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REVIEW ARTICLE

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Exploring the less prominent relatives of *Ficus benjamina* L. in Indonesia: A review on the botanical, ethnobotanical, and future perspectives of *Ficus deltoidea* Jack. and *Ficus septica* Burm.f.

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Abstract

Ethnobotany plays a significant role in drug discovery. However, some species are often overlooked due to the lack of cultural importance. In this paper, we conducted a literature review on two lesser-known *Ficus* species in Indonesia, namely *Ficus septica* Burm.f. and *Ficus deltoidea* Jack. Compared to *F. benjamina*, these two species remain understudied. Our results showed that there are three recorded different uses of *F. deltoidea* and twelve of *F. septica*. The utilization of *F. deltoidea* is purely for ethnomedicine (100%), while *F. septica* is used for ethnomedicine (69%), culture (23%) and others (8%). The stems (50%) and the roots (50%) are the only plant parts utilized from *F. deltoidea*, while almost all plant parts of *F. septica* are utilized. Traditionally, *F. deltoidea* is used as an aphrodisiac, to treat internal diseases and wounds, and to increase stamina. Studies support the use of *F. deltoidea* as a cure for internal diseases and wounds as it has antimicrobial compounds. *F. septica* is traditionally used to cure boils, anthelmintic and fever for children, appendicitis, asthma, venomous snake bites, skin diseases, eye-redness, haemorrhoid, and tuberculosis. Studies support that *F. septica* could cure boils as its chemical compounds inhibit the growth of *Staphylococcus aureus,* the bacteria that cause boils. Furthermore, there are many other active compounds found in these species which are still understudied. Therefore, we conclude that *F. deltoidea* and *F. septica* have the potential to be used as modern medicine and require more in-depth research using the most advanced methods and technology.

Keywords: Cultural, Ethnobotany, Ethnomedicine, Fig, Moraceae, Indonesia

Introduction

Indonesia is an archipelago comprising more than 17,000 islands that have undergone complex geological changes over the last 50 million years which influenced many environmental variables such as the topography and climate[1,2,3]. These events, along with biogeographic and ecological factors led to the evolution of a megadiverse flora and fauna in the region[4,5]. Indonesia is home to 19,112 identified flowering plants (approximately 8% of the world's flowering species) and has the second-highest number of indigenous medicinal plants in the world.

Apart from the high level of biodiversity, Indonesia is also home to approximately 1,340 indigenous tribes[6]. These are people from local communities that live alongside nature and utilize the plants around them for food, medicine, religious rituals, clothing, housing, and many more[7]. Ethnobotanical studies play an important role in discovering plant species that could be used in modern medicine. The documentation of the indigenous peoples' knowledge has been proved useful in medicine, as it led to the discovery of some important drugs we know today[8,9]. In fact, many medicines that we use contain drugs that are derived from plants[10]. One of the well-documented plants that have important health and spiritual benefits for humans are *Ficus*[11,12].

Ficus is a pantropical plant with a wide distribution due to its high variability in growth form. This genus consists of trees, shrubs, climbers, epiphytes and hemi-epiphytes which gives this genus the ability to thrive in different living conditions[13]. Ecologically, plants in the *Ficus* genus are keystone species that provide a large number of syconia as a food source for many vertebrates such as bats, monkeys, birds, and many small frugivorous mammals[14]. Bats of the subfamily Stenodermatinae are mostly frugivores that specialize on *Ficus* as their primary food source and consequently act as a seed dispersal agent[15,16]. The more *Ficus* fruits these bats consume, the wider the distribution of *Ficus* plants. Therefore, the presence of *Ficus* species plays a significant role in shaping the species composition within an ecosystem[17]. These characteristics make *Ficus* an ideal indicator for an ecosystem's health and its presence is often used to assess forest restoration projects in the tropics[18,19].

