ReviewArticle

Jasmine(*Jasminumsambac*(L.)Aiton):PotentialUtilizationandBioactivity

Abstract

Jasminumsambac(Oleaceae)isamulti-functionalplantthatisusedasdecoration,traditional medicine, and a source of essential oil. This study aims to explain the botany,bioactivityandessentialoilof*J.sambac*.Theresearchmethodwithonlinelibraryresea rch is mainly sourced from Google Scholar using the keywords *J. sambac*, uses of *J.sambac*and *J. sambac*essential oil. The essential oil of *J. sambac*is one of the mostexpensiveoilsusedinthecosmetic,pharmaceutical,perfumeryandaromatherapyindus tries. In traditional medicine *J. sambac*is used to treat dysmenorrhea, menorrhea,ringworm,leprosy,skindiseases,analgesic,antidepressant,anti-inflammatory,antiseptic, aphrodisiac, sedative, expectorant, fever, pain and inflammation and cancer.Thebioactivityof*J.sambac*istosuppresslactation,analgesic,anti-microbial,antioxidant, anti-cancer, anti-hypertensive, treat wounds, treat ulcers. The distinctivearoma of *J. sambac*flowers is related to the content of essential oils, namely linalool, α-farnesene, d-nerolidol, geraniol, α-cadinol, benzyl alcohol, benzaldehyde, benzyl acetate,benzylbenzoate, 3-hexen-1-ol benzoate, and(Z)-3-hexen-1-ol acetate. The bioactivityof *J. sambac*as an anti-microbial can be developed as a natural food preservative andalsotokeep thebodyfresh.

Keywords:*Jasminumsambac*,anti-microbial,linalool

Introduction

Jasmine or *J. sambac*is a multi-functional plant that is easy to find in Indonesiaand is often used as an ornamental plant in the yard. Even though*J. sambac*is notindigenous to Indonesia, this plant has cultural values attached to the various ethnicitiesused for ritual materials, "tea", and wedding decorations. The *J. sambac*is used as themaincomponent in ritual ceremonies such as the BabadDalanritual(Figure 1)byethnic Javanese in GunungKidul, Indonesia [1]. Empirically it can be seen that *J. sambac*has long been traded in various traditional and modern markets so that it plays a role inimprovingtheeconomy.Jasminehasanoptimisticandpotentialmarketpotentialby

Indonesiabyseekingthequalityofwhitejasmineflowersinaccordancewiththerequirements desiredbyexportdestinationcountries[2].

Figure 1. A. Offerings in the Babad Dalan ceremony in Giring Village, GunungKidul (*J.sambac*asoneofitscomponents.

The *J. sambac*has the most significant economic value because it has a refreshingfragrancethatiswidelyusedinvariousindustries[3],food,cosmeticsorotherchemicals[4,5].Thesecompounds(methylanthranilateand(R)-(−)-linalool)weredetermined as the main aroma of jasmine tea flavor [5]. Younis *et al* [6] stated that *J.sambac*essentialoilisoneofthemostexpensiveoilsusedinthecosmetic,pharmaceutical,perfumeryandaromatherapyindustries.

Besides being used in various industries, *J. sambac*flowers have been used astraditional medicine in Asia to treat various diseases, including dermatitis, diarrhea, andfever [7]. The ethanol extract of *J. sambac*is becoming a source for obtaining new andeffective herbal medicines to treat infections against various infectious diseases [8]. Theuse of *J. sambac*as a traditional medicine is related to its bioactivity. The extract of *J.sambac*hasanti-inflammatory,analgesic,andantipyreticactivitiesrelatedtoitssecondarymetabolites,especiallyhesperidin[9].Essentialoilcompoundshavetherapeuticpropertiesandcanbeusedasanalgesics,antidepressants,anti-

inflammatories, antiseptics, antispasmodics and stimulants [6]. Empirically it appearsthat local Indonesian people have long used *J. sambac*as both traditional and culturalmedicine,butin-depthstudiesof*J.sambac*havenotbeenfoundmuch.Thisstudyaimsto explain the botany, utilization and *J. sambac*essential oil in a comprehensive mannerso thatthepotentialforitsutilizationcanbeincreased.

