Open Access Research Journal of
Life Sciences
Journals home page: https://oarjpublication/journals/oarjls/
ISSN: 2783-025X (Online)

OARJ OPEN ACCESS RESEARCH JOURNALS

(REVIEW ARTICLE)

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Cananga odorata (Lam.) hook. f. & Thomson (uses and essential oils)

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Open Access Research Journal of Life Sciences, 2023, 05(01), 073–079

Publication history: Received on 16 January 2023; revised on 08 March 2023; accepted on 10 March 2023

Article DOI: https://doi.org/10.53022/oarjls.2023.5.1.0016

Abstract

Cananga odorata (Annonaceae) has been long used as an ingredient in aromatherapy, cosmetics and traditional medicine. This study aims to explain the relationship between the utilization and content of *C. odorata* essential oil so that its potential can be developed. The research method uses a literature review of research results or scientific articles published online using the keywords *C. odorata*, essential oil of *C. odorata* and *C. odorata* bioactivities. Indonesian local communities use *C. odorata* as a decoration, traditional medicine, ritual material, and a source of aromatherapy. The bioactivity of *C. odorata* includes inhibiting the growth of bacteria/fungi, inhibiting the growth of mosquitoes, anti-hepatitis, overcoming kidney disorders and herbal teas. The utilization of *C. odorata* is related to the content of its secondary metabolites, especially its essential oil. Each organ *C. odorata* contains essential oils, especially -caryophyllene, but the types and levels vary. The *C. odorata* content of essential oil is mostly found in flowers. The compounds O-Methylmoschatoline, liriodenine and 3,4-dihydroxybenzoic acid are essential oils that have antibacterial activity. Empirically, it can be seen that the extract or aroma of *C. odorata* is used as an additive in cosmetics related to skin care such as shampoo, soap, face tonic, perfume, body lotion, powder, and face mask, which is suspected to be related to its anti-microbial activity.

Keywords: *Cananga odorata*; Essential oil; Anti-bacterial; Jakarta

1. Introduction

Cananga odorata is one of the species in the Annonaceae that is easy to find in Indonesia, especially in the yard. This plant is used as an ornamental plant and its flowers are widely used as materials for rituals because it has a fragrant aroma. Empirically it can be seen that *C. odorata* flowers have long been traded in various traditional markets which are used for various ritual ceremonies as well as for beauty and flowers for grave pilgrimages. This shows that *C. odorata* is very potential for developing economic commodities. Silalahi and and Wahyuningtyas [1] reported that *C. odorata* flowers are used as one of the ingredients for offerings in the babad dalan ceremony (a ritual of cleaning the road as an expression of gratitude for the harvest) in Gunungkidul (Figure 1).

Besides being used as decoration and rituals, local Indonesian people have long used *C. odorata* as a construction material, furniture, cosmetics, perfume, and traditional medicine [2]. In traditional medicine, *C. odorata* is used to treat malaria, gastric disorders, asthma, gout, and rheumatism [3]. Empirically, it can be seen that the extract or aroma of *C. odorata* is used as an additive in cosmetics related to skin care such as shampoo, soap, face tonic, perfume, body lotion, powder, and face mask, which is suspected to be related to its anti-microbial activity. In its use, *C. odorata* is usually mixed with other materials. Tan et al [3] reported that *C. odorata* is one type of plant that is exploited on a large scale because its essential oil is an important raw material for the pharmaceutical/cosmetic industry [3], which directly or indirectly has implications for its preservation.

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Figure 1 *Cananga odorata* flower as one of the components for the Babad Dalam ritual by the local community of Gunungkidul, Yogyakarta

The use of *C. odorata* as a traditional medicine is associated with the content of its secondary metabolites. From our search results, the activity of *C. odorata* as an antimicrobial is more prominent than others. Various studies have reported the bioactivity of *C. odorata* as an antimicrobial such as Toghueo et al [4], Maulidya et al [5], Rahman et al [6] and Hastuti et al [7]. Maulidya et al [5] reported that *C. odorata* essential oil extracted from flowers had antibacterial activity. *Cananga odorata* showed anti-hepatitis B activity with an inhibitory concentration of 50% (IC50 = 56.5 g/ml) [8]. Empirically, it can be seen that *C. odorata* flower organs are used more than other parts, this is thought to be related to differences in the content of secondary metabolites, especially essential oils. Until now in-depth studies on botany, bioactivity and *C. odorata* essential oil are still limited, therefore this study was carried out so that the potential for its utilization could be increased.

