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Utilization and bioactivity of *Blumea balsaminifera* (L.) DC.

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Abstract

Sembung or *Blumea balsaminifera* a species belonging of Asteraceae has been long used as a traditional medicine. The using of plants as traditional medicine, directly or indirectly related to their bioactive compounds. The writing of this article is based on literature review of the published online and offline such as journals, books, and other research to obtained comprehensive information of the benefits, secondary metabolites, bioactivity, and prospects for the use of *B. balsaminifera*. The ethnobotany of *B. balsaminifera* uses as an ingredient of *loloh* (Bali Aga ethnic health drink), treat of wounds, diarrhea, malnutrition, kidney stone, and traditional sauna ingredients, headaches, gastric disorders, and rheumatism. *Blumea balsaminifera* has bioactivity such as: anti-wound, anti-microbial, anti-cancer, gastroprotective, antioxidant, and anti-kidney stones. *Blumea balsaminifera* leaves contains volatile oil and falvonoid compounds. The volatile oil in *B. balsaminifera* is borneol, 1,8-cineole, limonene, kampor, β-eudesmol, β-champene, myrcene, dimethoxydurene, β-caryophyllene, and α-caryophyllene. The Dimethoxydurene, β-caryophyllene, and α-caryophyllene of *B. balsaminifera* have activities as antioxidant. The flavonoid glycosides of *B. balsaminifera* has a therapeutic effect on wound healing while anti-microbial activity has associated with borneol.

Keywords: *Blumea balsaminifera*; Borneol; Anti-wound; Anti-microbial

1. Introduction

Plants produce various secondary metabolites as adaptation and defense to the environment. Alkaloids, terpenoids, and flavonoids are a group of secondary metabolites that humans use as medicine. The types and levels of secondary metabolites produced by plants vary from one species to another, even if one species grows in different environments. This results in the use of plants as medicinal substances that differ between species and growth stages.

Blume balsaminifera known as *sembung* has long been used as a medicine. This plant is one type of essential oil producer described in the plant resources of South-East Asia No. 19 (Essential Oil Plant) and is the main source of borneol and camphor [1]. Pang et al [2] stated that in China *B. balsaminifera* has been used since 2000 years ago as a traditional medicine. This plant is easily found in various landscaping such as yards and gardens or fields. As a traditional medicine, *B. balsaminifera* is used as an ingredient in loloh (Balinese Aga ethnic health drink) [3], as a wound medicine [2,4], diarrhea [5,6], malnutrition [4], kidney stones [7], and traditional sauna materials [6,8], headaches, gastric disorders, and rheumatism [6].

The use of plants as traditional medicines is directly or indirectly related to their secondary metabolite content. For example, essential oils are widely used for relaxation which are used as ingredients for traditional sauna [8]. Sujarwo et al. [3] stated that *B. balsaminifera* contains more than 100 secondary metabolites which have bioactivity as anti-cancer, anti-microbial, anti-plasmodial, anti-wound and anti-inflammatory. Yuan et al [9] stated that the time to grow and the type of plant organs *B. balsaminifera* affects oil production, its composition, and antioxidant activity.

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Silalahi et al. [5] stated that *B. balsaminifera* has been traded in the Kabanjahe traditional market in the form of simplicia as *oukup* (traditional Batak ethnic sauna). Various people consider that the effectiveness of *B. balsaminifera* as a drug is often questioned because it is considered not scientifically proven, even though there have been many studies, but tend to be fragmented. Information regarding the content of secondary metabolites, bioactivity is very important in the development of medicinal plants as traditional medicines and standardized herbal medicines so that side effects can be minimized. The results of this study can be used as a source of information in the use of *B. balsaminifera* as a traditional medicine.

2. Methods

The writing of this article is based on literature studies on various books and scientific journals published both online and offline. The books used as references in this paper are Plant Resources of South-East Asia No. 12 (1) and No. 19. Scientific articles research was obtained from Google scholar using the keywords *Blumea balsaminifera*, secondary metabolites of *B. balsaminifera*, and bioactivities of *B. balsaminifera*. The information synthesized to obtain comprehensive information to explain secondary metebolite and bioactivity of *B. balsaminifera*.

