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Michelia alba: A Review on Its Biological Profile and Ethnobotany in Java

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ABSTRACT

Michelia alba DC (white champaca) is an ornamental, flowering, and aromatic plant that grows widely in tropical and subtropical areas of Southeast Asia. This plant has long been known as a medicinal plant in several regions in Southeast Asia. However, this plant is still not widely known by people in various parts of the world, the number of studies that examine this plant is still relatively small, and ethnobotanical discussions about this plant are difficult to find. This study aims to provide a review of the current ethnobotanical status of Michelia alba in Java, Indonesia, which includes its biological profile, role in Javanese customs, related myths, and scientific review in terms of its pharmacological activity. The results of the ethnobotanical study revealed that this plant is fairly unique because it is often associated with magical things and is very closely related to various cultural practices of the Javanese indigenous people (kejawen). Scientifically, the results of research prove that the M. alba plant does contain various chemical constituents that have many benefits. The pharmacological activities of M. alba reported include anti-cancer, antistress, anti-fungal, antioxidant, skin protection, and effective in killing Trypanosoma parasites.

Introduction

Indonesia has long been known as an archipelago rich in biodiversity, flora and fauna. With the mixture of native species from the Asian and Australian continents, it is stated that biodiversity in Indonesia ranks the second largest in the world, including 40,000 endemic plant species, including 6,000 species of medicinal plants (Nugraha & Keller, 2011). Apart from the richness of biodiversity, the ethnicity is also diverse, no less than 300 ethnic groups with different customs and cultures (Pitoyo & Triwahyudi, 2018). This causes interaction between the culture of each ethnic group (including the view of life, values, norms, and applicable rules) and the surrounding environment, which then gives birth to patterns of behavior that are typical of the community in treating its environment (Mustaqin et al., 2018). Since ancient times, these community groups have used plants for various needs such as building materials, clothing, household appliances, traditional ceremonial equipment, as well as food and medicine. Composition of

ingredients; composition; processing process; Until the efficacy that is believed, everything is still traditional according to the way of their respective ethnicities or groups and is passed down from generation to generation (Hulyati et al., 2014). The relationship between community groups (ethnicities) and the plants around them, as well as how indigenous knowledge of plants to support life is a central theme in ethnobotany (Dhea Dani et al., 2019).

Indigenous knowledge about the benefits of various plant species for medicine, food, and other uses is a treasure trove of knowledge that is very valuable to study, as many have been proven to be useful after empirical testing. From here, ethnobotany, ethnomedicine, ethnopharmacology, and so on developed studies (Usbar et al., 2018). Various studies have also been carried out and succeeded in revealing the scientific side of local wisdom in Indonesia in utilizing plants, including: how the tradition "Nginang" (i.e. chewing betel nut mixed with gambier, areca nut, and betel leaves) can improve periodontal health (Lumbantoruan & Halawati, 2019) and how the ingredients "Nginang" can be an antimicrobial compound in the mouth (Saraswati et al., 2019), how betel leaves can stop nosebleeds (Sutopo, 2016), androgenic and estrogenic effects of purwoceng in which it is widely used as aprodisiaka by many ethnicities; its ability to increase LH (luteinizing hormone) and testosterone; increase the degree of spermatogenesis; as well as increasing the number and motility of spermatozoa (Darwati & Roostika, 2016; Fauzi et al., 2019), and so on.

However, the rapid advancement of science and technology, the development of the times, and the transformation of society due to globalization have brought many changes in various aspects of life, including culture. These changes led to the marginalization of traditional knowledge; cultural products; and local wisdom, the abandonment of everything that is traditional and the shift of most people—especially the younger generation—to contemporary things (Mustaqin et al., 2018). This is a problem that occurs almost everywhere, including in Indonesia, especially in the midst of urban communities. Ethnobotanical products are considered primitive products and irrelevant to the progress of the times. The perception of inferiority causes people living in modern times to abandon traditional lifestyles that are in many ways more natural; more environmentally friendly; even has exotic values (Purwanti et al., 2017; Yulina, 2017).

Therefore, a continuous study of these ethnobotanical products is needed. This effort can start from the basics in the form of inventory and collection. Furthermore, it can be continued by conducting studies to reveal the benefits of these various plants empirically with the lens of modern science and cutting-edge technology (Hulyati et al., 2014). In other words, indigenous knowledge and local wisdom about plants and their use must continue to be studied and have great potential as a complement and support for modern science. In addition, it also contributes benefits in providing prospects for product development with economic value.

This study aims to provide a review of the current ethnobotanical status of Michelia alba, one of the endemic flora of the island of Java, Indonesia (Gunawan et al., 2017; Shodiq et al., 2019) known by the Javanese ethnicity or tribe as a plant"Cantil" or "White

cempaka"And it has long been used for various needs, including traditional ceremonies. Michelia alba looks very close to Javanese culture to give birth to various myths and public beliefs related to it (Puspita & Poerbantanoe, 2019). The benefits of this plant have attracted the interest of many people, so that this plant has been widely cultivated in other areas and is still used today. There are still few publications of research results or literature reviews which discusses the Michelia alba, as also stated by H. M. Wang et al. (2010), even more so in the ethnobiology review. Therefore, through this paper, the author tries to elaborate on the biological profile of Michelia alba, its role in Javanese customs, myths believed by the Javanese people, as well as a scientific review in terms of its pharmacological activities.

Method

This study uses a literature review approach. The selection of this approach is intended to synthesize information from the literature about the traditional knowledge of the Javanese people and their traditional uses of the Michelia alba plant and how its scientific side is seen from its biological, phytochemical, and pharmacological profiles. The discussion in this study is also enriched with the potential use of Michelia alba in the modern era so that it can be more widely accepted and provide economic benefits. This literature review approach refers to the guidelines proposed by Oosterwyk, Brown & Geeling (2017) which includes five steps, namely: 1) determination of protocols or criteria; 2) literature search; 3) article selection; 4) analysis, synthesis, and interpretation, and 5) review writing. In determining the protocol or criteria, we adopt the method used by Oliver (2013). As a criterion set out in this literature review, topics are limited to Michelia alba and literature sources include journal articles published between 2010 and 2020. The range of articles used in this study is through database searches such as PubMed (https://pubmed.ncbi.nlm.nih.gov/), JSTOR (https://www.jstor.org/), ProQuest (https://www.proquest.com/), Taylor and Francis (https://www.tandfonline.com/), Science Direct (https://www.sciencedirect.com/), and Google Scholar (https://scholar.google.com/). Searches on Indonesian journal databases such as the Garuda Portal (http://garuda.ristekbrin.go.id/) are also used considering that Michelia alba is an endemic plant so there is a possibility that it will be discussed more in local-scale journals. The keywords used to conduct searches are open in both English and Indonesian, namely: Michelia alba; Magnolia alba; white cempaka; Cantil flower or combined with one or more of the following terms: chemical; phytochemical; pharmacological; ethnobotany; traditional uses; traditional health practices; traditional rituals. Reference books and theses are also used to enrich information that cannot be found in journal articles.

Results and Discussion

The plant names and scientific classification

Michelia alba or Magnolia alba is known in Javanese and Indonesian as "white cempaka". From an etymological point of view, cempaka means a gemstone. Indonesians

used to call topaz stone as "ratna cempaka stone" (Wind & Job, 2015). In fact, "champa" became the name for the kingdom that flourished in Vietnam (Glover et al., 2004). This plant is so named because of the beauty of its flowers, like white topaz stones. Therefore, in English, this plant is also called white jade orchid tree.