Not only are *Ficus* important for the ecosystem, but it is also important for the indigenous people of Indonesia. *Ficus* is often consumed as food, utilized for traditional medicine, traditional ceremonies, or religious rituals[20,21]. The Balinese people have a close relationship with *Ficus* trees as there is at least one *Ficus* tree present in every village in Bali that are used for religious ceremonies[22]. However, the utilization of *Ficus* plants varies between different tribes and different islands in Indonesia. Understanding the different local wisdom on *Ficus*, and compiling information on the utilization of *Ficus* plants may give insights on potential uses in modern medicine. Taxonomically, *Ficus* is a plant that belongs to the Moraceae family and it consists of 873 accepted species that are well-distributed all over the world. This genus is characterized by its milky-white latex secretion, stipules, and produce "fruits" from an enclosed inflorescence structure called syconium[23].

In Indonesia, many studies on *F. benjamina* have been conducted regarding its ecology, ethnobotany, bio-prospect, medicine, and cultural significance. Out of all *Ficus* species, *F. benjamina* has the highest socio-cultural values as it is believed to be a dwelling for spirits, a place to put offerings, accelerate fortune, and for other occasions[24]. Due to this, *F. benjamina* is considered sacred by many Indonesian tribes which make them the most prominent and important *Ficus* species. Beside *F. benjamina*, there are other *Ficus* species utilized by the indigenous people of Indonesia, such as *F. deltoidea* and *F. septica* which still understudied. The authors believe that the lack of information on the utilization of *F. deltoidea* and *F. septica* is due to having less cultural significance compared to *F. benjamina*.

In December 2021, a Google Scholar search with the keywords "'*Ficus benjamina*' Indonesia" showed 2,240 results, while "'*Ficus deltoidea*' Indonesia" showed 681 results and "'*Ficus septica*' Indonesia" showed 1,130 results. Specifically, in ethnobotanical aspects, the search on Google Scholar

using keywords "'*Ficus benjamina*' *etnobotani* Indonesia" showed 124 results, while "'*Ficus deltoidea*' *etnobotani* Indonesia" showed 47 results and "'*Ficus septica*' *etnobotani* Indonesia" showed 119 results. These search results indicate that there are more studies on *F. benjamina* compared to its relatives, *F. deltoidea* and *F. septica*. Therefore, in this paper, we conducted a review on two *Ficus* species, namely *F. deltoidea* and *F. septica* that are not as prominent as *F. benjamina.*

Through this paper, the authors aim to investigate the importance of these two species, their use in traditional medicine and their potential use in modern medicine. By compiling all published information on the biology, ethnobotany, and current uses of *F. deltoidea* and *F. septica* by indigenous people, the authors hope to lay down the foundational knowledge for future research on the utilization of these two species.

Materials and methods

Procedures

For this research, literature reviews were carried out using scientific papers, theses and proceeding conferences as the main source of information regarding the botanical aspects, ethnobotany, and phytochemistry of *Ficus septica* Burm.f. and *Ficus deltoidea* Jack. All information on the usage of these species by local communities is compiled in one table and presented in pie charts for ease of comparison and discussion.

Results

Taxonomy and ecology

Ficus deltoidea

Local Names: Tabat Barito (Kalimantan)
Description: Shrub, up to 3 m tall, epiphytic or terrestrial or epilithic. Twigs leafy, 1–5 mm thick, glabrous, bark greyish or pale brown. Leaves spirally arranged; lamina oblong to elliptic to obtriangular to oblanceolate to spathulate to linear or to suborbicular, 1–8 (–25) × 0.5–8 (–14) cm, coriaceous less often subcoriaceous, apex acuminate to acute to rounded to emarginated, or often to bilobate, base acute less often sub-acute, margin entire, adaxially and abaxially glabrous; venation pinnate (2–) 3–8 (–9) pairs of lateral veins, tertiary venation reticulate; petiole 0.2–1.5 (–9) cm long, glabrous or puberulous; stipules up to 1 (–1.5) cm long, caducous (or subpersistent). Figs axillary, in pairs or solitary, with a peduncle up to 1.5 (–3) cm long or sub-sessile; basal bracts 3, 0.5–3 mm long, ciliolate or also minutely puberulous outside; receptacle globose to ellipsoid to (sub)ovoid to oblongoid to fusiform or almost cylindrical, 0.4–0.8 cm diameter.
Distribution and Ecology: *F. deltoidea* is distributed throughout the Malay Peninsula, Sumatra, Java (western region), Borneo, Moluccas, and Thailand. *F. deltoidea* is an epiphytic or terrestrial plant that lives in lowland and montane forests at altitudes up to 1500 m a.s.l., with some individuals found at 2500 m a.s.l. albeit less often. *F. deltoidea* could also grow on sandy soils or rocks as an epilithic plant[23]. Traditionally, each *Ficus* species were assumed to have an obligate mutualistic association with a single species of pollinating wasp. However, according to Rosnah et al. [25], there are no specific wasp species that has been determined as a pollinator of *F. deltoidea.*

