwhile, 1,2-benzenedicarboxylic acid, butyl octyl ester; 1,2-benzenedicarboxylic acid, mono(2-ethylhexyl) ester; cyclopropanebutanoic acid,2-[(2-[(2-[(2-pentylcyclopropyl)methyl]cyclopropyl)methyl]cyclopropyl)methyl]-,methyl ester; 17-(1,5-dimethylhexyl)-10,13-dimethyl-3-styrylhexadecahydrocyclopenta(a)phenanthren2-one; ergosteryl acetate; glycine,N-[(3a,5a,7a,12a)-24-oxo-3,7,12-tris[(trimethylsilyl)oxy]cholan-24-yl]-,methyl ester; and (5a)pregnane-3,20a-diol,14a,18a-[4-methyl-3-oxo-(1-oxa-4-

azabutane-1,4-diyl)]-,diacetate were poisonous. In oral rats, however, all compounds were predicted to have a low toxicity to nontoxic. Through *in silico* research, the usage of animals for toxicity estimates can be reduced[23]. This study was suspected that *E. oxypetalum* leaves are safe for humans and could be used to produce new medications in the future. Of course, before that, scientific evidence of *in vivo* toxicity from extracts and individual compounds of *E. oxypetalum* leaves in animal models is required.

## FUTURE PROSPECTS

Based on the information provided, the *E. oxypetalum* plant in the future has the potential to be developed into a source of medicinal ingredients. So, it can be used as a raw material for natural medicine to treat various diseases. The flower and leaves of this plant contain chemical compounds in the form of primary and secondary metabolites. Steroid chemicals dominate the chemical substances detected in this plant, such as testosterone cypionate, stigmasterol, and others. No active chemical compounds against specific pharmacological actions have been isolated on this plant. These isolates will determine quality standards from the extracts or fractions production. In the future, it will also be essential to investigate the plant's roots to complete the information about the plant. The pharmacological activity of *E. oxypetalum* has the potential as an anti-inflammatory, a source of antioxidants, and antimicrobials. The chemical compounds discovered in these plants, particularly steroids, need to be researched further to see whether they may be used for additional therapeutic purposes, such as hormone treatment for fertility, contraception, or even aphrodisiacs.

## CONCLUSION

*Epiphyllum oxypetalum* contains chemical compounds such as carbohydrates, proteins, amino acids, alkaloids, saponins, terpenoids, steroids, flavonoids, tannins, glycosides, and resins. This plant has pharmacological activity such as anti-inflammatory, antimicrobial, antidiabetic, and a source of antioxidants. *Epiphyllum oxypetalum* is a plant that is safe because it is not toxic. *Epiphyllum oxypetalum* has the potential to be investigated and developed further so that the plant's benefits can be shared with the rest of the community..

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## AUTHORS' CONTRIBUTION

**Chandra Adam Lesmana**: conceptualization, investigation, data curation, resources, visualization, writing - original draft, and writing - review & editing. **Ni Putu Ermi Hikmawanti**: conceptualization, methodology, project administration, supervision, validation, visualization, writing - original draft, and writing - review & editing. **Agustin Yumita**: conceptualization, supervision, validation, writing - original draft.

## DATA AVAILABILITY

None.

## CONFLICT OF INTEREST

The authors have declared no conflict of interest.

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NOMOR: 925 /F.03.01/2022

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| Jabatan | : | Dosen FFS UHAMKA |
| Alamat | : | Islamic Center Jl. Delima Raya II/ IV, Perumnas Klender – Jakarta Timur |
| Tugas | : | Sebagai Penulis pada As-Syifaa Jurnal Farmasi: **"Identifikasi Kualitatif Fenolik dan Penapisan Aktivitas Peredaman Radikal DPPH Menggunakan KLT pada Ekstrak Batang *Pluchea indica* L"** |
| Waktu | : | Semester GASAL TA. 2022/2023 |
| Lain-lain | : | Setelah melaksanakan tugas agar memberikan laporan kepada Dekan atau sama yang memberi tugas. |

Demikian surat tugas ini diberikan untuk dilaksanakan dengan sebaik–baiknya sebagai amanah dan ibadah kepada Allah Subhanahu Wata`ala

Jakarta, 05 Oktober 2022

Dekan,

**Dr. apt. Hadi Sunaryo, M.Si.**

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# IDENTIFIKASI KUALITATIF FENOLIK DAN PENAPISAN AKTIVITAS PEREDAMAN RADIKAL DPPH MENGGUNAKAN KLT PADA EKSTRAK BATANG *Pluchea indica* L.