Because each ethnicity in Indonesia has its own regional language, this plant is also called by other names in various regions in Indonesia, including: "kantil", or "white seeker" (Javanese), "campaka bodas" (Sundane), "campaka pote" (Madura), "cempaka mawure" (North Sulawesi), "jeumpa gadeng" (Aceh), "campaka putieh" (Minangkabau), "sampaka mopusi" (Mongondow), "bunga eja kebo" (Makassar), "patene" (Ujung Pandang), "bunga eja mapute" (Bugis), "capaka bobudo" (Ternate), and "capaka bobulo" (Tidore) (Hariana, 2013; Julianto, 2016). In English, this plant is known as white champaca, magnolia blossom, joy perfume tree, or banana shrub (Lim, 2014; Rhind, 2015). The scientific classification is shown in table 1.

Table 1
Scientific classification *of Michelia alba*

Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Order	Magnoliales
Family	Magnoliaceae
Genus	Michelia
Species	*Michelia alba*

Distribution

Michelia alba is a species belonging to the Magnoliaceae family. The family consists of 12 genera and 220 species of perennial evergreens and shrubs native to the tropics and subtropics of the South and Southeast Asia (Indomalaya) Region, including Southern China (Raja & Koduru, 2014). Michelia alba itself is a plant native to Indonesia (Kumar et al., 2012; C.-H. Lee et al., 2018; H. M. Wang et al., 2008; H. M. Wang, Chen, et al., 2010), precisely from Java (Randhawa & Mukhopadhyay, 2001), but its distribution reaches Southeast Asia, East Asia, the southeastern United States, Central America, and India (Sukewijaya et al., 2016). This plant grows in lowlands (≤ 300 m above sea level) to 1200 m above sea level (Julianto, 2016). According to the IUCN RedList database, the Michelia alba plant is included in the category of least-concern species.

Botanical description

Michelia alba is a tree with a height range of between 10-15 meters and can even reach 20-30 meters if cultivated in areas with high humidity levels. The trunk is woody. The bark is brown. If split, it is light yellow in color and easily splits. As for the root bark, it is red. The leaves are single, flat-edged, green, ovate, and staggered in position. On the underside of the leaves there are fluffy hairs. Each leaf bud is protected by 2 protective leaves. The petioles are quite long and can reach almost half the length of the leaves. The flowers are white and have a very pleasant smell. Inflorescences with a single flower that are terminal, often look axial. Flower diameter ± 5 cm. Bisexual flowers, actinomorphic, with elongated receptacula. Flowering all year round. The flowers begin to bloom in the

evening followed by a fragrant aroma; The scent begins to fade at night. The tent leaves (tepal) number 6 to many, obviously, sometimes the outermost 3 are modified like petal leaves (sepal). Stamens are numerous, the stamens are thick, short, undifferentiated into pronounced stamens. Heteropolar pollen, monosulkat (1-sulcate), between 40-110 μm in length. The fruiting proximity (> 20), obviously, is located on an elongated receptacle, with lateral placenta. Seed seeds usually amount to 2 per fruit, sometimes many. There are no honey glands. The fruit is elongated, slightly bent, first green, then pale gray. Seeds with red or orange fleshy seed membranes, small embryos, and homogeneous endosperm (Avizienis, 2019; Erdtman, 1986; C.-H. Lee et al., 2018; Sudarsono et al., 2005; Tjitrosoepomo, 2007; van Steenis, 2013). This plant is the host of the butterflies "Tailed Jay" Graphium agamemnon and "Common Jay" Graphium doson (Sulistyani, 2013; Suwarno et al., 2018).

Myths, customs and traditional uses related to the tree

For the traditional Javanese people ―or commonly referred to as "Kejawen" which is a syncretism between Hinduism and Hinduism Islamic Folk-, M. alba or tree Cantil It is considered a plant that is very closely related to the mystical dimension. Javanese myth says that this plant is very popular with supernatural beings and can attract their attention. It is believed that kuntilanak ―The type of female ghost that is described as having a terrifying appearance, with long hair, dressed in white- is the waiter of this tree. Occurrence kuntilanak often attributed to the appearance of scents such as those emitted by flowers Cantil (Duile, 2020; Mayangsari & Dorjanto, 2016; Newland, 2001). It is even believed that kantil flowers are one of the favorites of Nyi Roro Kidul, a subtle spirit that the Javanese people believe to be the queen of the southern sea (Triyanto et al., 2018).

M. alba It is also believed to have magical powers to attract the opposite sex or known as "Pellets". Kantil can mean "Kemantils" in Javanese, which means: crazy. Not a few of the shamans who serve this clinic practice ask the perpetrators Pellets to store the clothes of the intended person and hang them with kantil flowers so that the intended person always remembers and misses the perpetrator (Elvitasari & Faidah, 2020). In the conception of planting in the yard according to Yogyakarta customs, kantil trees are planted on the right and left pendhapa (large pavilion) and the mother house. This tree is planted near the door with the intention that the person who enters through the door feels "Kemantils" (dear and cherished) by the owner of the house, so that things that are not good or expected will not happen (Sadilah et al., 1992). It should also be noted that the word Cantil can also mean bed. This word is used in books Chronicles of the Land of Jawi (The Chronicles of Java) to refer to Nyi Roro Kidul's golden bed where he lay down when he saw the distraction caused by the meditation of Panembahan Senopati ―founder of the Sultanate of Mataram-. This may be nothing more than a coincidence. However, the relationship of the cantils with the magic of love; the erotic aspects inherent in Nyi Roro Kidul; as well as the Javanese belief that Senopati and Nyi Roro Kidul had sex which created a relationship between the southern sea supernatural palace and the Mataram Sultanate, all of this deserves attention to understand the myth of the magical power of trees Cantil (Koelink, 2020).

Flower M. alba It is also very close to various traditional rituals. In the Javanese traditional wedding procession, kantil flowers are used in rituals flushing (bathing the bride-to-be). This ritual is usually used "Seven-fold flower" or seven types of flowers ― The number seven has magical value in Javanese culture- which consists of: flowers Cantil (M. alba), yellow cempaka (M. champaca), rose (Rosa hybrida), jasmine (Jasminum sambac), good nightshade (Polianthes tuberose), water henna (Impatiens balsamina), and ylang ylang (Cananga odorata) (Nurhadi et al., 2018). Ritual flushing This is sometimes also done for women who are pregnant. The use of these flowers is believed to be beneficial for pregnancy health (Nuha & Nisak, 2020). Similar to this ritual, together with jasmine and roses, the flowers Cantil Immersed in water used for rituals ranupada (ranu: washing, at: feet). In this ritual, the bride washes the groom's feet as a sign of a wife's devotion to her husband (Hidaya et al., 2016). Cantil flowers are also used to make necklaces that become bridal accessories, called Tri Puspita Sari necklaces (Tri:three puspita:flower sari: beautiful), in a threefold arrangement that depicts the three stages of human life: birth, marriage, and death. The myth is that kantil flowers can make the love of the bride and groom always last (Elvitasari & Faidah, 2020). In some areas, rituals are also held.Balangan Gantal" (throwing gantal). The bride and groom threw each other Gantal which is made from betel leaf rolls and filled with flowers Cantil and tied with woven threads. It is said that the meaning of this ritual is to throw love to each other between husband and wife (Hidaya et al., 2016). In addition, the interest M. alba is also one of the components that always exists in various forms of offerings in traditional and religious ceremonies, in Java (Purwanto et al., 2020) and also in Bali (Sujarwo et al., 2020; Sukewijaya et al., 2016).