Figure 1. *Ficus deltoidea*

Ficus septica

Local Names: Besule (Kaili Rai, Donggala, Central Sulawesi), Libo (Buton), Kuciat (Sunda), Awar-awar (Java, Bali, Buton), Lombonug (Central Sulawesi), Matuni (Papua).

Description: Shrub to deciduous tree, up to 25 m tall; yellowish latex. Leaf single, spirally arranged, or subopposite, leaf shape elliptic to oblong, less often obovate to ovate to lanceolate, (7–)15–28(–35) × (3–)5–14(–30), apex acute or acuminate, base cuneate to rounded, less often subcordate, margin entire both adaxially and abaxially glabrous, lateral veins 6–12 (–15) pairs, tertiary venation scalariform to reticulate (to subcordate); petiole (0.5–) 1–5 (–12) cm long, glabrous; stipules 1–6(–8) cm long, glabrous, caduceus. Syconium is axillary or below the leaves, solitary, in pairs or up to 4 together on short; peduncle 0.2–1.2(–2.2) cm or even sessile; receptacle depressed–globose (or ellipsoid), 1.5–2(–3.5) cm diameter. ostiole 2–4 mm diameter[23].

Distribution and Ecology: Found in northeast India to south China and Taiwan. *F. septica* is widely distributed throughout Malesia and are also present in Australia (Queensland) as well as the New Hebrides. Their natural habitat is in the lowland and montane forests or secondary growth, often near rivers, up to an altitude of 1800 m a.s.l.[23]. Their fast-growing nature and rapidly maturing fruits allow them to also strive in disturbed areas[13], as well as urban areas and home gardens in Indonesia where they are either planted or occur naturally. Unlike the traditional assumption that each *Ficus* species are pollinated by a single species of wasp, Lin et al., [26] discovered that there are three putative pollinator species (*Ceratosolen* spp.) associated with *F. septica* in southern Taiwan. In Japan, the nematode species *Caenorhabditis inopinata* is found to have an association with *F. septica* and its pollinating wasps. This nematode is mostly found in the interior of pollinated figs and is seldom observed on the outside surface. Adult *C. inopinata* typically dominate early phase figs, whereas late phase figs with wasp offspring are dominated by *C. inopinata* larvae[27].

Figure 2. *Ficus septica*

Ethnomedicinal uses

In medicine, *F. deltoidea* is a well-known medicinal plant that has been utilized by the people in Indonesia, particularly in Sumatra and Kalimantan[28]. The Batak Simalungun people from North Sumatra use this plant to make a potion called tinuktuk in order to increase stamina[29]. A study carried out by Runtunuwu[30], explains that indigenous people of Dayak Tunjung Linggang, from Kutai Barat Regency, East Kalimantan utilize a decoction of roots and stems of *F. deltoidea* as a treatment for internal diseases and wounds. According to a study by Hidayat[31] about medicinal plants in Bogor, *F. deltoidea* is used as an aphrodisiac. However, no details were given about the preparation steps or the plant parts used. Although the utilization of *F. deltoidea* as a medicinal plant is already well-known, Silalahi[32] mentioned that its usage in Indonesia is left behind compared to Malaysia. This is indicated by the lack of scientific publications on the utilization of *F. deltoidea* in Indonesian traditional and modern medicine.