Methods

The method used in this research is a literature study. Literature is obtained online,mainly sourced from Google Scholar using several keywords such as *J. sambac*, uses of *J.sambac*and *J. sambac*essential oil. The information obtained is synthesizedso that itcanexplainthebotany,utilizationand essentialoilsfrom*J. sambac*.

ResultsandDiscussion

1. Botanyof*Jasminumsambac*(L.)Aiton

TheOleaceaehasabout28generaand900species[10].*Jasminum*L.isthelargest genus containing 200 species [10-12]. Jasminum is native to tropical and warmclimates in Eurasia, Australasia, and Oceania [11]. *Jasminum sambac*is a species thathasbeencommercializedandiswidelyusedinthepharmaceuticalandbeautyindustries. *Jasminum sambac*originates from tropical and sub-tropical regions [13]. Thedistribution of the genus is wide but most of the species are centered in India, China andMalaysia. The *J. sambac*is native to the East Himalayas and India, while in Indonesia it is anintroducedplant,buthaslongbeencultivated[14].

The *J. sambac*has a perennial shrub habitus that propagates with a height ofabout 0.3 – 2 m. The stem is brown, woody, round to rectangular in shape, knuckles andbranches as if clumping. Single leaf and located opposite (Figure 2A). The petioles is short, the lamina is ovoid with 2.5–10 cm x 1.5–6 cm. The apex acuminates, rounded base. Leaf veins pinnate, prominent on the under surface andglossy green leaf surface. The inflorescence located axillary (in the armpits of theleaves). In one flower base will grow 3 flowers at once, so it will look solid (Figures 2Band C). The arrangement of the crown is single or double (stacked), fragrant, but sometypes of jasmine flowers have no fragrance. Petals numbered 4-9 pieces. Stamens are 2in number with very short filaments. This flower also has 4 ovules and 2 stamens orloculus[15].

Figure2.*Jasminumsambac*.A.Habitusandoppositeleaves,B.Twigswithflowering,C.Flowersw ithwhitecorolla.

2. UsesandBioactivities

Natural products are increasingly in demand because this system is pollutionfree, less toxic and without side effects [13]. Extract from *J. sambac*flowers can be astrongantioxidant,bleach,andnon-toxicmaterialthatcanbeusedinthepharmaceutical,cosmetic,andfoodindustries[16].Traditionally*J.sambac*isusedto

treatdysmenorrhea,amenorrhea,ringworm,leprosy,skindiseases,analgesic,antidepressant, anti-inflammatory, antiseptic, aphrodisiac, sedative, expectorant [13],fever, pain and inflammation [9,17], and cancer [19]. The following will explain in moredetailthebioactivityof*J.sambac*tosuppresslactation,analgesic,anti-microbial,antioxidant,anti-cancer,anti-hypertensive,treatwounds,and treatulcers.

SuppressesLactation

Theessentialoilof*J.sambac*flowersisusedasperfumeandanti-lactation[19,20].Bromocriptine(astandarddrugtotreatprolactintoohigh)and*J.sambac*flowers resulted in a significant reduction in serum prolactin, a significantly greaterreduction with bromocriptine. The reduction of breast swelling, milk production andintake of *J. sambac*flower analgesics and Bromocriptine are equally effective. Jasmineflower seems to be an effective and inexpensive method to suppress puerperal lactation[18]. The ethanol extract of *J. sambac*root has anti-inflammatory, analgesic, and anti-pyreticactivity[9].

Analgesic

The ethanol extract of dry leaf *J. sambac*has analgesic activity [9,17,21,22]. The *J.sambac*floralalcoholextract(400mg/kgbodyweight)significantlyreducedcarrageenan-induced edema formation. Acetic acid-induced writhing rats, extracts andfractions had a good analgesic effect which was marked by a decrease in the number ofwrithes comparable to Diclofenac sodium (standard drug) [17]. The extract of dry leaf *J.sambac*produced significant inhibition of acetic acid-induced writhing in rats at oraldoses of 250 and 500 mg/kg body weight comparable to the standard drug diclofenacsodium (25 mg/kg body weight) [21]. Its bioactivity as an analgesic is related to itssecondary metabolites, especially its hesperidin [9]. The ethanol extract of *J. sambac*leaves contains flavonoids, phenols, saponins, tannins and hesperidin [9]. The *J. sambac*leaf ethanol extract significantly inhibited adjuvant-induced arthritis and also showedsignificant antipyretic effect [9]. Jasmine root methanol extract (200 and 400 mg/kg) issimilar to standard drugs such as Buprenorphine (0.05 mg/kg subcutaneously) andAspirin(100mg/kgintraperitoneally) [22].

