

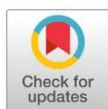
A review on ethnobotanical aspects of *Artocarpus altilis* (Park.) Fosberg (Syn: *Artocarpus communis* J.R.Forst. & G.Forst.) (Breadfruit) In Indonesia

Reza Raihandhany^{1,2*}

¹Division of Botany, Generasi Biologi Indonesia Foundation, Gresik, Indonesia

²Master in Biology Study Program, Faculty of Biology, Universitas Gadjah Mada, Yogyakarta, Indonesia

*Corresponding Author: rezaraihan11@gmail.com



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Abstract

Ethnobotany has a significant impact for discovering medicine and food. The practice which is applied by traditional communities about their relation with plants in daily life can lead to research by scientist in order to seek the evidence from the local knowledge. *Artocarpus altilis* or known sukun as its local name, is one of a plants which widely used in Indonesia. *A. altilis* belong to Moraceae or mulberry family. Literature review was carried out in this research on *A. altilis* utilization as traditional medicine, local food, and any other uses by the traditional communities throughout Indonesia. Result showed that *A. altilis* is used by the traditional communities in almost region of Indonesia start from Sumatera, Java, Madura, Nusa Tenggara, Kalimantan, Sulawesi, Maluku, and Papua except Bali. *A. altilis* is used as traditional medicine. Leaf is the most used part and the way these traditional communities process the medicine by boiling the leaf of *A. altilis*. Other plant part like fruit, root, and bark are also utilized as materials for traditional medicine. Some research support the use of *A. altilis* as medicine. However, in Indonesia the consumption of *A. altilis* is just as a snack food, served by frying it called 'keripik sukun' (re: breadfruit chips). The fruit of *A. altilis* is rich of nutrition source the like carbohydrate, protein, less fat, some minerals, and essential amino acid. *A. altilis* is capable as potential future medicine and alternative food source, therefore more development about the study is still required.

Keywords: Ethnobotany, Food, Medicine, Moraceae, Sukun

Introduction

Artocarpus is a genus which is classified in Moraceae or mulberry family. The genus of *Artocarpus* is well known as an economic important plant species, because many of the species are recognized as an edible fruit producing plants. According to Jarret¹, along with *Ficus* and *Morus*, *Artocarpus* is one of an



economic source of food and medicinal plants for traditional medicine practices, also a commodity in agricultural, as well as in industrial sectors. The species in *Artocarpus* genus which produces edible fruit is *A. heterophyllus*, *A. altilis*, *A. integer*², *A. camansi*³, *A. lacucha*⁴, *A. nitidus* subsp. *lingnanensis*, *A. tonkinensis*⁵, *A. dadah*, *A. lanceifolius*, *A. nitidus* subsp. *Griffithii*, and *A. scortechinii*⁶.

In *Artocarpus* genus, one of the most popular species is *Artocarpus altilis*. *A. altilis* is a traditional and important staple food on Pacific Island^{7,8,9}, Polynesia and then has grown widely and well distributed in tropical, Caribbean and African countries^{8,10}. In Indonesia this plant is consumed whether the raw fruit is eaten directly or cooked and served it by frying, called 'keripik sukun' (re: breadfruit chips). The fruit of *A. altilis* is a good source of carbohydrates and vitamins¹¹ with a low fat. Historically, *A. altilis* is originated from *A. camansi* and *A. mariannensis*^{3,12}. It was originally domesticated about 3.000 years ago in the region of Western Pacific by aboriginal people that spread it throughout Oceania – tropics by migrating Polynesians^{3,12}.

The genus of *Artocarpus* comes from Greek words, *artos* means bread and *carpos* means fruit¹³. According to Small¹⁴, the species epithet of *altilis* is derived from Greek word *too* means fat, referring to its fruit form. Etymologically, *A. altilis* named breadfruit by the exhausted and hungry European seamen, when they made landfall on some Pacific islands in the Middle Ages. By consuming the *A. altilis* cooked fruits, they were saved and the smell of this fruit reminds them of a bread¹⁵.

