Available online at
www.heca-analitika.com/malacca_pharmaceutics

Malacca Pharmaceutics

Vol. 1, No. 1, 2023

Ficus minahassae (Teijsm. & de Vriese) Miq.: A Fig Full of Health Benefits from North Sulawesi, Indonesia: A Mini Review

Abdul Hawil Abas [1], Trina Ekawati Tallei [2,*], Rinaldi Idroes [3,4] and Fatimawali Fatimawali [5]

[1] Faculty of Bioscience Engineering, Ghent University, Gent 9000, Belgium; AbdulHawil.Abas@UGent.be (A.H.A.)
[2] Department of Biology, Faculty of Mathematics and Natural Sciences, Sam Ratulangi University, Manado 95115, North Sulawesi, Indonesia; trina_tallei@unsrat.ac.id (T.E.T.)
[3] Department of Pharmacy, Faculty of Mathematics and Natural Sciences, Universitas Syiah Kuala, Banda Aceh 23111, Aceh, Indonesia; rinaldi.idroes@unsyiah.ac.id (R.I.)
[4] Pusat Riset Obat Herbal, Universitas Syiah Kuala, Banda Aceh 2311, Aceh, Indonesia;
[5] Pharmacy Study Program, Faculty of Mathematics and Natural Sciences, Sam Ratulangi University, Manado 95115, North Sulawesi, Indonesia; fatimawali@unsrat.ac.id (F.F.)

***** Correspondence: trina_tallei@unsrat.ac.id

Article History

Received 4 May 2023
Revised 28 May 2023
Accepted 9 June 2023
Available Online 15 June 2023

Keywords:
Ficus minahassae
Neutraceutical
Natural medicine
Hagimit
Langusei

Abstract

Plants have been widely utilized as traditional medicine for an extended period of time. Numerous traditional remedies have demonstrated inherent anti-disease properties. Among the countries that extensively rely on traditional medicine, Indonesia stands out. Within the region of North Sulawesi, Indonesia, *Ficus minahassae*, an indigenous plant possessing several health benefits, is utilized by the local community as a traditional medicinal resource. This plant is employed for the treatment of various ailments such as rheumatism, physical discomfort, stimulation of lactation in breastfeeding women, bruises, relapse, fever, fatigue, migraines, bodily pain, headaches, convulsions, colds, coughs, influenza, and fractures. Typically, the leaves, roots, and stems of *F. minahassae* are boiled and consumed. Additionally, this plant has been reported to possess antibacterial and antioxidant properties. However, scientific investigations exploring the health advantages of *F. minahassae* are significantly limited in comparison to other traditional medicines. Consequently, it is highly recommended to conduct further research on the health benefits associated with this plant.

Copyright: © 2023 by the authors. This is an open-access article distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License. (https://creativecommons.org/licenses/by-nc/4.0/)

1. Introduction

Throughout ancient times, the utilization of plants from forest sources as a form of natural medicine has been prevalent and continues to be practiced extensively in contemporary times [1]. While many of these traditional medicinal practices lack scientific basis, a subset of them has been substantiated through scientific investigations, thereby warranting further exploration for the development of effective pharmaceutical interventions [2]. Natural ingredients have also served as the basis for the development of certain drugs, exemplified by aspirin. Salicin, a compound related to aspirin, was discovered over 3,500 years ago when the bark of willow trees was employed for its analgesic and antipyretic properties [3]. The journey of aspirin's development involves contributions from an Oxfordshire priest, scientists at a German dye company, a Nobel Prize-winning discovery, and a series of pivotal clinical studies. Presently, aspirin stands as the most commonly prescribed medication worldwide [4]. Its groundbreaking role in the prevention of cardiovascular and cerebrovascular diseases has established it as one of the most remarkable pharmacological success stories of the century [5].

Health care in Indonesia, Malaysia and the Philippines is inseparable from natural products which are traditional customs handed down from ancestors. In Indonesia, medicines made from natural substances are known as Jamu, and its characteristics have been extensively researched. Jamu has even been commercialized and exported to various countries [6]. Jamu is made up of a single component or a combination of medicinal herbs. *Zingiber aromaticum*, *Curcuma xanthorrhizae*, *Curcuma zedoaria*, *Curcuma heyneana*, *Curcuma aeruginosa, Curcuma longa* are all members of the Zingiberaceae (ginger) family that are commonly used in Jamu [7].