F. septica on the other hand, may not be as well-known as *F. deltoidea* in medicine but more tribes are recorded to use this species as traditional medicine. The indigenous people at Trunyan Village, Bali, utilize the leaves of *F. septica* as a treatment for boils[33]. Parents in Colo Village, Dawe Sub-District, Kudus District use the leaves of *F. septica* as a treatment for anthelmintic and fever for their children[34]. The people of Pamekasan District, Madura Island, East Java, use almost every part of *F. septica*, such as leaves, roots, sap, and syconia (fruits) to treat various diseases such as appendicitis, boils, asthma, and venomous snake bites[35]. The people of Naga Village, Neglasari, Salawu Sub-District, Tasikmalaya District, West Java use the leaves and sap of *F. septica* to treat skin diseases such as warts[36].

The Togian Tribe in Tojo Una-Una District, Central Sulawesi utilize the leaves of *F. septica* to cure boils[37]. The Kaili Rai Ethnic Group of Wombo Village, Tanantovea Sub-District, Donggala District, Central Sulawesi utilize the leaves and stem of *F. septica* as eye drops by mashing both plant parts and the resulting mixture is dropped into the eyes[38]. The Muna Tribe of Tongkuno Sub-Districts, Muna District, Southeast Sulawesi uses *F. septica* as eye drops (local name: trahom) too, specifically for curing redness. Leaves of *F. septica* and *Phyllanthus niruri* are burned using charcoal for 2 minutes, then mixed with the pith (stem) of *F. elastica*. The mixture is then squeezed until the last drop and is used every morning[39].

The Wolio Sub-Ethnic in Baubau City, Southeast Sulawesi, utilizes the leaves as a treatment for haemorrhoids and the roots of *F. septica* to treat tuberculosis (TB). To cure haemorrhoids, the patient sits on the leaves that have been heated over a fire. To cure TB, the patient drinks warm water infused with the peeled roots[40]. **Table 1** summarizes the location of the indigenous tribes and which plant parts of *F. deltoidea* and *F. septica* are used for treating diseases.

Cultural uses

No studies were found that recorded the use of *F. deltoidea* for cultural purposes, contrary to *F. septica.* According to Purnomo[41], local people in Java categorized *F. septica* as one of their cultural garden plants. Lauje ethnic group of Parigi Moutong District, Central Sulawesi use *F. septica* in their traditional ritual to cure diseases[42]. The Wolio Sub-Ethnic in Bau-Bau City, Southeast Sulawesi uses the leaves of *F. septica* from their yard during the pregnancy ceremony (Posipo) until childhood (Dole-Dole) as a symbol of salvation[43].

Other uses

Other than its uses in medicinal and cultural aspects, the local people of Buton Island, Southeast Sulawesi, utilize the leaves of *F. septica* as a traditional eco-friendly wrap for food instead of using plastic wrap[44].

Summary of the ethnobotanical aspects

Overall, there are three recorded different uses of *F. deltoidea,* while there are twelve recorded different uses of *F. septica*. **Table 1** summarizes the ethnobotanical aspects of both *F. deltoidea* and *F. septica* usage by the indigenous people of Indonesia.

Table 1. Summary of the ethnobotanical aspects of *F. deltoidea* and *F. septica* utilization by the indigenous people of Indonesia

Island	Province	Area	Plant Part	Use
		F. deltoidea		
Java	West Java	Bogor Regency	-	Aphrodisiac
Kalimantan	East Kalimantan	Kutai Barat Regency	Stem and root	Internal diseases and wounds
Sumatera	North Sumatera	Batak Simalungun	-	Potion called tinuktuk to increase stamina
		F. septica		
Bali	Bali	Trunyan Village	Leaves	Boils
Java	Central Java	Colo Village, Dawe Sub-District, Kudus District	Leaves	Anthelmintic and fever for children
	East Java	Pamekasan District, Madura Island	Leaves, roots, sap, syconia (fruits)	Appendicitis, boils, asthma, and venomous snake bites
	West Java	Naga Village, Neglasari, Salawu Sub-District, Tasikmalaya District	Leaves and sap	Skin diseases such as warts