Anti-microbial

Antimicrobialcompoundsarecompoundsthatinhibitthegrowthofmicroorganisms. *J. sambac*is widely used as a traditional medicine in India for skindisorders soitisverypotentialtobedevelopedasanantibiotic[23].The*Malassezia*sp.

cause skin diseases such as pityriasis versicolor, folliculitis, and tropical dermatitis [24].The microbial pathogenic in human such as: bacteria (*Bacillussubtilis, Bacilluscereus,Staphylococcusaureus,Escherichiacoli,Pseudomonasaeruginosa*)and fungi(*Aspergillusniger,Aspergillusflavus,Candidaalbicans*)[8]. The bioactivity *J. sambac*as an antimicrobial is more prominent than otheractivities. *J. sambac*can be used as an alternative treatment against skin infections suchas Malassezia [24].The essential oil of *J. sambac*and methanol extract showed betteractivityagainstbacterialspeciesthanagainstyeast[25].

The extract *J. sambac*inhibits the growth of bacteriasuch as*Escherichia coli*[8,11,23,26],*Staphylococcusaureus*[8,11,26],*Pseudomonasaeruginosa*[8,11,26],*Staphylococcus albus, Proteus mirabilis, Salmonella typhi*[23], *Bacillus subtilis* [8,26],*Bacillus*sp.,*Streptococcus*sp.,*Salmonella*sp.,*Pseudomonas*sp.,*Serratiamarcescens,Klebsiella pneumonia* [11], and *Bacillus cereus* [8]. In addition to inhibiting bacteria, *J.sambac*also inhibits the growth of fungi such as*Aspergillus niger, Candida albicans*[8,26], *Aspergillus flavus* [8], and *Trichophyton mentagrophytes* [26]. The bioactivity of *J.sambac*as an anti-microbial varies depending on various factors, namely the organsused[24]andthetypeofessentialoil[26].

Methanol extract of flowers, leaves and essential oil of*J. sambac*flowers hadantifungal activity with inhibition zones of 11.10 ± 1.92, 12.90 ± 1.68, and 13.06 ± 0.26mm respectively [24]. The compounds caryophyllene oxide, benzyl benzoate, farnesylacetate, and methyl isoeugenol showed moderate activity against *P. aeruginosa* and *A.niger*, and mildle activity against *E.coli, B. subtilis, C. albicans,* and *T. mentagrophytes*.The compoundmethylisoeugenolhaslittleactivityagainst*S.aureus*[26].Theextractof *J.sambac*containsalkaloids,glycosides,flavonoids,terpenoids,tannins,resins,andsalicylic acid [23]. The ethanolextract of *J. sambac*leaves was higher than the highestformoderateethylacetate,petroleumetherandchloroformagainstbacterialstrains[8]. The phytochemical content of the extract is influenced by the solvent used whichresults in differences in alkaloids, flavonoids, tannins, saponins, glycosides, steroids andterpenoids[8].

Antioxidant

Antioxidantcompounds are compounds that are able toinhibitfree radicals.Antioxidant test was measured with 2,2-diphenyl-1-picrylhydrazyl (DPPH) scavenger,ferricreducingantioxidantpower(FRAP)and2,2'-azino-bis(3-

sulphonic acid) (ABTS)-reducing [27]. The antioxidant properties of Jasminum can bedevelopedasanaturalpreservativeforfoodandpharmaceuticalproducts[28]andasan anti-depressant [19]. *J. sambac*extract fermented with *Lactobacillus rhamnosus*caneffectivelyrepairUVB/H2O2-inducedagingskincellsandcanbeconsideredasapromising ingredient in skin aging therapy [7]. *Jasminum sambac* flowers will functionasstrongantioxidant propertiesagainstfreeradicals[28,29].

Free radicals can stimulate skin aging through antioxidant system destruction,wrinkle formation, and melanogenesis [27]. The *J. sambac*has anti-aging activity related toits activity as anantioxidant so that it can bedeveloped asherbal anti-aging agent[27]. Concentrations of antioxidants and several pro-oxidative enzymes in the humanbrainarethoughttobeinvolvedindepression[19].Reducingoxidativestresscorrelatedwithantidepressanttreatmentandledtoclinicalrecoveryofmoderatedepression[19].