A. altilis is also known as sukun, its Indonesian local name, is one of the most utilized plants as food source, despite this plant species is as not as popular its relatives, *A. heterophyllus* or nangka. Nonetheless, many Indonesian people including the traditional communities utilize *A. altilis* not only as food plants but also as traditional medicine to treat various diseases. Moreover, *A. altilis* is easily found around because it had been cultivated and planted at roadside, park, backyard, home garden, plantation, side of rice field, open space, urban green space, or even campus/school, etc.

In addition, beside as food plant *A. altilis* has been well known about its efficacy as medicine, for example the leaves have been used traditionally to treat liver cirrhosis, hypertension, and diabetes. Silalahi¹⁶ has made a review that *A. altilis* can be utilized as medicine and alternative food plant.

Ever since a long time ago, plants had been utilized by human in order to provide their basic daily needs like food, as one of the most important basic needs. Ethnobotany is a study of relation between human and plants in their environment¹⁷. Usually, the subject human in this study come from traditional communities. Through these traditional communities' local knowledge, ethnobotany aims to reveal and record the utilization plants for food, clothing, housing, medicine, colouring, and religious or traditional rituals, etc.¹⁸. This research, the article review aims to comprehensively explanation the utilization of *A. altilis* as traditional medicine, food source, and any other usage by the traditional communities in Indonesia.

Materials and methods

Procedures

In this research, the method of literature reviews on various scientific articles published online at Google Scholar using scientific papers, theses, books, and proceeding conferences was carried out. Some of the keywords that was used are: "etnobotani *Artocarpus altilis*", "etnobotani sukun". The results obtained from those sources were compiled and analyzed so as to be able to explain the botany, traditional utilization regarding traditional medicine/ethnomedicine, local food uses, and other uses of *A. altilis* by the traditional tribes/communities in Indonesia.

Results

Botany of *Artocarpus altilis* (Park.) Fosberg

Description

Trees are up to 35(–40) m tall, evergreen or deciduous, buttresses. Twigs are 5–22 mm thick, minutely whitish, appressedly puberulous to subglabrous; lenticel in the upper part of internode or scattered. Leaves spirally arranged, leaf blade coriaceous to chartaceous, elliptic to obovate, 20–80(–100) x 15–50(–60) cm, pinnatifid with 1–5(–9) pairs of lateral lobes or segments, incision mostly to halfway, occasionally down to near the midrib, base cuneate to rounded (to subcordate), apex short acuminate to acute, margin subentire to repand; lateral veins 9–13(–18) pairs, tertiary venation scalariform¹⁹, abaxially pale green, adaxially dark green and shiny⁵; petiole 3–9(–13) cm; stipules (3–)10–25(–35) cm whitish to brownish or brownish to yellowish subsericeous to subvillous or hirsute, caducous. Staminate inflorescences axillary, solitary; peduncle 1–6 cm, whitish to brownish, scabrous to smooth; head cylindrical to clavate to spicate, 5–30(–40) x (0.5–)1–3(–5.5) cm; perianth tubular, 1–2 mm, apex 2-lobed; stamen 1.5 – 2.8 mm, anther 0.6–0.8 mm. Pistilate inflorescences axillary, solitary; peduncle 2–14 cm, whitish strigilose or brown to yellowish hirtellous to (sub)hirsute, scabrous to smooth; head obovoid, ellipsoid, subglobose, or cylindrical; perianth tubular 1 mm, whitish to brownish hispidulous to puberulous (or subglabrous), apex 2-lobed to convex. Infructescences ellipsoid to subglobose to ovoid cylindrical, 5–10(–15) x 5–10 in diameter, covered by 2–3 mm pyramidal, 2–8 mm cylindrical or 8 – 15 mm long subulate to filiform; fruit ellipsoid 1–1.2 or 2–2.5 cm¹⁹.

Local Name

Amo (Totodoku Village, North Maluku), Bakka (Bulo-Bulo village, South Sulawesi), Pedalai (Sungai Mawang Villagge, West Kalimantan) Sokon (Pamekasan Regency, Madura Island, East Java), Sukun (in the most area of Indonesia).