Parts commonly used in traditional use of plants M. alba are the flowers. As previously explained, the fragrance of this flower makes it often used in various Javanese traditional rituals, in addition to being used as a fragrance in traditional cosmetics (for example, as an ingredient in making "cem-ceman" oil), an herb for spice baths to eliminate body odor, and as a hair fragrance (Puspita & Poerbantanoe, 2019; Tilaar, 1999). In addition, it is also used to make fragrant tea (Lim, 2014). As a traditional herb, the flowers are used to treat vertigo, sinusitis, and vaginal discharge. It is also used for the treatment of gonorrhea by boiling it with young coconut. Its leaves are traditionally used as medicine. Usually leaf decoction water M. alba It is used as a mouthwash to eliminate bad breath, as well as used for the treatment of coughs, bronchitis, urinary tract infections, and breaking down kidney stones, and when added honey can be used to treat stomach pain. The bark of its roots is used in the treatment of inflammation, constipation, irregular menstruation and dysmenorrhea. The bark of the trunk is used in the treatment of gastritis and fever. There are also other uses, for example the trunk, which is used to make household furniture (Aditya & Ramadhania, 2019; Gede Bawa, 2011; Julianto, 2016; Puspita & Poerbantanoe, 2019).

Phytochemistry

The results of testing the composition of essential oils and absolute oils using GC-MS (Gas Chromatography-Mass Spectroscopy) show that linalool is the main component

of essential oils. While indole, linalool and phenylethyl alcohol are the main components of absolute oils (Punjee et al., 2009). The content of essential oils from flowers M. alba (Figure 1) among them are linalool 72.8%, α-terpineol (6.04%), β-phenylethyl alcohol (2.58%), β-pinene (2.3%), methyl 2-methylbutyrate (1.46), geraniol (1.239%), and 1,8-cineole (1.03%) (Burdock, 2016). Another study succeeded in uncovering 78 volatile compounds (approximately representing 93-98% of the total number of volatile compounds present) at seven stages of flower development M. alba, namely: S5 = The buds become yellowish and swollen; S6 = The bud turns greenish-cream, swollen and elongated; S7 = The buds turn full beige and the bractea open; S8 = Quarter bloom, outer circle of petals open; S9 = Half bloom, outer circle and middle petals open; S10 = Full bloom, outer, middle and inner petals open and S11 = Stamens turn brown, part of the petals fall off. Thirty-three of these compounds (30-50%) belong to the isoprenoid group, while the rest belong to fatty acid derivatives, benzenoids, phenylpropanoids and other hydrocarbon compounds.

Several studies have attempted to unravel the chemical constituents isolated from the roots (D.-J. Wang, 1979; Yang, 1962)leaf (C. Y. Chen, Huang, et al., 2008; Qin et al., 2018; H. M. Wang, Lo, et al., 2010)flower (Sanimah et al., 2008; Shang et al., 2002)trunk (Lo et al., 2010), and bark (Asaruddin et al., 2003) M. alba. These phytoconstituents that have been successfully isolated from various parts of the M. alba plant organs are summarized in table 2 below.

Table 2
Some phytoconstituents successfully isolated from *M. alba*

Chemical Constituents	Plant Parts	Reference
ushinsunine	roots, flowers	(C. Y. Chen, Huang, et al., 2008; D.-J. Wang, 1979; Yang, 1962)
oxoushinsunine	roots, flowers	(C. Y. Chen, Huang, et al., 2008; D.-J. Wang, 1979; Yang, 1962)
Salicifoline	roots, flowers	(C. Y. Chen, Huang, et al., 2008; D.-J. Wang, 1979; Yang, 1962)
Michelalbine	roots, flowers	(C. Y. Chen, Huang, et al., 2008; D.-J. Wang, 1979; Yang, 1962)
S-limonene	roots, flowers	(C. Y. Chen, Huang, et al., 2008; Shang et al., 2002; D.-J. Wang, 1979; Yang, 1962)
benzyl acetate	roots, flowers	(C. Y. Chen, Huang, et al., 2008; D.-J. Wang, 1979; Yang, 1962)
Linalool	roots, flowers	(C. Y. Chen, Huang, et al., 2008; Punjee et al., 2009; Sanimah et al., 2008; Shang et al., 2002; D.-J. Wang, 1979; Xia et al., 2010; Yang, 1962)
Nerol	roots, flowers	(C. Y. Chen, Huang, et al., 2008; D.-J. Wang, 1979; Yang, 1962)
hydroxycitronellal	roots, flowers	(C. Y. Chen, Huang, et al., 2008; D.-J. Wang, 1979; Yang, 1962)

Chemical Constituents	Plant Parts	Reference
Benzaldehyde	roots, flowers	(C. Y. Chen, Huang, et al., 2008; D.-J. Wang, 1979; Yang, 1962)
Benzyl benzoate	roots, flowers	(C. Y. Chen, Huang, et al., 2008; D.-J. Wang, 1979; Yang, 1962)
eugenol methyl ether	roots, flowers	(C. Y. Chen, Huang, et al., 2008; Pongpuntaruk, 2010; D.-J. Wang, 1979; Yang, 1962)
lariciresinol	roots	(Pongpuntaruk, 2010)
-(3',4',5'-trihydroxy-3'-methylbutanoyloxy)-11βH-dihydroparthenolide	roots	(Pongpuntaruk, 2010)
T-cadinol	roots	(Pongpuntaruk, 2010)
reynosin	roots	(Pongpuntaruk, 2010)
aphorpines: (-)-anonaine, (-)-norushinsunine, ushinsunine, (-)-N-acetylanonaine and (-)-N-formylanonaine	leaves	(C. Y. Chen, Huang, et al., 2008; Pongpuntaruk, 2010; H. M. Wang, Lo, et al., 2010; Yang, 1962)
Oxoaphorpines: liriodenine, oxoxylopine	leaves	(C. Y. Chen, Huang, et al., 2008)
sesquiterpene lactones: michelenolide, costunolide, dihydrocostunolide, parthenolide, 9βhydroxy-11βH-dihydroparthenolide, 11,13-dehydrolanuginolide	roots, leaves, bark	(Asaruddin et al., 2003; C. Y. Chen, Huang, et al., 2008; Pongpuntaruk, 2010)
amide: N-trans-feruloyltyramine	leaves	(C. Y. Chen, Huang, et al., 2008)
lignan: (+)-syringaresinol	leaves	(C. Y. Chen, Huang, et al., 2008)
Benzenoids: 4-hydroxybenazaldehide, 4-hydroxybenzoic acid, methylparaben	leaves	(C. Y. Chen, Huang, et al., 2008)
Steroids: β-sitosterol and stigmasterol	leaves	(C. Y. Chen, Huang, et al., 2008)
Liphatic compounds: palmitic acid, stearic acid and linoleic acid	leaves	(C. Y. Chen, Huang, et al., 2008; Shang et al., 2002)
clorophylls: pheophorbide, aristophyll-C, mycephyll-A, and pheophytin-A	leaves	(C. Y. Chen, Huang, et al., 2008; H. M. Wang, Lo, et al., 2010)
(-)-oliveroline	leaves	(H. M. Wang, Lo, et al., 2010)
(+)-nornuciferine	leaves	(H. M. Wang, Lo, et al., 2010)
Lysicamine	leaves	(H. M. Wang, Lo, et al., 2010)
(+)-Cyperone	leaves	(H. M. Wang, Lo, et al., 2010)
(+)-epi-yangambin	leaves	(H. M. Wang, Lo, et al., 2010)
Ficaprenol-10	leaves	(H. M. Wang, Lo, et al., 2010)
santamarine	Bark	(Asaruddin et al., 2003)
α-pinene	flowers	(Sanimah et al., 2008; Shang et al., 2002)
β-pinene	flowers	(Shang et al., 2002)