## (*Qualitative Identification of Phenolics and Screening of DPPH Radical Scavenging Activity Using TLC on Pluchea indica L. Stem Extracts*)

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**ABSTRACT**

*Pluchea indica L. (beluntas) from the Asteraceae is a plant known to be rich in phenolics. Studies on the phenolic content of P. indica stems have not been explored much. The purpose of this study is to qualitatively identify the presence of phenolic compounds and to screen for the radical scavenging ability of DPPH in P. indica stem extracts using the TLC method. Extraction was carried out with the ultrasonic directly and sequentially using 50% ethanol as solvent. Separation was carried out on a silica gel plate GF254 with ethyl acetate: water: formic acid: toluene (20:2:2:1) as the mobile phase. Gallic acid and chlorogenic acid were used as comparisons. Identification of the presence of phenolic using FeCl3 5% as a spray reagent, while screening for radical scavenging activity using DPPH 0.1 mM as a spray reagent. The results showed that the 50% ethanol extracts of P. indica stems, both obtained from direct and stratified extraction, indicated the presence of phenolic compounds as antioxidants. The phenolic compounds detected were identical to gallic acid and chlorogenic acid, respectively, at hRf values of 89.4 and 55.3. The development of phenolic utilization from P. indica stems as a source of antioxidants still needs to be studied.*



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## ABSTRAK

*P. indica* L. (beluntas) dari keluarga Asteraceae merupakan tanaman yang diketahui kaya akan fenolik. Studi kandungan fenolik pada batang *P. indica* belum banyak dieksplorasi. Tujuan penelitian ini adalah untuk mengidentifikasi keberadaan senyawa fenolik secara kualitatif dan menapis kemampuan peredaman radikal DPPH pada ekstrak ekstrak batang *P. indica* menggunakan metode KLT. Ekstraksi dilakukan dengan bantuan ultrasonik secara langsung dan bertingkat menggunakan pelarut etanol 50%. Pemisahan dilakukan pada plat silika gel GF254 dengan etil asetat: air: asam format: toluena (20:2:2:1) sebagai fase geraknya. Asam galat dan asam klorogenat digunakan sebagai pembanding. Identifikasi keberadaan fenolik menggunakan FeCl3 5% sebagai reagen semprot, sedangkan penapisan aktivitas antioksidan menggunakan DPPH 0,1 mM sebagai reagen semprot. Hasil menunjukan bahwa dalam ekstrak etanol 50% batang *P. indica* baik yang diperoleh dari ekstraksi langsung maupun bertingkat menunjukan keberadaan senyawa fenolik sebagai antioksidan. Senyawa fenolik yang terdeteksi tersebut diantaranya identik dengan asam galat dan asam klorogenat, masing-masing secara berturut-turut pada nilai hRf 89,4 dan 55,3. Pengembangan pemanfaatan fenolik dari batang *P. indica* sebagai sumber antioksidan masih perlu terus dipelajari..


**Kata kunci**: Aktivitas antibakteri; *Cayratia trifolia* L; Fungi endofit; Konsentrasi hambat minimum.

## PENDAHULUAN

*Pluchea indica* L. (beluntas) merupakan tanaman yang berasal dari keluarga Asteraceae.[1] Tanaman ini mudah ditemui di Indonesia dan secara tradisional telah digunakan untuk berbagai manfaat seperti mengatasi gejala tuberculosis (Alvin et al., 2014), perawatan pasca melahirkan [3,4], nyeri haid, keram perut [5], penghilang bau badan, mengatasi demam, diare dan batuk.[6] Studi melaporkan bahwa kandungan fenolik dari batang *P. indica* menduduki posisi kedua terbanyak setelah daun, diikuti dengan bunga dan akarnya.[7] Kandungan kimia fenolik utama dalam tanaman ini adalah asam kafeoilquinat yang banyak ditemukan pada bagian daun.[8–10] Salah satu asam kafeoilquinat yang penting adalah asam klorogenat.[11]