The bioactivity of *J. sambac*as an antioxidant is influenced by dose [29]. Theyoung leaves showed a moderate reducing effectin sequence againstDPPH radicals(122g/mL),nitricoxide(173.94g/mL)andhydrogenperoxide(125µg/mL)whencompared to ascorbic acid [19]. The essential oil of *J. sambac*has antioxidant activitywhich was tested by DPPH and β-carotene-linoleic acid free radical scavenging testscompared to Butylated hydroxytoluene (BHT) (positive control) [25]. Increasing theactivity of hyaluronidase, elastase and collagenase causes skin aging [27]. Anti-agingproperties are measured through the inhibitory activity of collagenase, elastase, andhyaluronidase [27].

Thebioactivityof*J.sambac*asanantioxidantisrelatedtoitsbioactivecompounds. *J. sambac*showed the presence of low levels of phenols, triterpenoids, andflavonoids, and high levels of terpenoids [27]. The main compounds identified from themethanolextractof*J.sambac*flowerswereα-farnesene,nerolidol,benzylalcohol,linalool, benzaldehyde, and α-cadinol [28]. The antioxidant bioactivity of young leaves isthoughttoberelatedto thecontentofalkaloids,glycosides,tanninsandflavonoids[19].

Anti-cancer

Anti-cancer compounds are compounds that inhibit excessive cell division. The *J.sambac*has an anticancer effect which was tested in albino rats [29]. The activity ofinhibiting tumor cell proliferation of methanol extract of *J. sambac*flowers was dose-dependentonHeLafibroblastcellsatconcentrationsof25-400µg/ml[29].

Anti-hypertension

*Jasminum sambac*is a South Asian folkloric medicinal plant that has traditionallybeen used to treat cardiovascular problems [30] such as hypertension. The extract ofraw *J. sambac*leaf produced ex-vivo vasorelaxant effects in endothelial intact aortic ringpreparations and hypotensive effects [30]. Oral administration of ethanol extract of *J.sambac*flowers to rats causes a vasodilatory effect on the rat aorta [31]. Jasmine flowerextractin0.05% dimethylsulfoxide(DMSO) markedlyreducedthe toneofisolatedthoracicaorticendotheliumringpre-constrictedwithphenylephrine(10^{-6}M),asadose-dependent manner [31]. The vasorelaxant and cardioprotective effects are thoughttobeviaactivationofmuscarinicreceptors,releaseofnitricoxide,andreducedadrenaline[30].

Anti-ulcers

The ethanol extract of *J. sambac*has a gastroprotective effect against acidifiedethanol-induced gastric ulcers in rats. In the laboratory, ulcers in rats can be inducedwithcarboxymethylcellulose.Theethanolextractof*J.sambac*showedsignificantprotection against gastric mucosal injury showing a significant reduction in ulcer area(compared to the standard compound omeprazole). Histology showed reduced edemaand leukocytes,significant submucosal infiltration[32].

CureofWounds

Wounds are one way for pathogenic microbes to enter the body, and to healwounds, new tissue formation is needed. Water and ethanol extracts of *J. sambac*leavesin the form of an ointment (200 mg/kg BW and 400 mg/kg BW) have wound healingactivityinrats.Theaqueousextracthasshownasignificantincreaseinwoundcontraction, hydroxyproline content and decreased period of epithelialization in theexcisionwoundmodelcomparedtothe ethanolextract[33].The increasedwoundhealing activity of aqueous extracts may be due to the action of free radicals and theantibacterial properties of the phytoconstituents (tannins and flavonoids) present inthem[33].

3. EssentialOil

Plants produce a variety of secondary metabolites that can be used directly orindirectly by humans. Essential oil is one of the secondary metabolites of plants thathaveeconomic valuebecauseitcanbeusedasarawmaterialformakingvarious

aromatherapy,cosmetics,perfumesandotherindustries[34].Theessentialoil*J.samba*cis one of the most expensive oils used in cosmetics, pharmaceutical, perfumeryand aromatherapy industries [6,35]. Volatile compounds namely linalool, α-farnesene,d-nerolidol, geraniol, α-cadinol, benyzlalcohol, benzaldehyde, benzyl acetate, benzylbenzoate, 3-hexen-1-ol benzoate, and (Z)-3-hexen-1- ol acetate plays an important rolein the distinctive aroma of jasmine [36,37], while benzene acetaldehyde, benzoic acid,methyl anthranilate, methyl 2-(methylamino) benzoate, and (E)-2-hexenal modify thearomaofjasmine [36].