Ecology

The habitat of *A. altilis* is in evergreen forest at low altitudes¹⁹, therefore it is occasionally found in the highlands up to 1.550 m, with mean annual temperature 21–32– (40)°C and mean annual rainfall 2.500–3.000 mm²⁰.

Distribution

A. altilis is native to Caroline Island and Marianas, and it was introduced to Andaman Island, Bangladesh, Brazil North, Brazil Northeast, Brazil Southeast, Brazil West-Central, Cameroon, Central African Republic, Central American Pacific, Chagos Archipelago, Comoros, Cook Island, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Fiji, Gambia, Gilbert Island, Gulf of Guinea Island, Hainan, Haiti, Hawaii, Honduras, India, Jamaica, Java, Laos, Leeward Is., Lesser Sunda Island (Nusa Tenggara), Line Island, Malaya, Maldives, Maluku, Marquesas, Marshall Island, Mexico Southeast, Nauru, New Guinea, Nicobar Is., Niue, Peru, Philippines, Pitcairn Is., Puerto Rico, Samoa, Santa Cruz Island, Seychelles, Society Island, Solomon Island, Southwest Caribbean, Sulawesi, Sumatera, Taiwan, Tokelau-Manihiki, Tonga, Trinidad-Tobago, Tuamotu, Tubuai Island, Tuvalu, Vanuatu, Venezuela, Venezuelan Antilles, and Vietnam²¹.