Asam klorogenat (asam 5-kafeoilquinat) merupakan salah satu senyawa dalam kelompok asam monokafeoilquinat. Senyawa ini ditemukan pertama kali tahun 1920 dari biji kopi.[12] Senyawa ini banyak ditemukan pada buah dan sayuran.[13] Asam klorogenat larut dalam alkohol dan campuran alkohol-air. Senyawa ini memiliki banyak manfaat, antara lain sebagai antioksidan dan memiliki efek proteksi peroksidasi lipid. Asam klorogenat juga memiliki aktivitas dalam melindungi saraf, kardiovaksular, saluran pencernaan, hati, dan efek antikarsinogenik.[11] Selain itu, asam galat sebagai suatu asam fenolat sederhana yang umum ditemukan pada tanaman juga memiliki peran penting sebagai suatu antioksidan. Senyawa ini seringkali digunakan sebagai pembanding dalam penentuan kadar fenolik total pada bahan tanaman.[14]

Sebelumnya, asam klorogenat terdeteksi dan terkuantifikasi menggunakan metode Kromatografi Lapis Tipis Kinerja Tinggi (KLT-KT) dari ekstrak etanol 50% daun *P. indica*.[9] Kromatografi lapis tipis (KLT) merupakan metode pemisahan yang dilakukan pada bidang datar (planar). Proses pemisahannya berdasarkan pada distribusi komponen kimia yang akan dipisahkan di antara dua fase, yaitu fase diam dan fase gerak.[15] Metode ini dapat digunakan untuk mengidentifikasi senyawa fenolik dan menapis aktivitas antioksidan terhadap radikal DPPH.[16] Keunggulan dari metode ini adalah waktu analisis yang cepat, dengan mudah mendeteksi senyawa target, biaya yang relatif lebih murah, serta resolusi

yang tinggi sehingga memberikan hasil yang akurat.[15]

Pentingnya fenolik (terutama asam klorogenat dan asam galat) sebagai salah satu sumber antioksidan alami menarik untuk dipelajari pada batang *P. indica*. Penelusuran kualitatif asam klorogenat dan asam galat serta penapisan antioksidan dari batang *P. indica* dengan teknik KLT belum pernah dilaporkan. Melalui penelitian ini akan diperoleh data kualitatif kandungan asam klorogenat dan asam galat beserta penapisan senyawa antioksidan pada ekstrak batang *P. indica* yang dihasilkan dari ekstraksi langsung dan bertingkat dengan bantuan ultrasonik menggunakan pelarut etanol 50%.

## METODE PENELITIAN

### Alat dan Bahan

Alat-alat yang digunakan dalam penelitian ini, antara lain: *ultrasonic-bath* (Branson 5510), *vacuum rotary evaporator* (Eyela), UV *box* (Camag), dan alat-alat gelas lain yang umum digunakan dalam penelitian. Bahan-bahan kimia yang digunakan dalam penelitian ini, antara lain: etanol, etil asetat, *n*-heksana, dan aquades sebagai pelarut pengekstraksi yang diperoleh dari PT. Brataco. Asam klorogenat dan asam galat sebagai pembanding yang dibeli dari MarkHerb, Institut Teknologi Bandung (ITB), Bandung, Indonesia. Pereaksi $FeCl_3$ 5%, DPPH (Merck) 0,1 mM, Dragendorff, Mayer, Bouchardat, gelatin 10%, serbuk Mg, HCl 2 N, HCl pekat, $H_2SO_4$ pekat, kloroform (Merck), dan asam asetat glasial. Plat KLT $GF_{254}$ (Merck) sebagai fase diam. Etil asetat p.a, asam format p.a, dan toluena p.a (Merck) sebagai fase gerak.