Flowers are the main part of *J. samba*cwhich is used as a source of essential oil.Aroma, grade, type of essential oils are influenced by geography [38], time of harvest[36-38], temperature, length of storage [40], and stage of flower development Younis *etal* [6]. The main content of *J. samba*cessential oil from Egypt is almost qualitativelysimilar but quantitatively different from that grown in other geographical areas
[38].Flowersharvestedattheopenstageproducedmoreessentialoilthanthoseharvestedatt heclosed bud stage [6].

The proportion of benzyl acetate decreased when the flowers were picked frommorning to evening and then increased at night collection [39], which is thought to berelated to the blooming process [36]. The floral aroma of *J. samba*cis related to volatilecondensate (FVC) compounds such as linalool, indole, and methyl anthranilate[40].Storage at room temperature for 30 months reduced the abundance of strong odors andaroma intensity, butcold temperature storage (4°C) was able to maintainthe intensityoftheFVCaroma [40]).

Themainingredientsin*J.samba*cfloweraromaarelinalool,benzylacetate[16,38,39], cis-3-hexenyl acetate, (E)-β-ocimene, and (E,E)-α-farnesene [38,39], pinene,pentadecyl-2-propyl ester, citronellol, jasminolactone, farnesol, and jasmon [16]. Theessential oils produced by *J. samba*chave distinctive sensory aromas such as linalool(flowers),methylanthranilate(likegrapes),4-hexanolide(sweet),4-nonanolide(sweet), (E)-2-hexenyl hexanoate (green), and 4-hydroxy-2,5-dimethyl-3(2H)-furanone(sweet) [5]. The removal of methyl anthranilate and the replacement of (R)-(−)-linaloolby (S)-(+)-linalool causes a major change in the odor model [5]. The aroma of jasmineflowers is associated with a mixture of linalool, benzyl benzoate, farnesyl acetate, andmethylisoeugenol[4,16],cis-3-hexenylacetate,linalylacetate,eugenolandmethyl

salicylate [4]. Methyl anthranilate and (R)-(−)-linalool) are the main aroma of jasmineteaflavor[5].

The *J.sambac*flowersproducecaryophylleneoxide,amixtureofbenzylbenzoate and farnesyl acetate, methyl isoeugenol, squalene, and sitosterol [26]. Otheringredients of *J. sambac*flowers are benzyl-O-β-D-glucopyranoside (1), benzyl-O-β-D-xylopyranoxyl(1→6-β-D-glucopyranoside,tertraol,molihuaosideD,sambacosideA,sambacosideE,rutin,kaempferol-3-O-(2,6-di-O-α-L-rhamnopyranosyl)-β-D-galactopyranoside,andquercetin-3-O-(2,6-di-O-α-L-rhamnopyranosyl)-β-D-galactopyranoside[41],citronellol,phenylethylalcohol,geranial,eugenol,farnesol,geranylacetate, citrinylacetate, 2-phenylethylacetate, citral(cisandtrans mixture),and benzylaldehyde [6].

Conclusions

1. Intraditionalmedicine*Jasminumsambac*isusedtotreatdysmenorrhea,menorrhea,ringworm,leprosy,skindiseases,analgesic,antidepressant,anti-inflammatory,antiseptic,aphrodisiac,sedative,expectorant,fever,painandinflammationandcancer.
2. The bioactivity of *J. sambac*is to suppress lactation, analgesic, anti-microbial,antioxidant,anti-cancer,anti-hypertensive,treatwounds, andtreatulcers.
3. The distinctive aroma of *J. sambac*flowers is related to the content of essentialoils, namely linalool, α-farnesene, d-nerolidol, geraniol, α-cadinol, benzyl alcohol,benzaldehyde, benzyl acetate, benzyl benzoate, 3-hexen-1-ol benzoate, and (Z) -3-hexen-1-ol acetate.

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