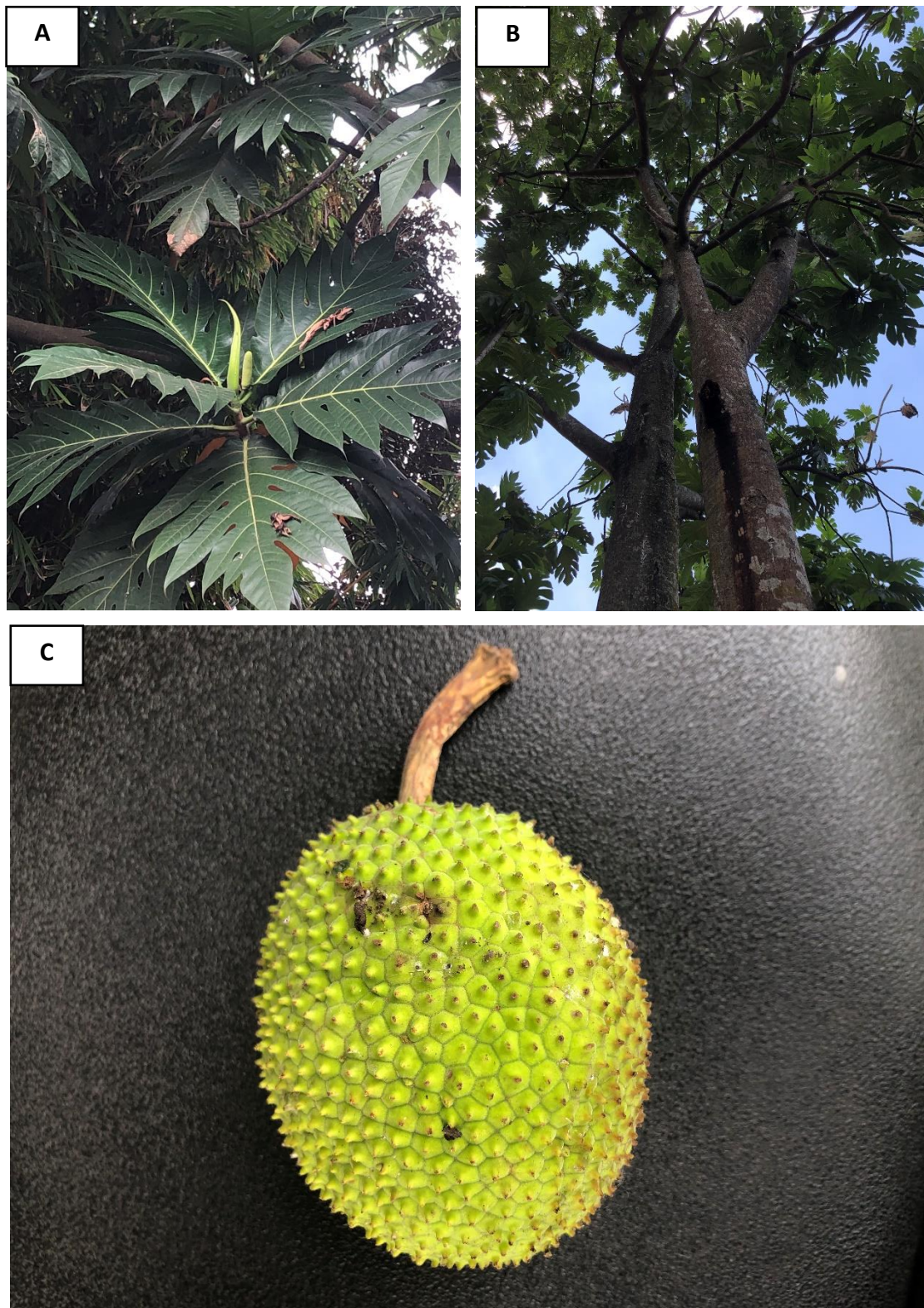


Figure 1. *Artocarpus altilis* (Breadfruit): A. Leaves and Stipule; B. Bark, Branches, and Canopy; C. Fruit

Ethnobotany of *Artocarpus altilis* (Park.) Fosberg

Ethnomedicine Aspect

The aspect of traditional medicine of *A. altilis* has been implemented by traditional communities since a long time ago throughout Indonesia region to treat various diseases. From Sumatera, Study from Safryadi et al.²² reported that people of Rema Village, Bukit Tusam Sub-District, Southeast Aceh

Regency, Aceh utilize leaf of *A. altilis* to cure liver cirrhosis. Washed leaf until clean, boiled it, then cooled the leaf decoction to room temperature after that consume it three times a day. Rizal et al.²³ recorded that Pagar Ruyung Village, Kota Agung Sub-District, Lahat Regency, South Sumatera consume the decoction of *A. altilis* dried leaf to manage the blood sugar level.

Syafitri²⁴ reported that people of Colo Village, Dawe Sub-District, Kudus Regency, Central Java use the leaves decoction of *A. altilis* to treat fever. Three to five leaves are washed till clean then cut them into small pieces. After that, boil the small pieces of leaves with two glasses of water, then reduce it till one glasses of water. Cooled the leaves decoction to room temperature and filter it. Consume the half of the glass in the morning and another half in the noon. Study from Umartani & Nahdi²⁵ recorded that people of on the slopes of Mount Merapi and Merbabu, use *A. altilis* as treatment for gout, despite how to process it is not explained.

In Java, research from Wahyuni²⁶ recorded that the people of Paciran Village, Lamongan Regency, East Java use *A. altilis* to treat rheumatic, cholesterol, and gout. Still from Lamongan Regency, study from Well²⁷ reported people of Laren Sub-District using decoction of *A. altilis* leaf as a treatment for diabetes and stomach ulcer. Habibah²⁸ reported that leaf of *A. altilis* is believed to cure liver cirrhosis and toothache by the people of Sresih Sub-District, Sampang Regency, Madura Island, East Java, despite there is no further explanation about the utilization. Still from Madura Island, Zaman²⁹ revealed that people of Pamekasan Regency in several villages utilize fruit and leaf of *A. altilis* to treat toothache and liver cirrhosis.

From Nusa Tenggara, Azmin et al.³⁰ recorded that people of Lambitu Sub-District, Bima Regency, West Nusa Tenggara to treat stomach ulcer and breast cancer. Stem of *A. altilis* is dried then boiled until the water colored. After that, cooled the stem decoction to room temperature and consume it day and afternoon. A study Tima et al.³¹ reported that people of Nangapanda Sub-District, Ende regency, East Nusa Tenggara to treat gout and diabetes. Yulia et al.³² reported that Topo Uma Tribe, in Oo Parese Village, South Kulawi Sub-District, Sigi Regency, Central Sulawesi use the decoction of several *A. altilis* leaves to treat liver cirrhosis. Consume it three times a day.