### Pengumpulan Bahan Tanaman

Batang *P. indica* diperoleh dari Unit Konservasi Budidaya Biofarmaka (UKBB) Pusat Studi Biofarmaka Tropika, LPPM IPB. Tanaman dideterminasi di tempat yang sama dengan nomor koleksi BMK0188092016. Batang dipanen pada bulan November tahun 2021. Batang dicuci bersih dengan air mengalir, kemudian dipotong-potong kecil dan selanjutnya dikering-anginkan. Simplisia batang yang telah kering kemudian diblender hingga menjadi serbuk. Serbuk diayak dengan ayakan mesh 40. Serbuk disimpan pada wadah kering tertutup rapat.

### Ekstraksi Langsung

Serbuk batang *P. indica* (5 g) diekstraksi secara langsung dengan pelarut etanol 50% (50 mL) menggunakan bantuan ultrasonik dengan frekuensi 40 KHz pada suhu 40 °C selama 15 menit mengikuti prosedur Kongkiatpaiboon et al. (2018). Filtrat disaring dari ampasnya menggunakan kertas saring. Ampas kemudian diekstraksi kembali dengan pelarut baru sebanyak 3 kali. Selanjutnya filtrat dikumpulkan dan dipekatkan hingga mencapai volume akhir 50 mL. Filtrat ini kemudian disebut sebagai ekstrak cair.

### Ekstraksi Bertingkat

Tahapan ekstraksi dilakukan sama seperti ekstraksi langsung. Namun, pelarut untuk ekstraksi digunakan secara berurutan sesuai tingkat polaritasnya pada simplisia. Ekstraksi bertingkat diawali dari pelarut dengan tingkat polaritas yang kurang polar hingga polar, yaitu: *n*-heksana (kurang polar), etil asetat (semipolar), dan etanol 50% (polar).

### Penapisan Kandungan Kimia

Penapisan fitokimia (fenolik, flavonoid, tanin, saponin, alkaloid, steroid, dan terpenoid) ekstrak batang *P. indica* dianalisis dengan prosedur yang mengacu pada Farmakope Herbal Indonesia [17] dan Shaikh & Patil (2020).

**Analisis KLT**

Fase diam yang digunakan adalah plat silika gel $GF_{254}$ yang telah diaktifkan di dalam oven suhu 110 °C selama 30 menit. Jarak rambat fase gerak sebesar 8,5 cm. Fase gerak yang digunakan adalah etil asetat: air: asam format: toluena (20:2:2:1). Asam klorogenat dan asam galat sebagai pembanding dibuat dalam konsentrasi 0,1%. Volume penotolan baik pembanding dan sampel ekstrak masing-masing secara berturut-turut adalah 5 μL dan 20 μL. Pengamatan dilakukan pada sinar UV 254 dan UV 366 di dalam UV *box* sebelum disemprot dengan reagen pendeteksi. Reagen pendeteksi yang digunakan adalah $FeCl_3$ 5% (deteksi fenolik) dan DPPH 0,1 mM (deteksi kemampuan peredaman radikal bebas). Setelah disemprot dengan reagen pendeteksi, pengamatan dilakukan pada sinar tampak. Bercak yang diperoleh kemudian dihitung nilai hRf-nya.

**HASIL DAN PEMBAHASAN**

Tahapan awal dalam melakukan pemisahan senyawa alami dari bahan tanaman disebut dengan ekstraksi. Teknik ekstraksi yang paling umum digunakan adalah ekstraksi dengan pelarut. Dengan demikian, pemilihan pelarut yang tepat akan secara selektif mengekstraksi senyawa yang dikehendaki dari tanaman.[19] Hasil penapisan kandungan kimia dari ekstrak batang *P. indica* disajikan pada Tabel 1. Berdasarkan Tabel 1, senyawa fenolik hanya terdeteksi pada ekstrak etanol 50% batang *P. indica*, baik dari hasil ekstraksi langsung maupun bertingkat. Selain fenolik, kedua ekstrak etanol 50% batang *P. indica* juga mengandung flavonoid, tanin, dan alkaloid. Sementara itu, ekstrak etil asetat dan *n*-heksana hanya terdeteksi mengandung senyawa steroid. Proses ekstraksi bertingkat telah mengelompokan kandungan kimia dari batang tersebut berdasarkan tingkat kepolaran pelarutnya. Etanol-air merupakan pelarut yang ideal untuk ekstraksi fenolik.[20,21] Jenis fenolik yang terekstraksi dan kuantitasnya sangat dipengaruhi oleh polaritas etanol yang digunakan sebagai pelarut.[22]