2. Methods

The writing of this article is based on a literature review on various research results or scientific articles published online. Some of the keywords used in the search for scientific articles are *C. odorata*, *C. odorata* essential oil and *C. odorata* bioactivities. The results obtained were synthesized to obtain comprehensive information about botany, benefits and bioactivity of *C. odorata*.

3. Results and discussion

3.1. Botany of Cananga odorata (Lam.) Hook.f. & Thomson

Annonaceae is a family of the order Magnoliales which has a habit of trees, shrubs, and lianas. The Anonaceae family has about 130 genera and c. 2500 species [9]. Cananga odorata is one of the species that is widely used as a source of essential oil and also as an ornamental plant. *Cananga odorata* (Lam.) Hook.f. & Thomson (Annonaceae) is a tree native to the tropical Indo-Pacific. It has long been cultivated for its strong fragrant flowers and is widely grown in the tropics, including in plantations for the production of essential oils. The species and genus have a long and somewhat confusing nomenclature history which has not been resolved [10].

Description: *C. odorata* is a medium-sized tree 10–40 m in height, though rarely above 30 m, and usually 10–20 m. In cultivation, trees are usually kept short by pruning about 3 m. The branches are pendulous or slightly erect with drooping and leafy branches. The tree is usually somewhat ruffled, often with long-leafed branches that hang 3–6 m. There is one main stem which is usually slightly bent. The skin is smooth and grayish white to silver. The leaves are dark green, up to 20 cm long, alternate, simple, entire, with an elliptic-oblong shape, slightly pubescent, and with a prominent midrib and drip tip. As with most members of this family, the leaves are arranged mainly along a plane. Flowers It flowers all year round in axillary hanging, umbellate flower clusters 4-12. The flowers have three sepals and six petals up to 8 cm long. The petals are bent when young, then limp and drooping as adults. The flowers are very fragrant, greenish yellow at first, then turn dark yellow/brown as they mature. The trees flower all year round, but especially during the rainy season from November to March. Fruit Greenish black, 1.5-2.5 cm (0.6-1.0) long, bearing 6–12 stalk leaflets, fleshy, olive-like, and borne in axillary clusters. There are 6–12, small, pale brown, ovoid seeds in each fruit

[2,11]. This species is accepted, and its native range is Malesia to Queensland. It is used to treat unspecified medicinal disorders, as animal food, a medicine and invertebrate food, has environmental uses and social uses and for fuel and food [12].

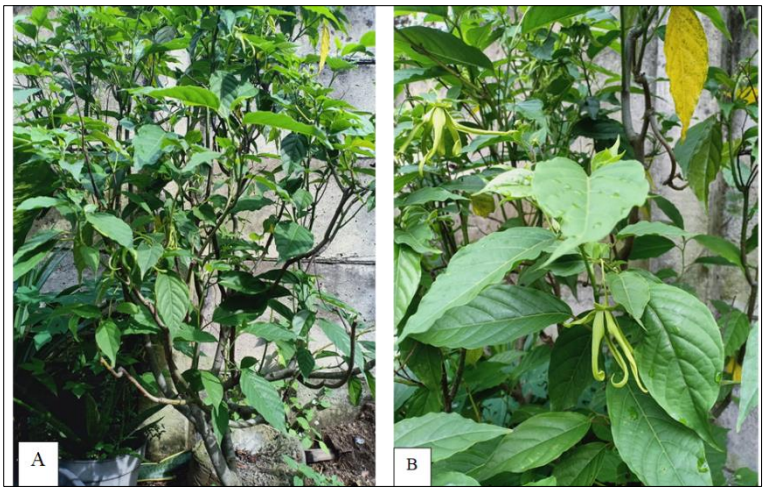

Figure 2 *Cananga odorata*. A. Habits. B. Branches that support leaves and flowers

3.2. Uses and Bioactivity

Cananga odorata has long been used as a medicinal ingredient and in the pharmaceutical/cosmetic industry. Empirically, it can be seen that the extract or aroma of *C. odorata* is used as an additive in cosmetics related to skin care such as shampoo, soap, face tonic, perfume, body lotion, powder, and face mask. The following will explain further the use of *C. odorata* as an anti-microbial, overcoming kidney disorders, anti-hepatitis, inhibiting mosquito growth and herbal tea ingredients.