From Kalimantan, according to research from Pradityo et al.³³, Dayak Iban Tribe in Sungai Mawang Village, West Kalimantan is believed that the leaf of *A. altilis* can cure diabetes. Still from West Kalimantan, people of Mengkiang Village, Sanggau Kapuas Sub-Districts, Sanggau Regency also utilize *A. altilis* as a medicine. Unlike Dayak Iban Tribe in Sungai Mawang Village that using leaf to treat women after they giving birth, people in Mengkiang Village utilizing bark decoction of *A. altilis* ³⁴.

Study from Randiawati et al.³⁵ showed that Teluk Batang Village, Teluk Batang Sub-District, Kayong Utara Regency of West Kalimantan use root decoction of *A. altilis* to treat cholesterol and manage blood pressure. According to Muthaharoh & Lagiono³⁶ Dayak Bakumpai, Muara Sompoi Village, Murung Sub-District, Murung Raya Regency, Central Kalimantan use the leaves decoction of *A. altilis* to treat (blood) pressure. After boiling the leaves, cooled it to room temperature and consume it once a day.

In Sulawesi, Slamet and Andarias³⁷ recorded that people of Wolio Sub-Ethnic in Baubau City, Southeast Sulawesi utilize the decoction leaf of *A. altilis* as a treatment for diabetes. Tabeo et al.³⁸ reported that Togian Tribe on Malenge Island, Talatako Sub-District, Tojo Una-Una Regency, Central Sulawesi utilize *A. altilis* leaf as a treatment for high blood pressure, however there is no further explanation about how to process it.

To the eastern region of Indonesia, in Maluku, Rupilu & Watuguly³⁹ reported that the Oirata tribe on Kisar Island, South West Maluku Regency using the yellow leaf of *A. altilis* to treat liver cirrhosis. The yellow leaf of *A. altilis* is washed, then boils it until the water turns yellow. That yellow water is consumed whenever the patient feels thirsty, drink it as a substitution of mineral water in daily consumption until he/she is fully recovered. Kiat et al.²⁰ discovered that Hatu Village, Tehoru Sub-

District, Central Maluku Regency, Maluku use the decoction of *A. altilis* stem and fruit to treat kidney pain, hypertension, and to help giving birth become easier.

Study from Batlajery et al.⁴⁰ recorded that people of Watmuri Village, Nirunmas Sub-District, Tanimbar Island Regency utilize *A. altilis* to cure asthma. As many as three old leaves is boiled, after that the water volume that is used to boil those leaves which about three water dipping is then reduced by boiling the water until about two glasses only. However, there is no specific explanation about time period of the consumption.

Soamole et al.⁴¹ recorded the utilization of *A. altilis* as herbal medicine that consist of some plants by the people of Pastina Village, Sanana Sub-District, Kepulauan Sula Regency, North Maluku to treat internal wound. The mixture of the herbal medicine consists of *A. altilis* root + *garcinia mangostana* root + five to six *A. heterophyllus* and *Annona muricata* leaves + three pieces of *Leea angulata* bark + *Pongamia pinnata* bark then add enough water, after that boiled it. Consume it necessarily.

In Papua, Study from Sulastri et al.⁴² record that Tobelo Dalam Tribe of Totodoku Village, Easr Wasile Regency, East Halmahera Regency, Maluku Utara utilize *A. altilis* as their one of medicinal plants that is collected from the forest among any others plants. In Papua, Susiarti & Rahayu⁴³ record that Muyu Tribe in Soa Village, Merauke Regency, Papua utilize *A. altilis* from their backyard to treat stomachache by consuming the leaf decoction.

Local Food Aspect

A. altilis is a plant species which popular as food plant because it produces fruit that can be consumed. In Indonesia, many of people consume *A. altilis*, despite as just a snack food. Patriono⁴⁴ discovered that fruit of *A. altilis* can be used as substitution for rice flour in making breadfruit hardtack in the Sikapat Village, Banyumas Regency, Central Java. Lumbantobing⁴⁵ reported that people of Batak Toba Tribe, Baktiraja Sub-District, Humbang Hasundutan Regency, North Sumatera consume *A. altilis* fruit while take a rest or in family gathering. Therefore *A. altilis* is not a staple food but just as a snack. Study from Setiawan⁴⁶ showed that the utilization of *A. altilis* fruit as a food also in Pamekasan Regency, Madura Island, East Java, in some sub-districts such as Tlanakan, Tadur, Pakong, and Waru.