Ficus minahassae (*F. minahassae*) is a medicinal plant from the Moraceae family. Mulberries and figs belong to this family, which produce numerous fruits from many blossoms. The genus *Ficus* is one of around 37 genera in the family. This genus includes around 850 epiphytes, vines, shrubs, and trees. *F. minahassae* is a ficus plant originating from North Sulawesi, Indonesia. The distribution of the plant is not only limited to Sulawesi and surrounding islands such as Kalimantan and Talaud (North Sulawesi), but also to the Philippines and Malaysia [8].

People in North Sulawesi, particularly in the Minahasa regency, have long recognized *F. minahassae* as a medicinal plant. This plant is frequently used to treat a wide variety of health issues, including rheumatism, cough, and fever. In this article, we explore the existing research data on *F. minahassae* with a focus on its health benefits to humans as well as other general uses. This article may serve as an introduction to *F. minahassae* for researchers who wish to delve deeper and provide preliminary data in the direct study of the plant as a source of drug candidates or other follow-up studies pertaining to its use as a source of nutraceuticals.

The helpful or harmful effects of a medicine on living matter are described as biological activity or pharmacological activity in pharmacology. This paper will review the biological activity of an *F. minahassae* extract that has been reported by researchers. Pharmacological/biological activity is one of the most important qualities of chemical compounds since it indicates how the chemicals might be used in medical applications. This area is still missing in herbal medicine, despite its importance, because chemical compounds might have undesirable and poisonous consequences that preclude their use in medical practice, and this section is frequently overlooked in the use of traditional medicine.

2. Distribution, Morphology, and Classification of *F. minahassae*

The word *minahassae* was derived from the name of the region and tribe in North Sulawesi, Minahasa. The natives of the area formerly referred to this plant as langusei [9]. As a result, despite the fact that the plant is now widely distributed in the Philippines (Figure 1), the people of North Sulawesi believe it originated or was discovered in Indonesia. Furthermore, *F. minahassae* has different names in other areas such as mahang kusei, nunu, tambing-tambing, waren kusei in Indonesia [8, 10], tapian diwit in Malaysia, and hagimit [10], alomit [11], aymit [12] and agimit [13] in Philippines. *F. minahassae* usually grows in the middle of primary forest, more specifically in riparian areas or beside rivers [8].

F. minahassae (Teijsm. & de Vriese) Miq belongs to family Moraceae, order Rosales, and class Magnolipsida. The plant typically grows between 50 and 700 masl (meter above sea level), but has also been spotted between 1000 and 1500 masl [14]. The height of this tree can reach 15 meters with white latex on the stems that are typically densely covered with fruiting *Ficus* that looks like a hanging beard (Figure 2a). The fruit of this plant has a very short stalk and is not visible, small, obovoid, the tip is angular and clustered. The base of the branch also produces flowers and fruit. Sessile, tight, spherical fruit that becomes scarlet when cooked. The stems of *F. minahassae* often peel in dry conditions. The leaves (Figure 2b) emerge from the tips of the twigs, are paper-thin, and are covered with long, reddish-brown hairs, particularly on the undersides of the leaves. The leaves are ovate in shape and 10-20 cm long, with serrated edges. The petiole is enlarged, and it is covered in long hair. Glands can be found at the base of the leaf bones (midrib).

F. minahassae bark can be used as a natural rope. *F. minahassae* have single, spirally organized, oblong leaf with a flat border and reddish-brown hairs on the surface and the leaves are often used as traditional medicine. The fruit of this plant also commonly used as a mixture in traditional drinks [10, 15]. Often found near a river which where animals like to go, this plant is also famous as a food source for many animals in the wild. The protein content the plant pulp was comparatively high with low crude fiber, indicating a good correlation with digestibility [16].