**Tabel 1.** Hasil penapisan kandungan kimia ekstrak batang *P. indica*

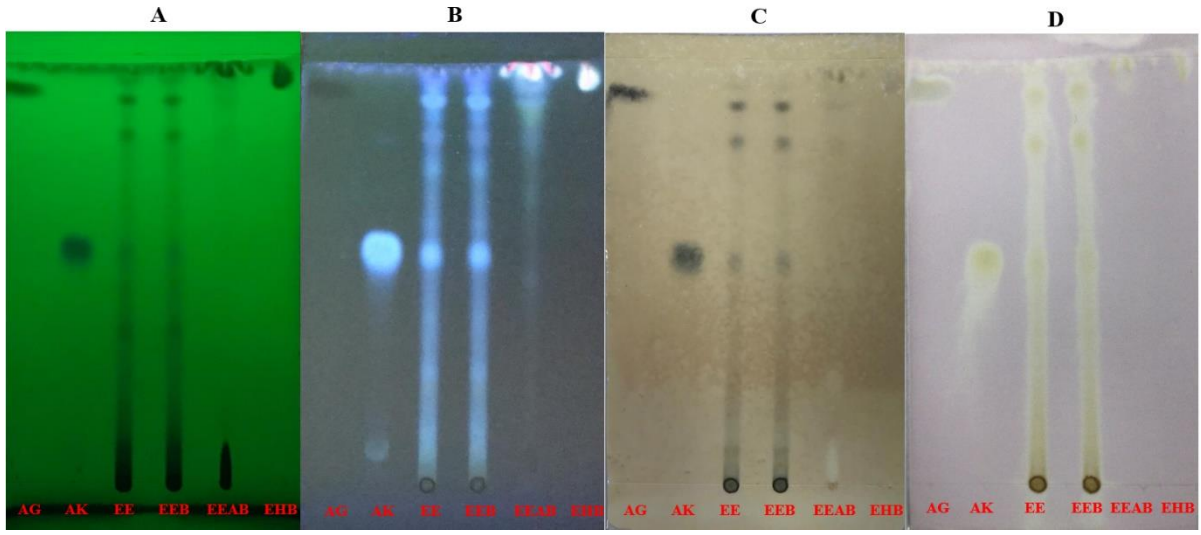
| Senyawa yang diidentifikasi | Ekstrak etanol 50% (langsung) | Ekstrak etanol 50% (bertingkat) | Ekstrak etil asetat (bertingkat) | Ekstrak *n*-heksana (bertingkat) |
|---|---|---|---|---|
| Fenolik | + | + | - | - |
| Flavonoid | + | + | - | - |
| Tanin | + | + | - | - |
| Saponin | - | - | - | - |
| Alkaloid | + | + | - | - |
| Steroid | - | - | + | + |
| Triterpenoid | - | - | - | - |

**Keterangan**: (+) = senyawa teridentifikasi; (-) = senyawa tidak teridentifikasi

Selain itu, faktor lain yang mempengaruhi keberhasilan ekstraksi adalah waktu dan suhu.[19] Pemilihan metode ekstraksi yang tepat dalam pengaturan kedua parameter ini akan meningkatkan kelarutan senyawa dalam pelarut pengekstraksi. Penggunaan teknik ekstraksi modern seperti ekstraksi yang dibantu dengan ultrasonik, *microwave*, enzim, dan lain sebagainya akan dapat memperpendek waktu ekstraksi fenolik dan menurunkan volume penggunaan pelarut.[22] Ekstraksi ini terbukti lebih unggul dalam hal

perolehan senyawa fenolik dibandingkan ekstraksi konvensional seperti maserasi ataupun refluks.[23]