3.2.1. Anti-microbial

Exploration of natural materials for antimicrobials continues to be carried out to obtain alternative compounds that are able to inhibit or kill microbes including *C. odorata*. *Cananga odorata* essential oil is extracted from flowers and is known as a source of antibacterial compounds [5]. Antimicrobial compounds can be applied as antibiotics and skin care. The bioactivity of *C. odorata* as an antimicrobial has been reported by Toghueo et al [4], Maulidya et al [5], Rahman et al [6] and Hastuti et al [7]. Compounds isolated from the bark that have antibacterial properties are O-Methylmoschatoline, liriodenine and 3,4-dihydroxybenzoic acid which inhibit the growth of Gram positive and negative bacteria and inhibit the growth of fungi [6].

The bioactivity of *C. odorata* extract as an antimicrobial varies depending on the compound used for extraction, concentration and type of bacteria. *Cananga odorata* essential oil was able to inhibit the growth of *Staphylococcus aureus* (Gram positive) but was unable to inhibit the growth of *Escherichia coli* (Gram negative) bacteria [5]. This difference is thought to be due to differences in the structure of the cell walls of Gram positive and Gram negative bacteria. The bioactivity of *C. odorata* as an anti-bacterial is thought to be related to the content of endophytic fungi [7]. Endophytic microbes isolated from samples of leaves, stems, bark, roots, and flowers of *C. odorata* have enzymatic activity of amylase, cellulose, lipase, and lacquers [4] which are thought to be able to damage bacterial cell walls [7].

3.2.2. Anti-hepatitis

Hepatitis is inflammation of the liver organs caused by viral infections such as hepatitis B virus which causes liver cirrhosis and hepatocellular carcinoma. *Cananga odorata* showed the highest anti-hepatitis B activity with an inhibitory concentration of 50% (IC50) of 56.5 g/ml and a cytotoxic concentration of 50% (CC50) of 540.2 g/ml [8].

3.2.3. Medicine of Kidney Disorder

Kidneys are organs that function to filter blood. Consumption of various drugs or other chemical compounds can cause kidney problems. Juliastuti et al [13] reported that administration of *C. odorata* flower extract in experimental animals improved renal vasculature triggered by age of menopause. The diameters of Bowman's capsule and renal glomerulus were significantly higher in the group treated with *C. odorata* flower extract compared to the control group. *Cananga*

odorata flower extract triggered endothelial cell repair, but increased intima thickness and renal hyperplasia in mice. Thus, ylang flower extract and improve renal vascularity are triggered by menopause age [13].

3.2.4. Inhibits the growth of Aedes aegypti

Dengue hemorrhagic fever (DHF) is a disease caused by *Plasmodium* sp. which is spread by *Aedes aegypti* [14,15]. Eradicating *A. aegypti* is one of the effective steps to treat DHF [14]. Decoction of *C. odorata* flowers resulted in the death of *A. aegypti* larvae significantly at a concentration of 90% and 100% concentration [15]. The bioactivity of *C. odorata* in inhibiting the growth of *A. aegypti* is thought to be related to the content of its secondary metabolites, especially essential oil. *Cananga odorata* flower extract is more potent biolarvicide against *A. aegypti* than other organs [14]. The content of *C. odorata* flower is essential oil of saponins, flavonoids and polyphenols and contains linalool, geraniol and eugenol [15]. *C. odorata* flower essential oil prevents oviposition, ovicidal, insecticidal, and repellent activity against *A. aegypti*. A concentration of 10% *C. odorata* showed a high effective percent repellency against oviposition at 99.4% for *A. aegypti* [16].

3.2.5. Tea Herbal

Tea has long been used as a refreshing drink as well as for health purposes. Empirically seen that most teas have a distinctive aroma that gives a relaxing effect. Various types of plants have long been processed into tea such as *Camelia sinensis*, *C. odorata* and *Rosella*. The herbs are usually made from plant parts such as leaves, flowers, seeds, roots and bark which are brewed with boiling water. The composition of tea with the formulation of *Ocimum basilicum* leaves with the addition of flower *C. odorata* and *Stevia* leaves has a good organoleptic aroma and taste with the best consumer acceptance in comparison (*O. basilicum* = 2g; *C. odorata* = 0.4g; *Stevia* sp. = 0.7g) [17].