3. Phytochemicals of *F. minahassae*

Research on the chemical constituents of plants can help determine which chemicals have positive effects on human health and make it simpler to investigate the mechanism of action of those chemicals, particularly in plants that are frequently employed in the practice of medicinal treatment. It is possible that a chemical

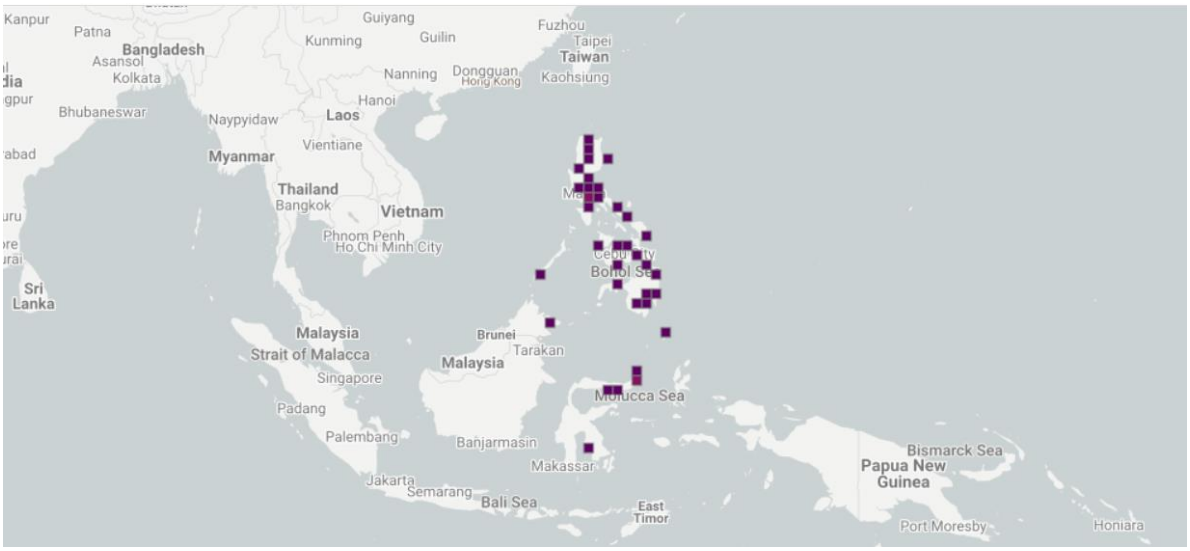

Figure 1. Distribution map of *F. minahassae* via gbif.org *(Ficus minahassae* (Teijsm. & de Vriese) Miq. in GBIF Secretariat (2021). GBIF Backbone Taxonomy. Checklist dataset https://doi.org/10.15468/39omei accessed via GBIF.org on 2022-05-22).

(a) (b)

Figure 2. (a) The fruits, and (b) the leaves of *F. minahassae.*

constituent of medicinal plants is responsible for their anti-disease properties. Alternatively, the beneficial effects of traditional plants may be the result of a synergistic effect, in which two or more chemical constituents of a single plant are responsible for the condition. The plant has a modest amount of alkaloids, flavonoids, tannins, and steroids in their phytochemical screening [17]. Additionally, the fruit contains steroids, flavonoids, tannins, saponins, and polyphenols, but no alkaloids were detected [11]. Tannins, flavonoids, and steroids were found in the leaves, along with some terpenoids and cardiac glycosides. However, the leaves did not have any alkaloids [18]. A study found that dichloromethane extract of *F. minahassae* leaves contained β-sitosterol, phytyl fatty acid ester, squalene and 2-hydroxyethyl benzoate [19].

In addition to phytochemicals, several recent studies have found that endophytic microorganisms such as bacteria and fungi present in plants also have medicinal and general health benefits [20]. Leaves of *F. minahassae* have been found to be hosts for several endophytic bacteria such as *Brachybacterium muris* dan *Pseudacidovorax intermedius* [9].

4. Nutraceutical Value of *F. minahassae*

In 1989, Stephen DeFelice was the first person to use the term "nutraceutical," which describes the role that food plays in the provision of various health and medical benefits [21]. Nutraceuticals are a type of pharmacological alternative that claims to provide physiological advantages. A nutraceutical is a food that contains health-promoting ingredients and has therapeutic properties. Most of traditional medicine is consumed by oral or applied in the surface of the human body. Traditional medicine is a form of hereditary medicine that is passed down from generation to

generation in a region where natural elements from the forest, such as fruits, leaves, roots, and other materials, are used. *F. minahassae* is commonly used as a traditional medicine to cure a variety of ailments, although none of the following have been thoroughly researched for their usefulness.