3. Results and discussion

3.1. Botany of *Blumea balsaminifera* (L.) DC

Blumea balsaminifera (L.) DC. sinonim with *Blumea apendiculata* (Blume) DC, *Blumea grandis* (Wallich) DC., *Blumea zollingeriana* C.B. Clarke [11], *Conyza balsaminifera* L., *Baccaris salvia* Lour., *Conyza appendiculata Blume* [1]. The vernacular of *B. balsaminifera* such as *galunggung* (Batak Simalungun), ngai camphor plant (English), *sembung* (Indonesia general), *sembung utan* (Sundanese), *sembungantung* (Javanese), chavor, *sembong* (Malaysia), sambong (Tagalog), *lakadbulan* (bikol), *poung ma-theing* (Myanmar), and *bai mat* (Cambodia) [11].

Blumea is estimated to have about 50 species and mostly distributed in tropical Asia from Sri Lanka to China, the Malesiana region and spread to West Africa, southern Australia, the Pacific as far as Hawaii. Species belonging *Blumea* are mostly found in the Philippines (19 species of which 4 are endemic), in Indonesia (18 species and 2 of them are endemic), New Guinea (13 species and 2 of them are endemic) and Peninsular Malaysia (6 species) [11]. The species contained in the genura *Blumea* are characterized by their phenolic content and 147 different compounds of the 12 *Blumea* species have been isolated [1].

Blumea balsaminifera is distributed from India, Urma, Indo-China, Southern China, Taiwan to Thailand, Malaysia, Indonesia and the Philippines [11]. Characteristics of *B. balsaminifera*: a shrub with a height of up to 4 m growing upright and a lot of hair on the trunk, the leaves are usually oblong-lanseolatus or sometimes oblong-vate or oblong-obovate. Leaves measuring 6-30 cm x 1.5-12 cm, oval in the basal area with flat, serrate, serulate to pinnata lobes. Capitula-shaped flowers found in the terminal or axillary section with a diameter of about 6-10 mm, peduncula length 3-10 mm, and involucru 7-9 mm long. Marginal flowers (edge flowers) up to 6 mm long, ith tube flowers 8-28 with a length of 5-7 mm. The fruit is an achene fruit with a length of 1 mm. PPaus flowers measuring 4-6 cm in length are whitish or reddish to yellow [11]. Bisexual tube flower. Achene fruit has 5 ribs with a length of about 1 mm, brown, short with hairs (Anguilar 1999). Can be found up to an altitude of 2200 m above sea level.

Blumea balsaminifera leaves contain about 5% volatile oil and the main component is borneol (25%) which is a compound that is closely related to camphor and readily excretes through the oxidation process [11]. Other compounds found in *B. balsaminifera* are 1,8-cineole, limonene, camphor, β-eudesmol, β-champene, and myrcene. *Blumea balsaminifera* contains flavonoids and sesquiterpenoids which have medicinal activity. In Vietnam, about 50 ton / ha *B. balsaminifera* are harvested annually to produce 50-200 kg of borneol [1]. For commercial purposes, the leaves are air-dried first [1]. The same is done by traders of medicinal plants in the Kabajahe market of North Sumatra [8]. The content of essential oil in young leaves of *B. balsaminifera* is the highest, followed by mature leaves and old leaves. The dominant type of essential oil in leaves is borneol, while in young shoots and stems is dimethoxy durene [9].

3.2. Uses and bioactivity of *Blumea balsaminifera* (L.) DC

In Southeast Asian countries, *B. balsaminifera* is used to treat a lot of diseases, especially those related to gastric disorders, anti-plasmodia, vermifuge and sudorific. The local communities in Philippines, it is used to treat kidney stones and has been commercialized. In Thailand, a cigarette containing *B. balsaminifera* dry leaves is believed to treat sinusitis and the ingredients and in combination with various other ingredients are used for postpartum maternal and baby bath ingredients [10]. *Blumea balsamifera* has long been used as traditional medicine for thousands of years. In

ethnobotany, *B. balsaminifera* is used to treat of wounds, indigestion, malnutrition, stomach disorders, headaches, sauna ingredients, and kidney stones. The bioactivity of *B. balsaminifera* includes anti-wound, anti-microbial, anti-cancer, anti-oxidant and anti-kidney stones and will be explained further.