Chemical Constituents	Plant Parts	Reference
Camphene	flowers	(Shang et al., 2002)
Yesterday	flowers	(Shang et al., 2002)
α-myrcene	flowers	(Shang et al., 2002)
α-phellandrene	flowers	(Shang et al., 2002)
β-phellandrene	flowers	(Shang et al., 2002)
3-carene	flowers	(Shang et al., 2002)
α-terpinene	flowers	(Shang et al., 2002)
γ-terpinene	flowers	(Shang et al., 2002)
p-cymene	flowers	(Shang et al., 2002)
Eucalyptole	flowers	(Shang et al., 2002)
(Z)-α-ocimene	flowers	(Shang et al., 2002)
Dihydromyrcenol	flowers	(Shang et al., 2002)
Acetic acid 5 -hexenyl ester	flowers	(Shang et al., 2002)
(R)-fenchone	flowers	(Shang et al., 2002)
2-nonanone	flowers	(Shang et al., 2002)
(Z)-rose oxide	flowers	(Shang et al., 2002)
Limonene-1,2-epoxide	flowers	(Shang et al., 2002)
Camphor	flowers	(Shang et al., 2002)
p-menth-8-en-2-ol	flowers	(Shang et al., 2002)
Linalyl acetate	flowers	(Shang et al., 2002)
Isolinalyl acetate	flowers	(Shang et al., 2002)
(Z)-geraniol	flowers	(Shang et al., 2002)
Isogeranyl formate	flowers	(Shang et al., 2002)
Cyclooctanol acetate	flowers	(Shang et al., 2002)
Isobornyl acetate	flowers	(Shang et al., 2002)
2-Undecanone	flowers	(Shang et al., 2002)
α-cubebene	flowers	(Shang et al., 2002)
1,2,3a,3ba,4,5,6,6aá,6ba-decahydro-1á-isopropyl-3aá-methyl-6-methylene-cyclobuta[1,2:3,4]diclopentene	flowers	(Shang et al., 2002)
γ-elememne	flowers	(Shang et al., 2002)
(Z)-β-farnesene	flowers	(Shang et al., 2002)
Caryophyllene	flowers, bark	(Asaruddin et al., 2003; Sanimah et al., 2008; Shang et al., 2002)
Copaene	flowers	(Shang et al., 2002)
Cedrene	flowers	(Shang et al., 2002)
α-muurolene	flowers	(Shang et al., 2002)
Germacrene D	flowers	(Sanimah et al., 2008; Shang et al., 2002)
n-Pentadecane	flowers	(Shang et al., 2002)
(*E*,*E*)-α-farnesene	flowers	(Shang et al., 2002)
1-methyl-4-(5-methyl-1-methylene-4-hexenyl)-(*S*)-cyclohexene	flowers	(Shang et al., 2002)
Cadinene	flowers	(Shang et al., 2002)
Eudesma-4(14),11-diene	flowers	(Shang et al., 2002)
2,6-Dimethyl-6-(4-methyl-3-pentenyl)-bicyclo[3,1,1]hept	flowers	(Shang et al., 2002)
(Z)-α-santalol	flowers	(Shang et al., 2002)

Chemical Constituents	Plant Parts	Reference
Caryophyllene oxide	flowers	(Shang et al., 2002)
β-Patchoulene	flowers	(Shang et al., 2002)
(E,E,E)-3,7,11,15-Tetramethylhexadeca-1,3,6,10,14-pentaene	flowers	(Shang et al., 2002)
6,10,14-Trimethyl-2-pentadecanone n-Nonadecane	flowers	(Shang et al., 2002)
n-Eicosane	flowers	(Shang et al., 2002)
n-Heneicosane	flowers	(Shang et al., 2002)
n-Docosane	flowers	(Shang et al., 2002)
n-Tricosane	flowers	(Shang et al., 2002)
n-Penracosane	flowers	(Shang et al., 2002)

Pharmacological activity

1. Trypanocidal effect

Ethyl acetate (AcOEt) extract from bark M. alba has been reported to show trypanocide activity against Trypanosoma cruzi. The eight chemical constituents that have a killing effect on T. cruzi along with their minimum concentrations are: caryophyllene oxide (61 μM), costunolide (7 μM), dihydrocostunolide (27 μM), parthenolide (0.04 μM), dihydroparthenolide (0.78 μM), 11, 13-dehydrolanuginolide (0.16 μM), santamarine (25 μM) and a monoterpene (5 μM) (Asaruddin et al., 2003).

2. Antifungal activity

Steam from essential oils M. alba (300-900 μL/L) has been studied for its effect on mold growth in brown rice. The results showed that oil vapor M. alba ≥ 450 μL/L provides effective antifungal activity to inhibit the growth of brown rice's natural mold for a minimum of 90 days of storage at $25^{oC\ and}$ relative humidity (RH) 100%. In this study, it was also reported that essential oils extracted from the leaves were more effective in inhibiting the growth of mold Aspergillus flavus than those extracted from the flowers. (Songsamoe et al., 2017, 2020). Songsamoe and Matan (2020) conducted research by developing an essential oil emulsion from M. alba which can be absorbed by water hyacinth plants in order to produce essential oil absorbent materials as a carrier of essential oil vapors that can be released to control fungi in a closed packaging system. The results showed that the roots, stems, and leaves of dried water hyacinth that had absorbed the essential oil emulsion from M. alba can release the vapor of the essential oil so that it inhibits the growth of mold Aspergillus flavus in malt extract agar (MEA) and Thai dessert food (Ja Mongkut) with the highest antifungal activity at a concentration of 500 μL/mL. To be optimal, fresh water hyacinth plants are soaked in an essential oil emulsion M. alba for 48 hours. Water hyacinth is then dried (≥ 0.4 g/L of air) and can be used to inhibit growth A. flavus in a closed packaging system (Songsamoe & Matan, 2020). This antifungal activity is thought to be the role of linalool, a monoterpene alcohol that is one of the main components of essential oils M. alba. Linalool is known to damage the cell

walls and cell membranes of mold (Songsamoe et al., 2020; Zeng et al., 2011). The use of linalool additives in food is proven to be safe based on testing and has also been approved by the US-FDA without any specific restrictions (Hongratanaworakit & Buchbauer, 2004; Songsamoe et al., 2020).

3. Antioxidant activity

It is known that reactive oxygen species (ROS), such as superoxide anions (O_2^-.), hydrogen peroxide (H_2O_2) and hydroxyl radical (· OH) is formed naturally by a number of enzymes as part of metabolism in the cytoplasm (in vivo), is highly reactive and can be produced endogenously or exogenously (Adegoke & Forbes, 2015; Hazra et al., 2004; Rajurkar & Hande, 2011). Excessive production of ROS will cause oxidative stress that can trigger a number of diseases such as cancer, stroke, Parkinson's disease, heart disease, arteriosclerosis, infections, aging, and autoimmune diseases (Adegoke & Forbes, 2015; K. J. Lee et al., 2015; Melo et al., 2015). Therefore, the intake of antioxidant compounds in the food consumed is very necessary to help the body neutralize free radicals. Medicinal plants include aromatic plants such as Michelia alba It is known to contain a number of phenolic compounds with strong antioxidant activity (Leelapornpisid et al., 2008; Rajurkar & Hande, 2011). This potential is very important to explore in order to find natural antioxidants from plant extracts or products isolated from plants instead of synthetic antioxidants that have a lot of records about the safety of their use (Brand-Williams et al., 1995; Rajurkar & Hande, 2011; Tripathi et al., 2007).