To cure weariness or physical soreness, the Higaonon people of Mindanao, Philippines, boil the roots of *F. minahassae* in water. It can also assist improve milk production in breastfeeding women. Bruises and boils are treated by rubbing powdered leaves with oil on the afflicted region [22]. The leaves of *F. minahassae* are also used as a rheumatic therapy in North Sulawesi, Indonesia [8]. The people there also used all plant components that are cooked and ingested for better pregnancy and prenatal care [17].

The people of Aurora, Zamboanga del Sur, Philippines, commonly use the roots of *F. minahassae* to treat relapse, fever, fatigue, migraine, body pain and headache. They make drink decoction drink twice a day or as desired with a dose of half a glass [23]. A study also reported that the Manobo Tribe of Prosperidad, Agusan Del Sur, Philippines. Drink squeezed young shoot mixed of *F. minahassae* with the *Alphitonia excelsa* to treat convulsion, colds, cough, fever, influenza [24]. Meanwhile, the local communities of Sitio Lomboyan, Barangay Guinabsan, Buenavista, Agusan del Norte, Philippines, have been reported to use *F. minahassae* roots as a treatment to relapse and fracture, they boiled it with water and serve as a tea [25].

5. Pharmacological Activities

F. minahassae consists of many phytochemicals that can be explored as potential pharmaceutical medicine. This plant has been used traditionally as home remedies for the local people of Philippines and Sulawesi, Indonesia. The summary of *F. minahassae* pharmacological activities are described in Table 1.

5.1. Antibacterial Effects

Anything that kills germs or inhibits their growth or reproduction is considered has antibacterial activity. Antibacterial qualities may be found in heat such as thermophilic bacteria, substances like chlorine, and antibiotic medications. Antibacterial cleaning and handwashing solutions are widely available nowadays. Plants have long been studied to have antibacterial effects. The five genera with the most species studied for antibacterial activity were Acacia, Cinnamomum, Salvia, Teucrium, and Thymus [26].

A study isolated the endophytic bacteria present in *F. minahassae* leaves to test their antibacterial ability, *B. muris* and *P. intermedius* were isolated and tested for their antibacterial ability against *Escherichia coli* and *Staphylococcus aureus* with the findings that *P. intermedius* had an anti-bacterial effect on *S. aureus* but not on *E. coli* and *B. muris* did not show an anti-bacterial effect on both [9].

5.2. Antioxidant Activity

Antioxidants are compounds that can prevent or delay cell damage caused by free radicals, unstable molecules produced by the body in response to environmental and other stresses. Antioxidants also known as "free-radical scavengers." Antioxidants can come from both natural and synthetic sources. Antioxidants are known to be abundant in some plant-based diets. Plant-based antioxidants are a type of phytonutrient, or nutrient that comes from plants.

In a prior investigation, the antioxidant properties of tomatoes (*Lycopersicon esculentum*) were assessed by applying a coating of *F. minahassae* extract (FME). The aim of the study was to ascertain how storage time affected the mature red tomato extracts from F. *minahassae*'s free radical scavenging activity (FRSA). Following the harvest of the tomato fruits on days 4, 6, and 8, coating was performed and FRSA was assessed. Making antioxidant tests using DPPH (1,1-diphenyl-1-picrylhydrazyl) allowed for the evaluation of free radical scavenging activity. The results reveal that after 6 days of storage, the untreated tomato fruit's ability to scavenge free radicals significantly decreased. The free radical scavenging activity, however, was maintained in tomato fruits coated with polar *F. minahassae* extracts for 12 days of storage with just a little decline till the end of its shelf life [27].

5.3. Antiviral Effects

A study found that *F. minahassae* compounds have good binding affinity with SARS-CoV-2 proteins. The ligands used in this work had a reasonably high binding affinity, particularly the -8.4 kcal/mol binding affinity of the β-sitosterol with the receptor-binding domain. When attached to the spike glycoprotein, the phytyl fatty acid ester has a value of -7.3 kcal/mol (closed state). β-Sitosterol and phytyl fatty acid esters showed the highest binding affinity for many SARS-CoV-2 receptors, according to the findings of this investigation [28].

6. Commercial Use

6.1. As a Food Source

F. minahassae has long been known as food for the people of North Sulawesi where the fruit is usually

Table 1. A summary of *F. minahassae* pharmacological activities.