	Unspecified	Unspecified	Whole plants	Cultural garden plants
Sulawesi	Central Sulawesi	Togian Tribe in Tojo Una-Una District	Leaves	Boils
	Central Sulawesi	Kaili Rai Ethnic Group of Wombo Village, Tanantovea Sub-District, Donggala District	Leaves and stem	Eye drops
	Central Sulawesi	Lauje ethnic of Parigi Moutong District	-	Traditional ritual during the curing process
	South East Sulawesi	Muna Tribe of Tongkuno Sub-Districts, Muna District	Leaves	Eye drops to treat eye-redness
	South East Sulawesi	Wolio Sub-Ethnic in Baubau City	Leaves and roots	Haemorrhoid and tuberculosis (TB)
	South East Sulawesi	Wolio Sub-Ethnic in Bau-Bau City	Leaves	Pregnancy ceremony/ritual (Posipo) until childhood (Dole-Dole) as a symbol of salvation
	South Sulawesi	Local people of Buton Island	Leaves	Eco-friendly wrap that substitutes plastic wrap

The ethnobotanical aspect of *F. deltoidea* fully focuses on medicinal uses, there were no studies found about its cultural or other uses. On the other hand, there were many studies of *F. septica* for ethnomedicine, cultural and other uses such as eco-friendly wrap. According to the pie chart in **Figure 3**, 69% of recorded *F. septica* utilization was used as medicinal plants, 23% for cultural purposes, and only 8% for other purposes by the indigenous people of Indonesia.

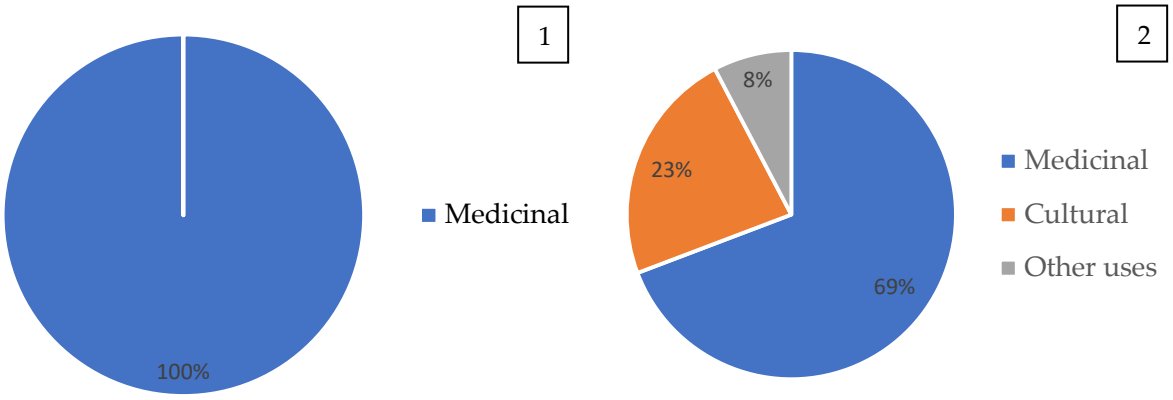

Figure 3. The utilization of *F. deltoidea* (1) and *F. septica* (2) in percentage

The plant parts of *F. deltoidea* that are used by the indigenous people of Indonesia are only stem (50%) and root (50%). There is no recorded use of *F. deltoidea* leaves or syconia. On the other hand, almost all plant parts of *F. septica* such as leaves, stem, syconia, root, and latex are utilized. The leaves of *F. septica* is the most frequently used organ for ethnomedicine (61%), followed by the stem (15%), while the syconia, latex, and stem were least used (8% respectively).