Micephyll A, one of the chemical constituents of the leaf extract M. alba, has been reported to have antioxidant activity against ABTS radicals$^+$ (2,2'-azino-bis-3-ethylbenzthiazoline-6-sulphonic acid) with an inhibition percentage of 40.5% while also showing metal chelation activity of 55.2% (at 100 μM) (H. M. Wang, Lo, et al., 2010). (-)-N-Formylanoinane is reported to have beneficial activative activity for human skin, and has the potential to be used in both medical cosmetology and dietary supplementation. The compound has antioxidant activity in DPPH (1,1-diphenyl-2-pikrilhydrazile) radical scavenging assay, has reducing power, and is able to chelate metal ions (H. M. Wang, Chen, et al., 2010). This result is reinforced by the finding that the extract M. alba can fight photoaging due to UV radiation by inhibiting the expression of MMPs (matrix metalloproteinases). Phytoconstituents on M. alba the putative ones that have antioxidant action are aporphines such as (-)-N-formylanonaine; (+)-nornuciferine; and lysicamine, chlorophyll such as pheophorbide A; aristophyll-C; and mycephyll A, as well as lignans such as yangambin and (+)-syringaresinol (Chiang et al., 2012). Extract n-hexane containing flavonoids and non-essential triterpenoids from M. alba flowers was reported to have a large antioxidant activity of 79.14% at 60 minutes in GC-MS (Gas Chromatography-Mass Spectroscopy) analysis. (Gede Bawa, 2011).

4. Anticancer activity

One of the alkaloid compounds isolated from the leaves M. alba, (-)-anonaine (Table 2), has been reported to have many useful pharmacological activities, among which is anti-cancer activity. The compound (-)-anonaine is known to induce the mechanism of

apoptosis in HeLa cancer cells. Specific doses of (-)-anonaine induce DNA damage of dependent cancer cells which correlates with an increase in intracellular nitric oxide; reactive oxygen species (ROS); glutathione depletion; potential disruption of mitochondrial transmembranes; activation of caspases 3, 7, 8, and 9; and poly ADP ribose polymerase cleavage. (-)-anonaine also regulates the up-regulation of Bax expression and p53 proteins in HeLa cancer cells (C. Y. Chen, Liu, et al., 2008). (-)-anonaine in the concentration range of 50-200 μM was also reported to show significant inhibition of the growth and migration of human H1299 lung cancer cells within 24 hours (B. H. Chen et al., 2011). It is information that (-)-anonaine can be developed in chemotherapy or as a health dietary supplement as a method of hemoprevention of cervical cancer and lung cancer. In addition to its potential due to its anticancer activity, (-)-anonaine is also reported to show other pharmacological activities including as a relaxant (Chulia et al., 1995; Valiente et al., 2004), anti-oxidative (Martinez et al., 1992), anti-depressant (Protais et al., 1995), anti-bacterial and antifungal (Tsai et al., 1989; Villar et al., 1987).

5. Anti-stress activity

Effect of oil vapor M. alba that brown rice is administered to human brain activity has been studied through electroencephalogram (EEG) analysis. The results showed that brown rice cooked with the aroma of essential oil vapor M. alba (600 μL/L) can increase the power of α and β waves in the human brain which shows anti-stress effects and relaxed mood (Koomhin et al., 2020; Songsamoe et al., 2020). Linalool, is a chemical constituent in the essential oils of the flower M. alba (Table 2) which is strongly suspected to be one of the compounds that have antistress activity. A study has shown that the aroma of the extract Vallaris glabra (bread flower), Plumeria acuminata (pagoda tree), and Dracaena fragrans (Fragrant Dracaena) causes a relaxation stimulating effect because it contains the component Linalool (Promsomboon et al., 2014). Linalool is a monoterpene found in the essential oils of various aromatic plants. This compound is efficacious to induce relaxation, anti-stress effects and can improve sleep quality (Linck et al., 2010). This provides information for us that essential oils M. alba It can be developed as an aromatic substance in aromatherapy to provide a relaxing effect.

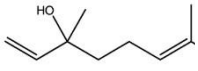
6. Skin protection

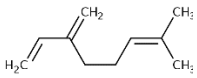
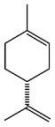
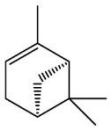
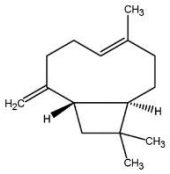
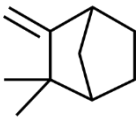
It is undeniable that many women want to look beautiful and have fair skin. That is why many women use skin lightening cosmetic products that often contain whitening ingredients that can cause negative effects. Some of the dangerous skin whitening ingredients that are sometimes found in cosmetics are mercury, hydroquinone and retinoic acid. Actually, dark skin color is caused by the synthesis of melanin. An enzyme that plays an important role in the melanin synthesis pathway is tyrosinase. Tyrosinase has the activity of hydroxylation of tyrosine, oxidation of L-DOPA (3,4-dihydroxyphenylalanine) and oxidation of hydroxyindole. Therefore, tyrosinase can catalyze several steps in melanin biosynthesis. The enzyme tyrosinase works to convert tyrosine into 3,4-dihydroxyphenylalanine (DOPA) and then into dopaquinone which then goes through several stages of transformation converted into melanin. The abnormal process of pigment

formation results in the uneven distribution of melanin content in the skin called hyperpigmentation. Therefore, inhibition of tyrosinase to safely and effectively address hyperpigmentation is an effort that deserves attention (Marles et al., 2003; Naoi et al., 2010; Solano et al., 2006). As mentioned earlier that the natural product, (-)-N-formylanonaine, which is isolated from the leaves M. alba has been found to have a significant effect in reducing tyrosinase activity in fungi with IC_{50} = 74.3 μM. In addition, (-)-N-formylanonaine also has tyrosinase and melanin-reducing activity in human epidermal melanocytes in the absence of significant cytotoxicity. It was even found that (-)-N-formylanonaine showed superior results to known tyrosinase inhibitors, such as kojic acid and 1-phenyl-2-thiourea (PTU) (H. M. Wang, Chen, et al., 2010). Leaf extract M. alba and its hydrolysate has also been shown to decrease the expression of the metalloproteinase matrix induced by UVB synapses, as well as decrease elastase activity; hyaluronic acid and type I procollagen in human skin fibroblasts (Chiang et al., 2012).

As explained earlier, the plant part M. alba The most widely used traditionally both in weddings, traditional ceremonies, and others is the flower. From flowers M. alba Essential and absolute oils that contain a number of volatile constituents that receive a lot of attention (Sanimah et al., 2008; Shang et al., 2002; D.-J. Wang, 1979; Yang, 1962). Essential oils from flowers M. alba contains many chemical constituents, especially terpene compounds (Table 3) which give rise to a fragrant aroma and have anti-stress and relaxation effects. In lavender, linalool compounds; 1,8-cineole; linalyl actetate; terpinene-4-ol; camphor; and B-ocimene has shown useful effects in therapeutic methods for neurological disorders such as anxiolytic (anti-anxiety); mood stabilizer; sedative (sedative); analgesic (pain reliever); anticonsultative, and neuroprotective (Koulivand et al., 2013). Rationally, it can be said that this relaxing fragrance is most likely the background for the myths related to flowers M. alba and its widespread use in wedding customs, pregnancy, religious rituals, beauty, medicine, and so on.