Field of Study	Bioactive	Subject	Dosage	Method	Outcome	Ref
Antimicrobial effects	Endophytic bacteria	*E. coli* and *S. aureus*	100 µl of each isolate	agar well-diffusion method	*P. Intermedius* shows an antibacterial effect on S. aureus	[9]
Antioxidant effects	FME	Tomatoes	-	For 5 minutes, tomato fruits were covered with polar hagimit extracts. The coated tomatoes were tested for free radical scavenging activity throughout their shelf life with totally randomized design at room temperature.	The free radical scavenging activity of the tomato fruit coated with polar hagimit extracts was sustained for 12 days of storage, with only minor reductions until the end of the shelf life compared to 6 days of the uncoated.	[27]
Antiviral effects	Endophytic bacteria	SARS-CoV-2 Main Protease and Spike Protein	-	Molecular Docking	β-sitosterol and phytyl fatty acid esters showed the highest binding affinity for many SARS-CoV-2 receptors	[28]

consumed directly [8], the leaves are used as vegetables and can be eaten directly, and the latex sap is also often consumed [10].

F. minahassae exhibits a broad consumption pattern not only limited to Indonesia but also among various groups in the Philippines. Research conducted in Benguet, Cordillera Administrative Region, the Philippines, revealed that the fruit of *F. minahassae* is extensively consumed by the local population. This study highlights the utilization of the shrub's fruit for the production of jam and traditional wine. Furthermore, observations indicate that this plant is also consumed by avian species, cloud rats, and other wildlife [29]. In Ligao City and Guinobatan, Albay, Philippines, the sap of *F. minahassae* is recognized as a drinkable substance. Local farmers employ it in the preparation of rice, wherein it undergoes boiling and subsequent cooling before consumption [30]. Moreover, a study focused on ethnobotany of plant resources in Conner, Apayao, northern Luzon, Philippines, revealed the utilization of *F. minahassae* as a source of food [13].

6.2. Benefits in Agriculture and Agro-tourism

During the dry season, farmers in upland vegetable growing communities in Ligao City and Guinobatan, Albay, Philippines, use *F. minahassae* as a source of water. The sap is collected from the tree by cutting part of its branches and leaves to allow more sap/water to flow through the incisions made on its trunk. According to the farmers, a fully developed tree can produce a drum of sap, or around 200 L, in two days and two nights. After the sap has been collected from the tree, it stays alive. The sap may be utilized to hydrate the plants as well as to create pesticide solutions for spraying. An indigenous practice is to tap *F. minahassae* sap and use it to water plants [30].

A study proposed that *F. minahassae* is good plant for canopy, retain groundwater and microclimate changer: *F. minahassae* also able to create shade to resist solar radiation, resist strong winds in architectural function of agro-tourism landscape [31].

6.3. Other Uses

A study shows that *F. minahassae* is a fiber-producing plant that is often used as a raw material for clothing in the past in Indonesia [8]. *F. minahasae* has been reported as a source of charcoal and firewood by residents of Tabango, Leyte, Philippines. Water exudates, a large canopy, and a water supply are all characteristics of this plant [32]. *F. minahasse* stem was identified during a survey of plants utilized by the Ayta people of Porac, Pampanga Province, Philippines, as repellents against hematophagous insects. The stem of *F. minahassae* was dried and then burned to repel insects, mostly mosquitos [12].

7. Conservation Status

The International Union for Conservation of Nature (IUCN) Red List of Threatened Species most recently assessed *F. minahassae* in 2018. Least Concern is assigned to this plant. The IUCN put *F. minahassae* in Least Concern because this tree species has a huge population, a wide distribution, and no serious dangers are now present, and no substantial future hazards have been recognized [33].

Although this plant is still quite common in the Philippines and is still commonly found in North Sulawesi,

Indonesia. This plant is considered a non-timber species, maintained and protected in the Philippines' Southern Leyte [34]. According to a study, invasive species such as *Spathodea campanulata* suppress the growth of *F. minahassae* and must be managed in a particular landscape [31].

8. Role in The Native Forest Ecosystem

Every plant in an ecosystem plays an important role, including *F. minahassae*. According to a study, there are seven important species of forage plants that are a food tree for *Macaca nigra* (critically endangered) in the Manembo-nembo Wildlife Reserve in Indonesia. *F. minahassa*e is one of them [35]. Moreover, to establish a nest, *Apis dorsata* Binghami, a native honey bee from Sulawesi that produces the most honey of all honey bees, requires more than 100 plants, one of which being identified is *F. minahassae* [36].