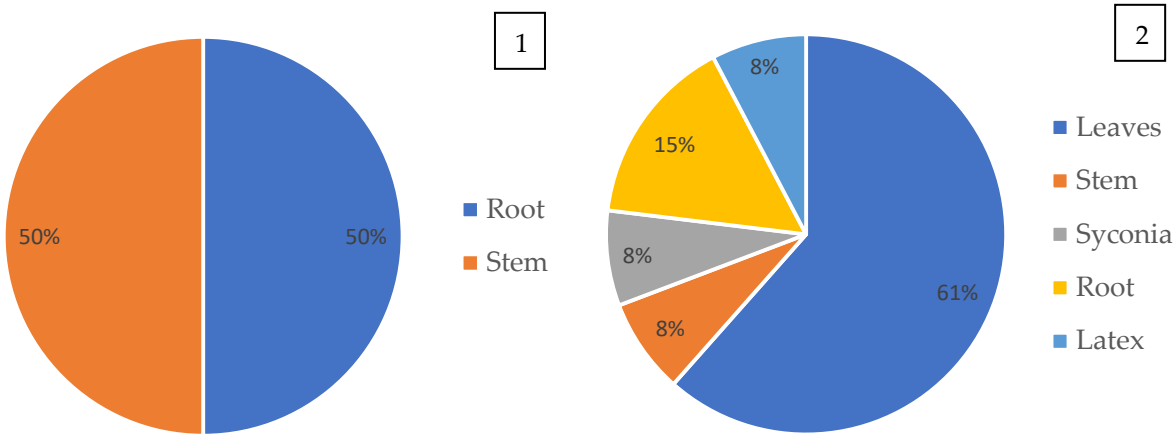

Figure 4. Percentage of *F. deltoidea* (1) and *F. septica* (2) plant parts used in ethnomedicine

From this study, it can be found that 9 provinces in Indonesia use both *F. deltoidea* and *F. septica* (**Figure 5**). The utilization of *F. deltoidea* is only found in 3 provinces: West Java, East Kalimantan, and North Sumatera, while the utilization of *F. septica* is found in 7 provinces. West Java is the only province that uses both *F. deltoidea* and *F. septica*.

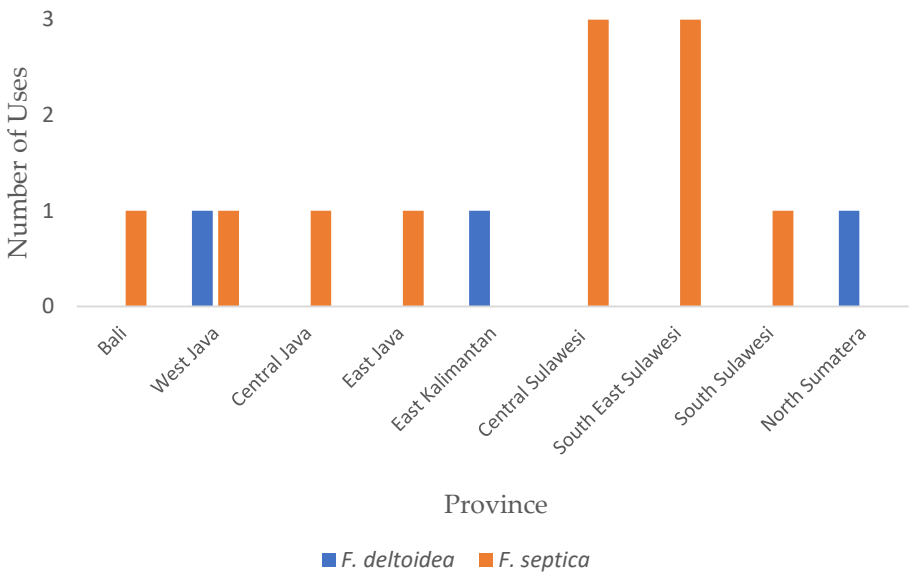

Figure 5. Utilization of *F. deltoidea* and *F. septica* in Indonesia's Provinces

Discussion

Future Perspective and Potential

Traditionally, *F. deltoidea* is used as an aphrodisiac, to treat internal diseases and wounds, and to increase stamina (**Table 1**). A study by Suryati *et al.*[45] showed that *F. deltoidea* possesses antimicrobial compounds as it can inhibit the growth of *Escherichia coli, Bacillus subtilis* and *Staphylococcus aureus.* Furthermore, a study carried by Azizan *et al.*[46] showed that the growth of *Enterococcus faecalis, Streptococcus mutans, S. mitis, S. salivarius, Aggregatibacter actinomycetemcomitans, Porphyromonas gingivalis,* and *Fusobacterium nucleatum* were also inhibited by the leaf extracts of *F. deltoidea*. Therefore, these studies support the belief of the people in East Kalimantan, that using *F. deltoidea* could cure internal diseases and wounds as it contains antimicrobial compounds. This evidence shows that *F. deltoidea* has the potential to be developed as an internal disease and wound medicine and requires further research.