Studi sebelumnya, ekstraksi asam klorogenat dari daun memberikan hasil terbaik menggunakan pelarut etanol 50% dengan metode ekstraksi yang dibantu ultrasonik.[8] Teknik ekstraksi yang dibantu ultrasonik terbukti pada banyak studi mampu mengurangi waktu ekstraksi dan penggunaan pelarut pengekstraksi.[24] Hal ini dikarenakan adanya radiasi ultrasonik (dengan frekuensi >20 kHz) yang memfasilitasi ekstraksi metabolit dari matriks tanaman. Gelombang ultrasonik akan menghasilkan gelembung kavitasi dekat dinding sel tanaman, yang selanjutnya akan merusak dinding sel tersebut dan membuat metabolit keluar dari dalam sel.[22] Dengan demikian, efisiensi ekstraksi senyawa kimia dari matriks tanaman juga meningkat [24].




**Keterangan**: **(AG)** Asam Galat; **(AK)** Asam Klorogenat; **(EE)** Ekstrak Etanol 50% (langsung); **(EEB)** Ekstrak Etanol 50% bertingkat; **(EEAB)** Ekstrak Etil Asetat Bertingkat; **(EHB)** Ekstrak n-Heksana Bertingkat

**Gambar 1.** Hasil Kromatogram KLT identifikasi keberadaan asam klorogenat serta aktivitas peredaman radikal DPPH secara kualitatif pada ekstrak batang *P. indica;* **(A)** Pengamatan pada sinar UV 254 nm; **(B)** Pengamatan pada sinar UV 366 nm; **(C)** Pengamatan pada sinar tampak setelah disemprot $FeCl_3$ 3%; **(D)** Pengamatan pada sinar tampak setelah disemprot DPPH.

Asam klorogenat tidak larut dalam benzena, kloroform, dan petroleum eter. Pelarut etanol 50% merupakan campuran air-etanol (1:1) yang baik untuk melarutkan senyawa fenolik, terutama asam klorogenat. Kepolaran asam klorogenat dan kelarutannya yang tinggi dalam pelarut polar berkaitan dengan banyaknya gugus hidroksil pada strukturnya.[25] Berdasarkan studi ini, jenis fenolik yang terdapat pada ekstrak etanol 50% (baik dari ekstraksi langsung maupun bertingkat) adalah identik (mirip) dilihat dari pola kromatogram KLT (Gambar 1). Gambar 1 menunjukan kromatogram KLT dari ekstrak batang *P. indica* beserta pembanding asam klorogenat dan asam galat. Tabel 2 menyajikan nilai hRf dari masing-masing bercak yang terdeteksi pada kromatogram KLT tersebut. Berdasarkan hasil KLT menunjukan bahwa hanya ekstrak etanol 50% baik yang diperoleh dari ekstraksi langsung maupun bertingkat yang mengandung senyawa fenolik (berwarna biru kehitaman setelah disemprot $FeCl_3$).

**Tabel 2.** Nilai hRf senyawa fenolik dan antioksidan batang *P. indica*

| Jenis Sampel | Nilai hRf | | | |
|---|---|---|---|---|
| | **UV254 (sebelum disemprot)** | **UV365 (sebelum disemprot)** | **Semprot $FeCl_3$ 5%** | **Semprot DPPH 0,1 M** |
| Ekstrak etanol 50%-langsung | 4 bercak berwarna gelap:<br>89,4<br>80,0<br>55,3<br>35,3 | 5 bercak berwarna biru:<br>89,4<br>85,8<br>80,0<br>74,1<br>55,3 | 3 bercak berwarna biru kehitaman:<br>89,4<br>80,0<br>55,3 | 3 bercak berwarna kuning:<br>92,9<br>80,0<br>55,3 |
| Ekstrak etanol 50%-bertingkat | 4 bercak berwarna gelap:<br>89,4<br>80,0<br>55,3<br>35,3 | 5 bercak berwarna biru:<br>89,4<br>85,8<br>80,0<br>74,1<br>55,3 | 3 bercak berwarna biru kehitaman:<br>89,4<br>80,0<br>55,3 | 3 bercak berwarna kuning:<br>92,9<br>80,0<br>55,3 |
| Ekstrak etil asetat (bertingkat) | bercak samar | bercak samar | bercak samar | bercak samar |
| Ekstrak *n*-heksana (bertingkat) | - | - | - | - |
| Asam klorogenat | 55,3 | 55,3 | 55,3 | 55,3 |
| Asam galat | 91,7 | 91,7 | 91,7 | 92,9 |

Keterangan: **(-)** Tidak terdeteksi adanya bercak; **nilai hRf** = nilai Rf x 100; bercak samar tidak dihitung nilai hRf-nya.