Furthermore, a study conducted at the National Botanic Garden in Quezon, Philippines, looked at a large fruiting *F. minahassae* for a total of 220 censuses in 55 hours over a 5-day period and discovered that seventeen species of birds and one species of mammal visited the fig, but only eight avian and one mammalian species ate the syconia. The bicolored flowerpecker (*Dicaeum bicolor*) was the most common frugivore, with 90.90 percent attendance, followed by the orange-breasted flowerpecker (*Dicaeum trigonostigma*) with 76.82 percent, the Philippine Bulbul (*Hypsipetes philippinus*) with 64.09 percent, and the olive-backed flowerpecker (*Prionochilus olivaceus*) with 45.00 percent [16].

9. Conclusions

F. minahassae is endemic to North Sulawesi in Indonesia, but it can also be found in the Philippines and Malaysia. Rheumatism, physical soreness, improving milk supply in breastfeeding women, bruising, relapse, fever, tiredness, migraine, bodily discomfort, headache, convulsion, colds, cough, influenza, and fractures have all been treated with this plant in the past. This plant's leaves, roots, and stems are commonly boiled and eaten. Furthermore, this plant has antibacterial and antioxidant properties that are beneficial to one's health.

However, to fully explore the therapeutic potential of *F. minahassae* and understand the underlying mechanisms, further research is warranted. The authors suggest several areas of focus for future investigations.

Firstly, more extensive pharmacological studies are needed to identify and isolate the specific active compounds responsible for the plant's medicinal properties. Such studies should aim to explore their pharmacological activities, mechanisms of action, and potential synergistic effects.

Additionally, well-designed clinical trials should be conducted to evaluate the efficacy and safety of *F. minahassae* in treating specific health conditions. These trials should incorporate appropriate control groups and endpoints to generate robust evidence regarding the plant's therapeutic benefits.

Furthermore, comprehensive phytochemical analysis is necessary to uncover the chemical composition of *F. minahassae*. This includes a thorough examination of its secondary metabolites and nutritional content, providing a deeper understanding of its bioactive components.

Lastly, efforts should be made towards sustainable cultivation of *F. minahassae* to meet the increasing demand for its medicinal and nutritional properties. Alongside cultivation, conservation measures should be implemented to protect the plant's genetic diversity and preserve its natural habitats.

By addressing these research areas, we can unlock the full potential of *F. minahassae* as a valuable natural resource for healthcare. This will not only expand our understanding of its therapeutic applications but also contribute to the development of new therapeutic options for various health conditions.

Author Contributions: The following statements should be used “Conceptualization, T.E.T. and A.H.A.; methodology, A.H.A.; formal analysis, A.H.A..; investigation, A.H.A.; resources, R.I.; data curation, A.H.A.; writing—original draft preparation, T.E.T., A.H.A., R.I. and F.; writing—review and editing, T.E.T., A.H.A., R.I. and F.; visualization, A.H.A..; supervision, T.E.T.; project administration, T.E.T. All authors have read and agreed to the published version of the manuscript.

Funding: This work received no external funding.

Data Availability Statement: The data used in this study are available upon request from the corresponding author in accordance with applicable data protection and privacy regulations.

Conflicts of Interest: The authors declare that there are no conflicts of interest regarding the publication of this manuscript.

References

1. Oyebode, O., Kandala, N.-B., Chilton, P. J., and Lilford, R. J. (2016). Use of traditional medicine in middle-income countries: a WHO-SAGE study, *Health Policy and Planning*, Vol. 31, No. 8, 984–991
2. Dashdondov, O., Wazir, J., Sukhbaatar, G., Mikrani, R., Dorjsuren, B., Aktar, N., and Zhou, X. (2021). Herbal nutraceutical treatment of chronic prostatitis–chronic pelvic pain syndrome: a literature review, *International Urology and Nephrology*, Vol. 53, No. 8, 1515–1528
3. Kuphal, G. J. (2018). Chapter 57 - Dysmenorrhea, D. Rakel (Ed.), *Integrative Medicine (Fourth Edition)* (Fourth Edition.), Elsevier, 569-577.e2. doi:https://doi.org/10.1016/B978-0-323-35868-2.00057-8