People of Bera Dolu Village, West Sumba Regency, East Nusa Tenggara use *A. altilis* as snack by frying the fruit. Similar with the Bera Dolu villagers, Nurrahmah⁴⁷ recorded that people of Sepakat Village, Masamba Sub-District, North Luwu Regency, South Sulawesi utilize *A. altilis* not as a medicine plant but as a food source plant from its fruit. The fruit is fried and served as snack. They get the fruit from their forest production area.

From West Kalimantan, there are found three articles about the utilization of *A. altilis* as food source. Dayak Iban Tribe in Sungai Mawang Villagge utilize fruit and seed of *A. altilis* as food source³³. Study from Liyanti et al.⁴⁸ people of Pesaguan Kanan Village South Matan Hilir, Sub-District, Ketapang Regency also utilize the fruit of *A. altilis* as one of their food sources. Dayak Kerabat Tribe in the Tapang Perodah Village Sekadau Hulu Sub-District, Sekadau District are also use the fruit of *A. altilis* as food⁴⁹. According to Amboupe⁵⁰, the Bentong people of Bulu-Bulu village, Barru Regency, South Sulawesi consuming *A. altilis* as vegetables.

Other Uses

Other than medicine and food, *A. altilis* is also used as ornamental plants both at home garden and roadside. *A. altilis* is one of the trees that planted at home garden in Bera Dolu Village, West Sumba, East Nusa Tenggara. Meanwhile people of Pesaguan Kanan Village South Matan Hilir, Sub-District, Ketapang Regency, West Kalimantan using the stem of *A. altilis* as firewood⁴⁸.

Discussion

Almost of people who live in Indonesia region utilize *A. altilis*. Except Bali, region of Sumatera,

Java, Madura, Nusa Tenggara, Kalimantan, Sulawesi, Maluku, North Maluku, and Papua are recorded use *A. altilis* both as food and medicine. Other than food and medicine, *A. altilis* is also used as ornamental plant and firewood. Almost the part of the plants is utilized, such as leaves, fruit, root, bark, and stem.

However, leaves are the part of the plants which are most used, because of their high regeneration to get sprout again and then will not affect the growth of a plant despite the photosynthesis take place in leaves⁵¹. Fruit is also consumed due to its nutritious component in it such as carbohydrates and vitamins¹¹, minerals like calcium, copper, iron, magnesium, potassium⁵², and essential amino acid Liu et al.⁵³.

Anti-Diabetic

According to the result, there are so many practices about diabetes treatment using leaf decoction of *A. altilis*. Several regions in Indonesia by the communities start from Pagar Ruyung Village, Kota Agung Sub-District, Lahat Regency, South Sumatera; Laren Sub-District, Lamongan Regency, East Java; Dayak Iban Tribe in Sungai Mawang Village, West Kalimantan; Wolio Sub-Ethnic in Baubau City, Southeast Sulawesi; Nangapanda Sub-District, Ende regency, East Nusa Tenggara are one of the communities that utilize *A. altilis* leaf decoction to cure diabetes.

Study carried out by Sani et al. showed that the leaf decoction of *A. altilis* has an anti-hyperglycemic effect by the dose of 600 mg/kgBB which was tested in the group of mice. Another study conducted by Putra et al.⁵⁴ showed that the dried leaf extract at a dose of 135 mg and 270 mg have some effects on blood glucose level of mice with diabetes which reduce blood sugar level that's induced by alloxan. Study carried out by Tandi et al.⁵⁵ showed that the ethanol extract of *A. altilis* leaf with the dose of 200 mg/kgBB.