Table 3
A number of terpene compounds in *M. alba*, their aroma and uses

Terpene compounds	Aroma	Uses	Also found in	Reference
Linalool 	Floral, citrus, candy	anti-inflammatory, analgesic, anti-stress/anxiety, sedation, anti-depressant, modulation of motor movements and locomotion, anti-bacterial, anticonvulsant, anti-insomnia, and antioxidant.	lavender, citrus, coriander, rosewood, laurels, birch trees	(Buchbauer et al., 1991; Cline et al., 2008; De Sousa et al., 2010; by Socorro S Rosa et al., 2003; X.-J. Li et al., 2016; Ma et al., 2015; Nakamura et al., 2009; Peana et al., 2003; Russo, 2011)

Myrcene 	Earthy cloves, herbs	anti-inflammatory, anti-cancer, relaxant, analgesic, and anxiolytic properties	sweet basil, bay leaves, lemongrass, wild thyme, parsley, and tropical fruits such as mango, and hops	(Do Vale et al., 2002; Lorenzetti et al., 1991; Maggi et al., 2013; Rufino et al., 2015)
Limonene 	Citrus	anti-inflammation, antioxidation, anti-cancer against skin cancer; breast cancer; prostate cancer; immunostimulant	All citrus fruits	(Crowell & Gould, 1994; Hansen et al., 2016; Jia et al., 2013; Komori et al., 1995; Mediavilla-Varela et al., 2009)
Pinene 	Pine	anti-inflammation, anti-cancer, antioxidation, neuroprotection	Fresh pine needles, conifers, and sage	(Cheng et al., 2014; Q. Li, 2010; Porres-Martínez et al., 2016; Rufino et al., 2014)
Caryophyllene 	Pepper, woody, spicy	anti-inflammation, anti-cancer, antioxidation, neuroprotection, anti-bacterial, larvicidal effect	Cinnamon, cloves, black pepper, oregano, basil, rosemary, and hops	(Calleja et al., 2013; Dahham et al., 2015; Govindarajan et al., 2016; Ojha et al., 2016; Pichette et al., 2006)
1,8-cineole (eucalyptol) 	Fresh mint-like	Antioxidation, neuroprotection, potential for use in Alzheimer's disease, anti-inflammatory and analgesic properties	Tea tree, rosemary, sweet basil, wormwood, mugwort, bay leaves, common sage, and eucalyptus	(Moss & Oliver, 2012; Porres-Martínez et al., 2016; Santos & Rao, 2000)
Camphene 	Similar as camphor	antioxidant, analgesic, antifungal	Turpentine, Camphor Oil, Citronella Oil, Cypress Oil, and Valerian	(Marei et al., 2012; Quintans-Júnior et al., 2013)

Based on the uses it has, there are various prospects for its use *M. alba*, is it as an industrial raw material of essential oils for aromatherapy (Punjee et al., 2009; Qin et al.,

2018; Sanimah et al., 2008; Sukewijaya et al., 2016), perfume making (Nasution et al., 2019)cosmetics (Hartati, 2012), medicines, or as exotic ornamental plants.

Figure 2
: Google Trends graph on M. *alba* *information* search from 2004 to the present

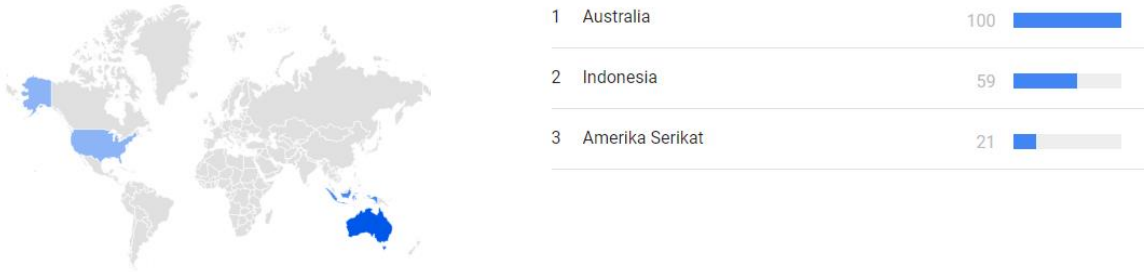


Figure 3
: Google Trends results on M. *alba* information search interest by region

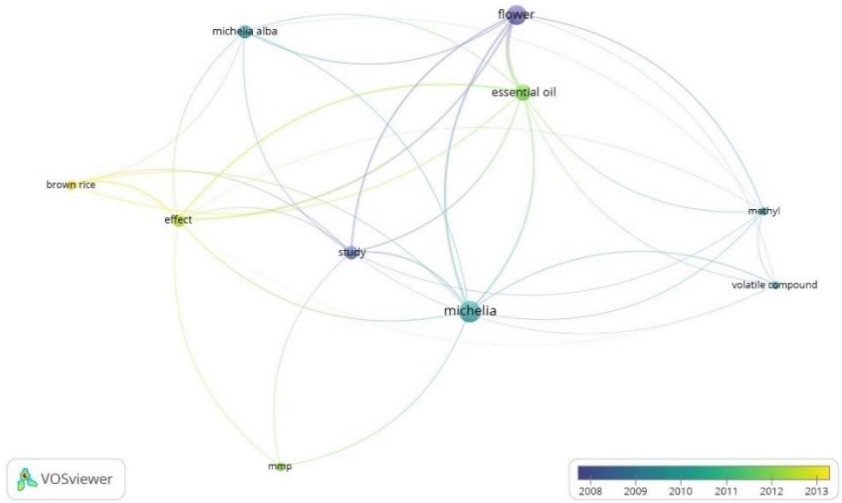


Figure 4
Overlay visualization of M. alba*'s research results*

The M. alba plant, its uses, and the commercial products that can be produced from it need to be introduced more widely. From the search results on Google Trends with the query "Michelia alba" and with a time span between 2004 and now, it is found that search interest for M. alba is only seen in three countries: Australia, Indonesia, and the United States (Figure 3), and the graph shows a decline in search interest for information about M. alba (Figure 2). Research on M. alba can also be said to be very little. From the results

of metadata harvesting using LENS (https://www.lens.org/) using the keyword michelia alba, only 72 scholarly works were found. Similarly, based on the results of bibliometric analysis (Figure 4), it can be seen that previous studies on M. alba have highlighted more about the essential oil of its flowers. There is still a need for more in-depth studies on other parts of M. alba besides its flowers, testing of pharmacological effects, and innovation of processed products as food additives; medicines; and cosmetics.

Conclusion

M. alba has long been known and used by the people in Java and has a very close relationship with the culture, customs and beliefs of the Javanese people. M. alba flowers are inseparable from ubarampe (parts or components) in weddings, pregnancy, and also offerings. M. alba is also mythical as the most preferred plant by female spirits and is a plant that has magical power to attract the opposite sex. Traditionally, people have used their flowers, leaves, stem bark, and root bark for beauty and medicinal purposes. The results of scientific research have shown that the M. alba plant has great biological potential. M. alba essential oil is known to contain a variety of chemical constituents, including terpene compounds that provide a distinctive aroma and have many uses. Phytoconstituents of M. alba have been reported to show several pharmacological activities such as anti-cancer, anti-stress, anti-fungal, antioxidant, skin protection, as well as effective as tripanosides. The information described in this review regarding the various chemical constituents of M. alba and its pharmacological activity provides evidence for the use of M. alba as a medicinal plant while providing more prospects for its future use in the essential oil, perfume, medicine, food, and cosmetics industries. The results of the study also provide rationalization to myths about this plant and its use in various traditional and religious rituals.