3.3. Essential Oils

Essential oils are odorless and volatile compounds only and only about 10% of the plants that produce them are stored in plants in special fragile secretory structures, such as glands, secretory hairs, secretory ducts, secretory cavities or resin ducts [18]. Based on their constituent compounds, essential oils are grouped into hydrocarbons, esters, oxides, lactones, alcohols, phenols, aldehydes, and ketones [18]. Each of these compounds has different volatile properties, namely volatile monoterpenes and sesquiterpenes, less volatile diterpenes, and non-volatile triterpenes and sterols [19]. *C. odorata* essential oil is widely used in the pharmaceutical and cosmetic industries, especially from the flower organs [20-22]. The characteristic *C. odorata* aroma produced by *C. odorata* is related to linalool and α-caryophyllene [23]. Besides being used in the cosmetic industry, *C. odorata* is also widely used in the food industry [24] because it can improve the taste.

The essential oil content in *C. odorata* fractions varies depending on the stage of development, processing, harvesting and compounds used in extraction. As much as 85% of the composition of fresh flower extract *C. odorata* contains essential oil which is represented by compounds with sesquiterpenes content 1.5 – 2 times lower than the concentration of monoterpenes [25]. In general, the main components in *C. odorata* essential oil are -caryophyllene, germacrene-D, linalool and humulene [25] and these levels can change according to the stage of development, especially in flowers.

Other factors that affect the type and concentration of *C. odorata* essential oil are *C. odorata* flower picking time [5] and distillation method [21]. The percentage of linalool compound produced by steam distillation method is relatively larger than other isolation methods so that the aroma of *C. odorata* essential oil produced is sharper [21]. *C. odorata* essential oil was around 0.48% - 0.73% and picking time in the morning had the highest caryophyllene component (29.60%), while in the afternoon picking (14.97%) [5]. The essential oil produced from the hydro distillation process for 1 hour mainly contains geranyl acetate, benzyl benzoate, β-caryophyllene, germacrene D, and farnesol [26].

Each organ *C. odorata* contains essential oils but the types and levels vary. Volatile organic compounds of *C. odorata* are mostly grouped as hydrocarbons, esters, alcohols, aldehydes, phenols, acids, ketones, and ethers, and the main compound is -caryophyllene (15.05% -33.30%) [27]. Large amounts of volatile oil *C. odorata* were detected in the middle of flower development, and more hydrocarbons, esters, and alcohols were identified at the full flowering stage [27]. The main components of *C. odorata* flower essential oil are: β-caryophyllene, benzyl benzoate, caryophyllene oxide, germacrene [28], α-humulene, germacrene D, (E, E) -α-farnesene, (E, E)-farnesol and benzyl benzoate [23]. The *C. odorata* leaf extract contains two aryl naphthalene lignan diesters from canangafruticoside A and one cyclobutane lignan diester from canangafruticoside A [29]. *C. odorata* leaf essential oil is linalool, linalool acetate (16,14%), α-pinene (12,73%), eugenol (8,86%) dan α-terpineol acetate (7,71%) followed by isobornyl acetate (3,56%), α-terpineol (3,46%), and camphor (3,23 [30]. Although all *C. odorata* organs contain essential oils, the types vary from one organ to another (Tabel 1).

Table 1 Essential oil content in various organs of *C. odorata* [3]