3.3. Wound Healing

The use of *B. balsaminifera* as herbal medicine has been carried out since 2000 years ago in China, especially to treat wound healing [2,11]. Wounds occur due to tissue damage resulting in open tissue so that microbes can enter the body. Plants that are used for wound healing are plants that can form new tissue for wound closure. Pang et al. [11] said that *B. balsaminifera* has activity for wound closure. The essential oil of *B. balsaminifera* with a concentration of 1/5 and 1/10 BW improved contraction and wound closure. The wound closure occurs with an increase in collagen tissue formation and a decrease in the number of fibroblasts. In addition, *B. balsaminifera* oil increases capillary regeneration, blood circulation, collagen deposition, granular tissue formation, epithelial deposition, and wound contraction [11].

Mice given ointment containing flavonoids extracted from *B. balsaminifera* leaves have anti-wound activity [11]. Mice given high doses of high doses (2.52 g / kg), medium doses (1.26 g / kg), and low doses (0.63 g / kg) of total flavonoids from body weight for 10 consecutive days has significant improvement of granulation tissue, fibroblasts, and capillary proliferation from day 7 in the high-dose and positive control groups. The results showed that total flavonoids had a significant effect on healing rats' skin excision wounds compared to controls, especially high doses. Flavonoid glycosides have a therapeutic effect in wound healing by inducing neovascularization and chlorogenic acid has anti-inflammatory and wound healing activities [2].

3.4. Anti-Kidney Stone

The kidneys are organs that function to filter of blood. One of the common kidney disorders is kidney stones. In the Philippines, *B. balsaminifera* is used to treat kidney stones [7]. Kidney stones are constructed by various substances such as antibodies, proteins and minerals. The types of minerals that can form kidney stones include calcium oxalate monohydrate ($CaC_2O_4.H_2O$), calcium okasalate dihydrate ($CaC_2O_4.2H_2O$), calcium phosphate struvite ($MgNH_4PO_4.6H_2O$), and uric acid [12]). Calcium oxalate crystals are found in most kidney stones with calcium oxalate monohydrate (COM) as one of the main types of kidney stones [7]. The *B. balsaminifera* extract decreased the crystal size by 5.22% to 82.62% depending on the concentration. *Blumea balsaminifera* extract was observed to have decreased crystal size and prevent the aggregation of calcium oxalate crystals [7].

3.5. Gastroprotectif

Various compounds can cause tissue damage in the stomach and other digestive tracts. Gastroprotective is a term used for compounds that function to protect stomach tissue. Gastric disorders are caused by an imbalance of various factors (gastric acid and pepsin), and defense factors (mucus secretion, bicarbonate secretion, mucosal blood flow, and mucosal epithelium regeneration). This imbalance is caused by various factors such as drugs (nonsteroidal anti-inflammatory drugs, aspirin), infections (*Helicobacter pylori*), food, stress, smoking and alcohol consumption [13]. In laboratory experiments, aspirin was used to induce ulcers in gastric tissue [13,14] and sucralfate was used as a positive control [13]). Sucralfate is a compound used to cement gastric ulcers because it can prevent mucosal tissue damage by preventing an increase in the number of mast cells and mobilization of eosinophils [14].

The use of *B. balsaminifera* as a gastroprotective is used with a combination of other herbs such as *Glycyrrhiza glabra*, pulasari (*Alyxia reinwardtii*) [13], *Curcuma domestica*, *Amomum compactum* [14]. The experimental mice given *G. glabra* as much as 273 mg / kg BW and leaves of 457.5 mg / kg, and pulasari stem in various doses, namely 100 mg / kg BW, 200 mg / kg BW, and 300 mg / kg BW showed an effect. protection was demonstrated by a smaller number and smaller area of gastric ulcers compared with the aspirin group ($P < 0.05$). The mucosal damage score also decreased in the herbal extract combination group. The number of eosinophils and mast cells of the herbal combination group was observed to be smaller than the aspirin group [13].

The combination of *Curcuma domestica, Amomum compactum*, and *B. balsaminifera* has activity as a gastric ulcer drug in mice. Mice given the three combinations of these plants at a dose of 10 mg / 200 g body weight, 300 mg and 50 mg had a smaller area of gastric ulcers and were significantly different than the control (sucralfate). This shows that *B. balsaminifera* has potential as a gastroprotective. In laboratory experiments, gastric ulcers can be induced with aspirin 90 mg / 200 g body weight [14].