4. Kwok, C. S., and Loke, Y. K. (2010). Critical overview on the benefits and harms of aspirin., *Pharmaceuticals (Basel, Switzerland)*, Vol. 3, No. 5, 1491–1506. doi:10.3390/ph3051491

5. Desborough, M. J. R., and Keeling, D. M. (2017). The aspirin story–from willow to wonder drug, *British Journal of Haematology*, Vol. 177, No. 5, 674–683

6. Woerdenbag, H. J., and Kayser, O. (2014). Jamu: Indonesian traditional herbal medicine towards rational phytopharmacological use, *Journal of Herbal Medicine*, Vol. 4, No. 2, 51–73

7. Widyowati, R., and Agil, M. (2018). Chemical constituents and bioactivities of several Indonesian plants typically used in Jamu, *Chemical and Pharmaceutical Bulletin*, Vol. 66, No. 5, 506–518

8. Rahayu, M., and Sihotang, V. B. L. (2013). SERAT KULIT KAYU BAHAN SANDANG: KEANEKARAGAMAN JENIS DAN PROSPEKNYADI INDONESIA, *Berita Biologi*, Vol. 12, No. 3, 269–275

9. Tallei, T. E., Linelejan, Y. T., Umboh, S. D., Adam, A. A., Muslem, and Idroes, R. (2020). Endophytic Bacteria isolated from the leaf of Langusei (Ficus minahassae Tesym. & De Vr.) and their antibacterial activities, *IOP Conference Series: Materials Science and Engineering*, Vol. 796, No. 1, 012047. doi:10.1088/1757-899X/796/1/012047

10. Pitopang, R., Lapandjang, I., and Burhanuddin, I. (2011). *Profil Herbarium Celebense Universitas Tadulako Dan Deskripsi 100 Jenis Pohon Khas Sulawesi*, (Z. Basri, Ed.), UNTAD PRESS, Palu

11. Barcelo, R. (2015). Phytochemical screening and antioxidant activity of edible wild fruits in Benguet, Cordillera administrative region, Philippines, *Electron J Biol*, Vol. 11, No. 3, 80–89

12. Obico, J. J. A., and Ragragio, E. M. (2014). A survey of plants used as repellents against hematophagous insects by the Ayta people of Porac, Pampanga province, Philippines, *Philipp Sci Lett*, Vol. 7, No. 1, 179–186

13. Angagan, J. S., Buot, I. E., Relox, R. E., and Rebancos, C. M. (2010). Ethnobotany of the plant resources in Conner, Apayao, northern Luzon, Philippines, *J Nat Stud*, Vol. 9, No. 1, 31–38

14. Sukmawati, J. G. (2019). Keanekaragaman dan distribusi ekologis Ficus spp. di Kalimantan, *Buletin Kebun Raya*, Vol. 22, No. 2, 85–94

15. Kurniawan, M. B., and Pratama, B. (2010). *Mengenal Hewan & Tumbuhan Asli Indonesia*, Cikal Aksara

16. Tabaranza Jr, B. R. (1987). Avifauna of national botanic garden in the UP [University of the Philippines] Quezon land grant, Luzon, Philippines and notes on frugivores at a fruiting fig (Ficus minahassae Teyson and De Vr.; miq.).

17. Kaunang, E. N. S., and Semuel, M. Y. (2017). Botanical and phytochemical constituents of several medicinal plants from mount Klabat north Minahasa, *Journal of Medicinal Plants*, Vol. 5, No. 2, 29–35

18. Lagunay, R. A. E., and Uy, M. M. (2015). Evaluation of the phytochemical constituents of the leaves of Ficus minahassae Tesym & De Vr., Casuarina equisetifolia Linn., Leucosyke capitellata (Pior) Wedd., Cassia sophera Linn., Derris elliptica Benth., Cyperus brevifolius (Rottb.) Hassk., Piper abb, *AAB Bioflux*, Vol. 7, No. 1, 51–58

19. Apostol, P. G., De Los Reyes, M. M., Mandia, E. H., Shen, C. C., and Ragasa, C. Y. (2016). Chemical constituents of Ficus minahassae (Teijsm. & de Vriese) Miq, *Der Pharma Chemica*, Vol. 8, No. 20, 220–223

20. Agrawal, S., Samanta, S., and Deshmukh, S. K. (2021). The antidiabetic potential of endophytic fungi: Future prospects as therapeutic agents, *Biotechnology and Applied Biochemistry*