Flowers	1,8-Cineole, Camphene, Geraniol, Geranyl acetate, Limonene, Linalool, Neral, Nerol, Neryl acetate, Plinol a, Plinol d, trans-Linalool oxide acetate, trans-*β*-Ocimene, *α*-Pinene, *β*-Myrcene, *β*-Pinene, (E,E)-Farnesol, (E,E)-*α*-Farnesene, (2E,2Z)-Farnesal, (2Z,6E)-Farnesyl acetate, 1,10-diepi-Cubenol, 1H-Indole, 1-epi-Cubenol, 5-Indanol, Bicycloelemene, Calamene, Caryophyllene oxide, Cedrol, Copaborneol, Cyperene, Germacrene D, Guaiol, Isogermacrene D, Jejunol, Levoglucosenone, Selina-4(15),5-diene, t-Muurolol, trans-Nerolidol, Zonarene, *α*-Amorphene, *α*-Bisabolol, *α*-Cedrene, *α*-Copaene, *α*-Humulene, *α*-Ylangene, *β*-Bourbonene, *β*-Caryophyllene, *β*-Cubebene, *γ*-Muurolene, *δ*-Cadinene, *ε*-Cadinene, *τ*-Cadinene, *τ*-Cadinol, *τ*-Muurolene, (2E,6E)-Farnesyl acetate, (E)-Hex-2-enol, (Z)-Hex-3-enol, 2-Hexenyl acetate, 2-Methyl-3-buten-2-ol, 3-Hexenyl acetate, 3-Methyl-2-buten-1-ol, 3-Methyl-2-buten-1-yl acetate (prenyl acetate), Benzyl alcohol, Decane, Diethyl 1,5-pentanedioate, Dodecane, Methyl 3-methylbutanoate, Methyl caprylate, Heptanal, Tetracosane, Tricosane, Undecane, (E)-Cinnamyl acetate, 1,4-Dimethylbenzene, 1-Methoxy-1-propylbenzene, 1-Phenyl-2-propen-1-ol, 1-Phenylallyl acetate, 2-Methoxy-4-methylphenol, 2-Phenylethyl acetate, 3,4-Dimethoxytoluene, 3-Buten-2-ol benzoate, 3-Hexen-1-ol benzoate, 3-Methyl-2-buten-1-yl benzoate, 4-(2-Propenyl)-phenol, 4-Allyl-phenyl-acetate, 4-Methoxy benzaldehyde, 4-Methoxyphenyl acetate, Anethol, Benzyl acetate, Benzyl benzoate, Benzyl salicylate, Benzylaldehyde, Benzyl-n-butyrate, Butyl benzoate, Cinnamyl alcohol, Ethyl benzoate, Isoeugenol, Methoxyphenol, Methyl benzoate, Methyl-2-methoxybenzoate, Methyl-4-methoxybenzoate Methyleugenol, p-Cresyl methyl ether (p-methylanisole), p-Vinyl-guaiacol, Vanillin, Veratrole, Phenylacetonitrile, 2-Phenyl-1-nitroethane, Methyl anthranilate.
Leaves	(E)-*β*-Ocimene, (Z)-*β*-Ocimene, 1,8-Cineole, Bornyl acetate, Camphene, Geraniol, Limonene, Linalool, Linalyl acetate, Myrcene, p-Cymene, Sabinene, Terpinen-4-ol, Terpinolene, *α*-Phellandrene, *α*-Pinene, *α*-Terpinene, *α*-Terpineol, *α*-Thujene, *β*-Phellandrene, *β*-Pinene, *γ*-Terpinene, (E,E)-Farnesal, (E,E)-Farnesol, (E,Z)-Farnesal, Aromadendrene, Bicyclogermacrene, Caryophyllene epoxide, Caryophyllene oxide, Germacrene D, Globulol, Spathulenol, t-Cadinol, Viridiflorol, *α*-Amorphene, *α*-Bulnesene, *α*-Cadinol, *α*-Copaene, *α*-Cubebene, *α*-Gurjunene, *α*-Humulene, *α*-Muurolene, *α*-Ylangene, *β*-Bourbonene, *β*-Caryophyllene, *β*-Copaene, *β*-Cubebene, *β*-Elemene, *γ*-Cadinene, *δ*-Cadinene, *δ*-Cadinol, *δ*-Elemene, (E)-Hex-2-enal, (E)-Hex-2-enol, (Z)-Hex-3-enol, n-Hexanol
Fruits	(E)-*β*-Ocimene, (Z)-*β*-Ocimene, 1,8-Cineole, Limonene, Myrcene, p-Cymene, Sabinene, Terpinen-4-ol, Terpinolene, Thujanol, *α*-Phellandrene, *α*-Pinene, *α*-Pyronene, *α*-Terpinene, *α*-Terpineol, *α*-Thujene, *β*-Pinene, *γ*-Terpinene, Germacrene D, *β*-Caryophyllene, *γ*-Muurolene, n-Hexanol

4. Conclusion

- The local people Indonesian have been used *C. odorata* as decoration, traditional medicine, ritual material, and source of aromatherapy.
- *C. odorata* bioactivities include inhibiting the growth of bacteria/fungus, inhibiting the growth of mosquitoes, anti-hepatitis, overcoming kidney disorders and herbal teas.
- The organ *C. odorata* contains essential oil, especially β-caryophyllene, but the types and levels vary. The *C. odorata* content of essential oil is mostly found in flowers.

Compliance with ethical standards

Acknowledgments

Thanks to the Universitas Kristen Indonesia for providing funds to carry out this research.

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