Asam klorogenat dan asam galat merupakan dua jenis fenolik yang terdeteksi secara kualitatif pada kedua ekstrak tersebut. Sementara itu, berdasarkan hasil KLT, kedua ekstrak etanol 50% juga menunjukan kemampuan peredaman radikal DPPH yang ditandai dengan adanya bercak berwarna kuning pucat. Senyawa asam klorogenat dan asam galat terdeteksi pada kedua ekstrak tersebut dengan nilai hRf, masing-masing sebesar 55,3 dan 89,4. Sementara itu, pada ekstrak etil asetat terdapat bercak namun terlihat samar. Bercak ini diduga merupakan fenolik namun dalam kuantitas yang sangat rendah. Ekstrak *n*-heksana tidak terdeteksi fenolik dengan fase gerak yang digunakan. Penelusuran lebih lanjut dari jenis fenolik lain ataupun kadar asam galat dan asam klorogenat pada ekstrak etanol 50% batang *P. indica* masih perlu dilakukan dengan teknik kromatograsi lain dengan tingkat sensitifitas lebih tinggi misalnya kromatografi cair kinerja tinggi (KCKT).

Analisis kualitatif menggunakan KLT dari semua jenis ekstrak dan kedua pembanding terhadap kemampuannya dalam meredam radikal DPPH juga dilakukan. Tujuannya adalah mengidentifikasi keberadaan senyawa dalam ekstrak yang berpotensi dalam meredam radikal bebas. Hasilnya, ekstrak etanol 50% batang *P. indica* (baik dari ekstraksi langsung maupun bertingkat) memiliki 3 bercak senyawa yang identik dan menunjukan hasil positif (peredaman) terhadap radikal DPPH (Gambar 1). Metode uji DPPH merupakan metode yang menggambarkan donor elektron sekaligus hidrogen dari senyawa antioksidan untuk menetralkan radikal DPPH.[26] Penapisan aktivitas peredaman radikal DPPH ditunjukan dengan bercak yang berwarna kuning dengan latar berwarna merah muda hingga ungu. Mekanisme kerja fenolik terhadap kondisi ini dikarenakan terjadinya donor elektron [27]

maupun donor hidrogen oleh fenolik kepada radikal DPPH.[28] Struktur fenolik ideal dalam meredam radikal bebas karena banyaknya gugus hidroksil didalamnya.[14] Penelusuran lebih lanjut mengenai total kapasitas antioksidan dari fenolik pada ekstrak etanol batang *P. indica* masih perlu dilakukan menggunakan teknik lain secraa kuantitatif seperti *Trolox equivalent antioxidant capacity* (TEAC), *oxygen radical absorbance capacity* (ORAC), *total radical-trapping antioxidant parameter* (TRAP), *ferric ion reducing antioxidant power* (FRAP), *cupric ion reducing antioxidant capacity* (CUPRAC), dan sebagainya.

**KESIMPULAN**

Berdasarkan penelitian ini dapat disimpulkan bahwa ekstrak etanol 50% batang *P. indica* baik yang diperoleh dari metode ekstraksi langsung maupun bertingkat mengandung asam klorogenat, asam galat dan beberapa senyawa fenolik lain yang belum teridentifikasi menggunakan metode KLT. Senyawa-senyawa fenolik pada batang *P. indica* berpotensi sebagai suatu antioksidan yang terbukti mampu meredam radikal DPPH melalui uji penapisan dengan metode KLT. Penelusuran lebih lanjut terhadap jenis fenolik lain dalam batang *P. indica* masih perlu dilakukan. Pemanfaatan batang *P. indica* sebagai bagian tanaman yang menjadi sumber asam klorogenat dan asam galat baru juga perlu dikembangkan.

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