Bibliography

Chulia, S., Ivorra, M. D., Cave, A., Cortes, D., Noguera, M. A., & D'Ocon, M. P. (1995). Relaxant Activity of Three Aporphine Alkaloids from Annona cherimolia on Isolated Aorta of Rat. Journal of Pharmacy and Pharmacology, 47(8), 647–650. https://doi.org/10.1111/j.2042-7158.1995.tb05852.x

Dahham, S. S., Tabana, Y. M., Iqbal, M. A., Ahamed, M. B. K., Ezzat, M. O., Majid, A. S. A., & Majid, A. M. S. A. (2015). The Anticancer, Antioxidant and Antimicrobial Properties of the Sesquiterpene β-Caryophyllene from the Essential Oil of Aquilaria crassna. Molecules (Basel, Switzerland), 20(7), 11808–11829. https://doi.org/10.3390/molecules200711808

Darwati, I., & Roostika, I. (2016). Status Penelitian Purwoceng (Pimpinella alpina Molk.) di Indonesia. Buletin Plasma Nutfah, 12(1), 9–15. https://doi.org/10.21082/blpn.v12n1.2006.p9-15

De Sousa, D. P., Nóbrega, F. F. F., Santos, C. C. M. P., & De Almeida, R. N. (2010). Anticonvulsant activity of the linalool enantiomers and racemate: Investigation of chiral influence. Natural Product Communications, 5(12), 1847–1851. https://doi.org/10.1177/1934578x1000501201

Dhea Dani, B. Y., Wahidah, B. F., & Syaifudin, A. (2019). Etnobotani Tanaman Kelor (Moringa oleifera Lam.) di Desa Kedungbulus Gembong Pati. Al-Hayat: Journal of Biology and Applied Biology, 2(2), 44. https://doi.org/10.21580/ah.v2i2.4659

DDuile, T. (2020). Kuntilanak Ghost Narratives and Malay Modernity in Pontianak, Indonesia. Bijdragen Tot de Taal-, Land- En Volkenkunde, 176(2–3), 279–303. https://doi.org/10.1163/22134379-17601001

Elvitasari, D. P., & Faidah, M. (2020). Tata Rias Pengantin pada Suku Tengger. E-Journal, 9(1), 44–51.

Erdtman, G. (1986). Pollen Morphology and Plant Taxonomy: Angiosperms. E.J. Brill.

Fauzi, F., Widodo, H., & Haryanti, S. (2019). Kajian Tumbuhan Obat yang Banyak Digunakan untuk Aprodisiaka oleh Beberapa Etnis Indonesia. Media Penelitian Dan Pengembangan Kesehatan, 29(1), 51–64. https://doi.org/10.22435/mpk.v29i1.466

Gede Bawa, I. (2011). Aktivitas Antioksidan Dan Antijamur Senyawa Atsiri Bunga Cempaka Putih (Michelia Alba). Jurnal Kimia, 5(1), 43–50.

Glover, I., Bellwood, P., & Bellwood, P. S. (2004). Southeast Asia: From Prehistory to History. RoutledgeCurzon.

Govindarajan, M., Rajeswary, M., Arivoli, S., Tennyson, S., & Benelli, G. (2016). Larvicidal and repellent potential of Zingiber nimmonii (J. Graham) Dalzell

(Zingiberaceae) essential oil: an eco-friendly tool against malaria, dengue, and lymphatic filariasis mosquito vectors? Parasitology Research, 115(5), 1807–1816. https://doi.org/10.1007/s00436-016-4920-x

Gunawan, H., Sugiarti, Rianti, A., Rendra, R. P. R., & Sudarso, I. (2017). Hutan kota kawasan industri untuk konservasi ex-situ flora endemik dan terancam punah di lingkungan perkotaan. Prosiding Seminar Nasional Masyarakat Biodiversitas Indonesia, 3(2011), 323–333. https://doi.org/10.13057/psnmbi/m030307

Hansen, J. S., Nørgaard, A. W., Koponen, I. K., Sørli, J. B., Paidi, M. D., Hansen, S. W. K., Clausen, P. A., Nielsen, G. D., Wolkoff, P., & Larsen, S. T. (2016). Limonene and its ozone-initiated reaction products attenuate allergic lung inflammation in mice. Journal of Immunotoxicology, 13(6), 793–803. https://doi.org/10.1080/1547691X.2016.1195462

Hidaya, A. Al, Alfiati, A., & Khoirunnisaa, K. (2016). Nilai-Nilai Religius dalam Tindakan Tutur pada Prosesi Temu Manten Upacara Pernikahan Adat Jawa di Kota Madiun. An-Nuha, 3(1), 73–91.

Koelink, M. (2020). The Queen of the Sea and the Limits of Religion: How a Javanese Sea Spirit Forces a Reconceptualization of Religion and Religious Syncretism. Utrecht University.

Lee, K. J., Oh, Y. C., Cho, W. K., & Ma, J. Y. (2015). Antioxidant and Anti-Inflammatory Activity Determination of One Hundred Kinds of Pure Chemical Compounds Using Offline and Online Screening HPLC Assay. Evidence-Based Complementary and Alternative Medicine, 2015. https://doi.org/10.1155/2015/165457

Leelapornpisid, P., Chansakaow, S., Chaiyasut, C., & Wongwattananukul, N. (2008). Antioxidant activity of some volatile oils and absolutes from Thai aromatic plants. Acta Horticulturae, 786, 61–66. https://doi.org/10.17660/ActaHortic.2008.786.5

Li, Q. (2010). Effect of forest bathing trips on human immune function. Environmental Health and Preventive Medicine, 15(1), 9–17. https://doi.org/10.1007/s12199-008-0068-3

Li, X.-J., Yang, Y.-J., Li, Y.-S., Zhang, W. K., & Tang, H.-B. (2016). α-Pinene, linalool, and 1-octanol contribute to the topical anti-inflammatory and analgesic activities of frankincense by inhibiting COX-2. Journal of Ethnopharmacology, 179, 22–26. https://doi.org/10.1016/j.jep.2015.12.039

Lorenzetti, B. B., Souza, G. E. P., Sarti, S. J., Santos Filho, D., & Ferreira, S. H. (1991). Myrcene mimics the peripheral analgesic activity of lemongrass tea. Journal of Ethnopharmacology, 34(1), 43–48. https://doi.org/10.1016/0378-8741(91)90187-I

Lumbantoruan, M., & Halawati. (2019). Pengaruh Budaya Makan Sirih Terhadap Status Kesehatan Periodontal pada Masyarakat Suku Karo di Desa Biru-Biru Kabupaten Deli Serdang tahun 2009. Jurnal Mutiara Kesehatan Masyarakat, 4(1), 7–16.

Ma, J., Xu, H., Wu, J., Qu, C., Sun, F., & Xu, S. (2015). Linalool inhibits cigarette smoke-induced lung inflammation by inhibiting NF-κB activation. International Immunopharmacology, 29(2), 708–713. https://doi.org/10.1016/j.intimp.2015.09.005

Maggi, F., Fortuné Randriana, R., Rasoanaivo, P., Nicoletti, M., Quassinti, L., Bramucci, M., Lupidi, G., Petrelli, D., Vitali, L. A., Papa, F., & Vittori, S. (2013). Chemical composition and in vitro biological activities of the essential oil of Vepris macrophylla (BAKER) I.VERD. endemic to Madagascar. Chemistry & Biodiversity, 10(3), 356–366. https://doi.org/10.1002/cbdv.201200253

Martinez, L. A., Rios, J. L., Paya, M., & Alcaraz, M. J. (1992). Inhibition of nonenzymic lipid proxidation by benzylisoquinoline alkaloids. Free Radical Biology & Medicine, 12, 287–292.

Mayangsari, R., & Dorjanto, D. (2016). Kajian komik Tuti and Friends karya RM Fajar. Jurnal Pendidikan Seni Rupa, 4(1), 97–105.