21. Whitman, M. (2001). Understanding the perceived need for complementary and alternative nutraceuticals: lifestyle issues., *Clinical Journal of Oncology Nursing*, Vol. 5, No. 5, 190–194

22. Olowa, L. F., Torres, M. A. J., Aranico, E. C., and Demayo, C. G. (2012). Medicinal plants used by the Higaonon tribe of Rogongon, Iligan City, Mindanao, Philippines, *Advances in Environmental Biology*, 1442–1450

23. Pucot, J., and Demayo, C. (2021). Ethnomedicinal documentation of polyherbal formulations and other folk medicines in Aurora, Zamboanga del Sur, Philippines, *Biodiversitas Journal of Biological Diversity*, Vol. 22, No. 12

24. Paraguison, L. D. R., Tandang, D. N., and Alejandro, G. J. D. (2020). Medicinal Plants used by the Manobo Tribe of Prosperidad, Agusan Del Sur, Philippines-an Ethnobotanical Survey, *Asian Journal of Biological and Life Sciences*, Vol. 9, No. 3, 327

25. Omac, M. G., Along, A. A., Ligalig, R. J., Rosal, J. J., and Almadin, F. J. F. (2021). Medicinal plants used by the local communities of Sitio Lomboyan, Barangay Guinabsan, Buenavista, Agusan del Norte, Philippines, *Humanities*, Vol. 3, No. 1, 1–14

26. Chassagne, F., Samarakoon, T., Porras, G., Lyles, J. T., Dettweiler, M., Marquez, L., Salam, A. M., Shabih, S., Farrokhi, D. R., and Quave, C. L. (2021). A Systematic Review of Plants With Antibacterial Activities: A Taxonomic and Phylogenetic Perspective , *Frontiers in Pharmacology*

27. Boko, J. M., and Solas, F. M. (2014). Free radical scavenging activity of mature red tomato (Lycopersicon esculentum Mill.) fruit coated with hagimit (Ficus minahassae Mig.) extract, *Philippine Journal of Crop Science (Philippines)*

28. Tallungan, M. E., de Queljoe, E., Fatimawali, F., and Tallei, T. E. (2021). Analysis of Inhibitory Potential of Bioactive Compounds from Langusei (Ficus minhassae Tesym. & De Vr.) against SARS-CoV-2 using an in silico Approach, *Journal of Biotechnology and Conservation in Wallacea (JBCW)*, Vol. 1, No. 1, 1–9

29. Chua-Barcelo, R. T. (2014). Ethno–botanical survey of edible wild fruits in Benguet, Cordillera administrative region, the Philippines, *Asian Pacific Journal of Tropical Biomedicine*, Vol. 4, S525–S538

30. Narvaez, L. M. (2019). Climate Change Responsive Indigenous Knowledge Systems in Crop Farming in Albay Province, Philippines, *Bicol University R & D Journal*, Vol. 22, No. 2

31. Saroinsong, F. B. (2020). Supporting plant diversity and conservation through landscape planning: A case study in an agro-tourism landscape in Tampusu, North Sulawesi, Indonesia, *Biodiversitas Journal of Biological Diversity*, Vol. 21, No. 4

32. Vega, B. A., and Mendoza, J. (2005). Benefits From Tree Growing in the Degraded Uplands: Empirical Realities from Tabango, Leyte, the Philippines

33. IUCN. (2019). The IUCN Red List of Threatened Species, from https://www.iucnredlist.org/species/156203589/156216585, accessed 18-5-2022

34. Polinar, A. N. (2009). Domesticated trees of upland farmers in Southern Leyte, Philippines, *J Nat Stud*, Vol. 8, No. 2, 69–76

35. Yakseb, A., Tasirin, J. S., and Lasut, M. T. (2019). DAERAH JELAJAH DAN PERILAKU MACACA NIGRA DI KAWASAN SUAKA MARGA SATWA MANEMBO NEMBO, *COCOS* (Vol. 1)

36. Semuel, M. Y., Kaunang, E. S. N., and Manopo, J. S. (2019). The bioactive contents and antioxidant activity of honey bee nest extract of Apis dorsata Binghami from the North Sulawesi, *Molekul*, Vol. 14, No. 2, 92–102