3.6. Antioxidant

Blumea balsaminifera has long been used as a traditional medicine in tropical and subtropical Asia [9]. *Blumea balsaminifera* leaves are rich in essential oils, especially on the young leaves. Essential oil on young leaves was highest (0.65 mL / 100 g), followed by mature leaves (0.57 mL / 100 g). *Blumea balsaminifera* essential oil content varied and was highest in October (0.47 mL / 100 g) compared to other months. The l-borneol is the main ingredient in leaves, and its contents are highest in old leaves and in December. In the essential oil of young shoots and young stems, the main component is dimethoxydurene [9]. Antioxidant compounds are compounds that function to counteract free radical activity. Free radicals are directly or indirectly associated with various types of diseases such as stroke and diabetes mellitus. Antioxidant activity can be determined using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) test and β-carotene (BCB) bleaching [9]. The results showed that β-carotene bleaching activity was much stronger than DPPH radical scavenging capacity, and young leaves and young shoots of *B. balsaminifera* showed stronger antioxidant activity. Dimethoxydurene, β-caryophyllene, and α-caryophyllene play a positive role in antioxidant activity, while β-eudesmol, phytol, and tetradecanal play a negative role [9].

3.7. Anti-cancer

Cancer is a disease caused by excessive cell division that interferes with metabolism in the body, therefore anti-cancer compounds are compounds that have activity to inhibit growth or result in cell death. The induction of cell apostosis resulting in cell death is one of the steps used in cancer therapy. Hasegawa et al. [15] stated that *B. balsaminifera* has apostosis-inducing activity so it is potential to be used as an anti-cancer.

3.8. Anti-Microbial

Various types of microbes (bacteria and unicellular fungi) are pathogenic, causing disease in humans. Compounds that function to inhibit growth or cause microbial cell death are called anti-microbes. The use of *B. balsaminifera* as an anti-microbial has been widely reported by Wang et al [16] and Ragasa et al. [6]. *Blumea balsaminifera* extract has activity as anti-bacteria Gram positive (*Staphylococcus aureus, Listeria monocytogenes*), anti-bacteria Gram negative (*Escherichia coli, Shigella flexneri, Salmonella enterica, Pseudomonas aeruginosa*) and anti-fungi (*Aspergillus flavus, Aspergillus brasiliensis, Trichophyton rubrum, Candida*) [16], *Aspergillus niger, Trichophyton mentagrophytes*, and *Candida albicans* [6]. The anti-microbial activity of the compounds produced from *B. balsaminifera* varies. For example, icthyothereol acetate has moderate activity against *Aspergillus niger, Trichophyton mentagrophytes,* and *Candida albicans*, while cryptomeridiol has low activity against *A. niger, T. mentagrophytes,* and *C. albicans* [6]. Icthyothereol and cryptomeridiol do not have antimicrobial activity of the bacteria *Psuedomonas aeruginosa, Staphylococcus aureus, Bacillus subtilis,* and *Escherichia coli* [6].

The ability of *B. balsaminifera* extracts as anti-microbial is strongly influenced by the type of compounds. The anti-bacterial activity of *B. balsaminifera* leaves is related to various types of (-) - borneol [16], while anti-fungal is related to icthyothereol acetate, cryptomeridiol, lutein, and β-carotene which function as anti-fungi [6]. Furthermore, Ragasa et al. [6] stated that icthyothereol acetate and cryptomeridiol did not have anti-bacterial activity against *Psuedomonas aeruginosa, Staphylococcus aureus, Bacillus subtilis,* and *Escherichia coli*.

4. Conclusion

- Ethnobotany *Blume balsaminifera* is used as a traditional medicine, including ingredients for *loloh* (Balinese Aga ethnic health drink), treat of wounds, diarrhea, malnutrition, kidney stones, and traditional sauna ingredients, headaches, gastric disorders, and rheumatism.
- *Blume balsaminifera* has bioactivity as anti-wound, anti-microbial, anti-cancer, gastroprotective, anti-oxidant, and anti-kidney stones.
- *Blume balsaminifera* leaves contain volatile oils and flavonoids in the form of borneol, 1,8-cineole, limonene, camphor, β-eudesmol, β-champene, myrcene, dimethoxydurene, β-caryophyllene, and α-caryophyllene.
- Dimethoxydurene, β-caryophyllene, and α-caryophyllene has antioxidant activity, flavonoid glycosides function in wound healing while borneol has anti-microbial activity.

Compliance with ethical standards

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