Mediavilla-Varela, M., Pacheco, F. J., Almaguel, F., Perez, J., Sahakian, E., Daniels, T. R., Leoh, L. S., Padilla, A., Wall, N. R., Lilly, M. B., De Leon, M., & Casiano, C. A. (2009). Docetaxel-induced prostate cancer cell death involves concomitant activation of caspase and lysosomal pathways and is attenuated by LEDGF/p75. Molecular Cancer, 8(1), 68. https://doi.org/10.1186/1476-4598-8-68

Mustaqin, A. Z., Astriani, W., Husodo, T., & Partasasmita, R. (2018). Pemanfaatan Tumbuhan Untuk Beberapa Upacara Adat Oleh Masyarakat Desa Pangandaran Kecamatan Pangandaran Kabupaten Pangandaran. Jurnal Pro-Life, 5(1), 496–505.

Nakamura, A., Fujiwara, S., Matsumoto, I., & Abe, K. (2009). Stress Repression in Restrained Rats by (R)-(−)-Linalool Inhalation and Gene Expression Profiling of Their Whole Blood Cells. Journal of Agricultural and Food Chemistry, 57(12), 5480–5485. https://doi.org/10.1021/jf900420g

Naoi, M., Maruyama, W., & Riederer, P. (2010). Melanin. In K. Kompoliti & L. V. Metman (Eds.), Encyclopedia of Movement Disorders (pp. 169–171). Academic Press. https://doi.org/https://doi.org/10.1016/B978-0-12-374105-9.00480-9

Nasution, R., Azwar, A. I., Helwati, H., & Marianne. (2019). Antibacterial Activities of Perfume: Combination Flower Magnolia alba, Cananga odorata and Mimusops elengi L, Fixed with Pogostemon cablin Oil. Indonesian Journal of Pharmaceutical and Clinical Research, 2(1), 19–23. https://doi.org/10.32734/idjpcr.v2i1.814

Nurhadi, Z. F., Salamah, U., & Vidiyanti, T. (2018). Etnografi Komunikasi Tradisi Siraman Pada Prosesi Pernikahan Adat Sunda. Jurnal Penelitian Komunikasi, 21(2), 101–118. https://doi.org/10.20422/jpk.v21i2.531

Ojha, S., Javed, H., Azimullah, S., & Haque, M. E. (2016). β-Caryophyllene, a phytocannabinoid attenuates oxidative stress, neuroinflammation, glial activation,

and salvages dopaminergic neurons in a rat model of Parkinson disease. Molecular and Cellular Biochemistry, 418(1–2), 59–70. https://doi.org/10.1007/s11010-016-2733-y

Peana, A. T., D'Aquila, P. S., Chessa, M. L., Moretti, M. D. L., Serra, G., & Pippia, P. (2003). (−)-Linalool produces antinociception in two experimental models of pain. European Journal of Pharmacology, 460(1), 37–41. https://doi.org/https://doi.org/10.1016/S0014-2999(02)02856-X

Pichette, A., Larouche, P.-L., Lebrun, M., & Legault, J. (2006). Composition and antibacterial activity of Abies balsamea essential oil. Phytotherapy Research : PTR, 20(5), 371–373. https://doi.org/10.1002/ptr.1863

Pitoyo, A. J., & Triwahyudi, H. (2018). Dinamika Perkembangan Etnis di Indonesia dalam Konteks Persatuan Negara. Populasi, 25(1), 64. https://doi.org/10.22146/jp.32416

Pongpuntaruk, J. (2010). Chemical constituents from the stem of punica granatum and the root of mechelia alba. Prince of Songkla University.

Purwanti, Miswan, & Pitopang, R. (2017). Studi Etnobotani Pada Proses Ritual Adat Masyarakat Suku Saluan Di Desa Pasokan Kabupaten Tojo Una-Una. Biocelebes, 11(1), 46–60.

Purwanto, S. R., Novenda, I. L., & Narulita, E. (2020). ETHNOBIOLOGY STUDY ON NATURE AND PROCESSING PLANTS AND. *Jurnal Mangifera Edu*, *5*(1), 38–54. https://doi.org/https://doi.org/10.31943/mangiferaedu.v5i1.90

Puspita, A., & Poerbantanoe, B. (2019). Galeri Bunga Cempaka di Kota Semarang. *Jurnal E-Dimensi Arsitektur*, *7*(1), 529–536.

Qin, D. Q., Huang, R. L., Li, Z. H., Wang, S. Y., Cheng, D. M., & Zhang, Z. X. (2018). Volatile component analysis of michelia alba leaves and their effect on fumigation activity and worker behavior of solenopsis invicta. *Sociobiology*, *65*(2), 170–176. https://doi.org/10.13102/sociobiology.v65i2.2014

Saraswati, R. A., Safitri, M., Rahmah, D. N. H., Monika, C., & ... (2019). Potensi Senyawa Antimikrobia Dari Organ Tanaman Ramuan Nginang. *Prosiding Seminar Nasional Pendidikan Biologi Dan Saintek*, 209–212.

Shodiq, M. A., Budiarti, T., & Nasrullah, N. (2019). *Kajian Potensi Koleksi Pohon Lokal Kebun Raya Cibodas Untuk Fungsi Estetika Dalam Lanskap* [Institut Pertanian Bogor]. https://doi.org/10.31220/osf.io/fhc6u

Songsamoe, S., Koomhin, P., & Matan, N. (2020). The effects of Michelia alba oil against mould on brown rice and assessing the brain response using electroencephalogram (EEG). *Journal of Food Science and Technology*. https://doi.org/10.1007/s13197-020-04689-8

Songsamoe, S., & Matan, N. (2020). Treatment of fresh water hyacinth with essential oil emulsion and subsequent use of the plant material for control of Aspergillus flavus on rice dessert products. *BioResources*, *15*(2), 2147–2162.

https://doi.org/10.15376/biores.15.2.2147-2162

Songsamoe, S., Matan, N., & Matan, N. (2017). Antifungal activity of Michelia alba oil in the vapor phase and the synergistic effect of major essential oil components against Aspergillus flavus on brown rice. *Food Control*, *77*, 150–157. https://doi.org/https://doi.org/10.1016/j.foodcont.2017.02.010

Sujarwo, W., Caneva, G., & Zuccarello, V. (2020). Patterns of plant use in religious offerings in bali (Indonesia). *Acta Botanica Brasilica*, *34*(1), 40–53. https://doi.org/10.1590/0102-33062019abb0110

Sukewijaya, I. M., Mahendra, M. S., Rai, I. N., & Temaja, G. R. M. (2016). Morphological Characters and Genetic Variability of Champaca in Bali. *International Journal of Bioscience and Biotechnology*, *4*(1), 29–38.

Usbar, N., Mahbub, A. S., & Makkarennu. (2018). Pengetahuan Lokal Masyarakat Adat Kajang Dalam Memanfaatkan Tumbuhan Hutan Untuk Pengobatan. *Jurnal Universitas Hasanuddin*, 1–11.

Valiente, M., D'Ocon, P., Noguera, M. A., Cassels, B. K., Lugnier, C., & Ivorra, M. D. (2004). Vascular activity of (-)-anonaine, (-)-roemerine and (-)-pukateine, three natural 6a(R)-1,2-methylenedioxyaporphines with different affinities for alpha1-adrenoceptor subtypes. *Planta Medica*, *70*(7), 603–609. https://doi.org/10.1055/s-2004-827181

Yulina, I. K. (2017). Back to Nature: Kemajuan atau Kemunduran. *Mangifera Edu*, *2*(1), 20–31. https://doi.org/10.31943/mangiferaedu.v2i1.15