Furthermore, a study by Adam *et al.*[47] showed that *F. deltoidea* has the potential as an antidiabetic agent by significantly stimulating insulin secretion from pancreatic P-cells which can also delay glucose absorption. A study by Manurung et al.[48] showed that *F. deltoidea* also possesses an antioxidant activity from flavonoids. The flavonoid was obtained from a methanolic extract from fresh leaves, ripened fruit, unripe fruit, and the lowest part on the stem.

F. septica is traditionally used to cure boils, anthelmintic and fever for children, appendicitis, asthma, venomous snake bites, skin diseases, eye-redness, haemorrhoid and tuberculosis (TB) (**Table 1**). According to Vital et al.[49], a crude extract of *F. septica* leaves has antimicrobial activities which inhibit the growth of *Staphylococcus aureus*, *Candida albicans* and *Escherichia coli*. This supports the belief of the indigenous people from East Java, Bali, and Central Sulawesi that *F. septica* could cure boils as it has antimicrobial compounds which inhibit the growth of *Staphylococcus aureus,* the bacteria that cause boils[50]. Therefore, more research is required to further investigate the potential use of *F. septica* as a medicine to treat boils.

Other than antibacterial activity, the methanol extract of *F. septica* leaves also possesses an antifungal activity. A study run by Sudirga et al.[51] showed that crude extract of *F. septica* could inhibit the growth of *Colletotrichum acutatum*, the pathogenic fungus which caused anthracnose disease on chili pepper. According to Mu'nisa et al.[52], the methanolic extract of *F. septica* dried leaves that were coarsely powdered possesses antioxidant activity, which was shown by DPPH (2,2-diphenyl-1-picrylhydrazyl)

scavenger activity and antioxidant capacity. Overall, de Padua et al.[53] reported that *F. septica* leaves, fruits, and roots contain chemical compounds such as alkaloids, saponins, flavonoids, tannins and polyphenols.

Conclusions

F. deltoidea and *F. septica* are important species utilized by the indigenous people of Indonesia for ethnomedicinal and cultural purposes. Based on the literature review, there are three different uses of *F. deltoidea* and twelve different uses of *F. septica*. The utilization of *F. deltoidea* is purely for ethnomedicinal purposes (100%), while *F. septica* is used for ethnomedicinal (69%), cultural (23%) and other uses (8%). The stems (50%) and the roots (50%) are the only plant parts utilized from *F. deltoidea*. There is no recorded utilization of *F. deltoidea* leaves or syconia. On the other hand, almost all plant parts of *F. septica* such as leaves, stems, syconia, roots, and latex are utilized. The leaves of *F. septica* are the most frequently used organ for ethnomedicine (61%), followed by the stem (15%) while the syconia, latex, and stems were least used (8% respectively). Traditionally, *F. deltoidea* is used as an aphrodisiac, to treat internal diseases and wounds, and to increase stamina. Studies support the use of *F. deltoidea* as a cure for internal diseases and wounds as it has antimicrobial compounds. *F. septica* is traditionally used to cure boils, anthelmintic and fever for children, appendicitis, asthma, venomous snake bites, skin diseases, eye-redness, haemorrhoid, and tuberculosis. Studies support that *F. septica* could cure boils as its chemical compounds inhibit the growth of *Staphylococcus aureus,* the bacteria that cause boils. Furthermore, there are many other active compounds found in these species which are still understudied and requires more in-depth research using the most advanced methods and technology.

Acknowledgments

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Conflicts of Interest

The authors declare there is no conflict of interest.

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