Anti-Hypertension

Beside diabetes, the treatment of hypertension is one of the most applied traditional medicine by some communities in Indonesia using *A. altilis*, start from Teluk Batang Village, Teluk Batang Sub-District, Kayong Utara Regency of West Kalimantan; Dayak Bakumpai, Muara Sompoi Village, Murung Sub-District, Murung Raya Regency, in Central Kalimantan; Togian Tribe on Malenge Island, Talatako Sub-District, Tojo Una-Una Regency, Central Sulawesi; Hatu Village, Tehoru Sub-District, Central Maluku Regency, Maluku.

Research from Chukwuemeka et al.⁵⁶ showed that the aqueous extract of *A. altilis* leaf by intravenous injection of each dose (20.88–146.18 mg/kg) to Sprague–Dawley rats would give hypotensive effect on it. A study carried out by Christian et al.⁵⁷ showed that *A. altilis* fruit extracts produced significant attenuation (20-30 mmHg) of the angiotensin II which could mediate the hypertension in Sprague-Dawley rats.

Liver Cirrhosis Treatment

Other than treat diabetes and hypertension, liver cirrhosis is one of the disease which is treated using *A. altilis*. People of Rema Village, Bukit Tusam Sub-District, Southeast Aceh Regency, Aceh; Sreseh Sub-District, Sampang Regency and Pamekasan Regency of Madura Island East Java; Topo Uma Tribe, in Oo Parese Village, South Kulawi Sub-District, Sigi Regency, Central Sulawesi; and Oirata tribe on Kisar Island, South West Maluku Regency utilize *A. altilis* to treat liver cirrhosis.

A research from Palimbong et al.⁵⁸ recommend the use of *A. altilis* leaf extract to make syrup as a functional drink for people with a liver disease such a hepatitis due to the flavonoid compound of this extract. Therefore, more advance research in vivo should be emphasize in order to make sure about it. Study conducted by Atmaja et al.⁵⁹ showed that the infusion leaf of *A. altilis* with 54 g/kg BW dose has a hepatoprotective effect. The research showed that giving *A. altilis* leaf infusion by 54g/kg BW dose for a

seven days respectively before inducing of 0,4 ml/kgBW dose of carbon tetrachloride perorally two hours after the last *A. altilis* infusion was given has a hepatoprotective effect in rroup of mice.

Nutritions

As mentioned earlier in the introduction, *A. altilis* has a rich source of carbohydrates and vitamins¹¹, also protein⁶⁰. According to Deivanai & Bhore⁵², *A. altilis* is also a source of mineral calcium, copper, iron, magnesium, potassium, thiamine, and niacin, then fiber. According to de Souza et al.⁶¹, the average concentration of mineral in mg 100/mg raw sample of *A. altilis* fruit respectively 269.4 for potassium, 40.97 for phosphorus, 26.32 for calcium, 24.35 for magnesium, 1.41 for sodium, 0.1891 for iron and 0.0381 for manganese; while the sample that cooked by boiling it in stove respectively 140.8 for potassium, 21.82 for phosphorus, 15.49 for calcium, 15.65 for magnesium, 0.7292 for sodium, 0.0965 for iron and 0.0131 for manganese.

Liu et al.⁵³ also stated that *A. altilis* has a great source of amino acid essential such as Lysine (lys), leucine (leu), threonine (thr), tryptophan (trp), histidine (his), isoleucine (ile), valine (val), phenylalanine (phe), tyrosine (tyr), and methionine (met). Due to that, this plant is used as staple food in the region of Oceania¹² and served as a snack in Indonesia.

Conclusions

A. altilis is among important plant species which utilized by traditional communities in almost region of Indonesia, start from Sumatera, Java, Madura, Nusa Tenggara, Kalimantan, Sulawesi, Maluku, and Papua. There is no recorded utilization of *A. altilis* in Bali. Based on literature review, *A. altilis* is utilized as food which served as snack, then the medicinal purposes called traditional medicine or ethnomedicine, to treat various diseases like diabetes, hypertension, stomach ulcer, and gout. Leaf is the most used part to treat those diseases and the way to process traditional medicine is by boiling the leaf in water and then the leaf decoction is consumed by drinking it. Beside leaf, others plant part of *A. altilis* such as fruit, bark, and root are also used as material for traditional medicine. Many of recent research support that *A. altilis* has efficacy as medicinal plant. For food, *A. altilis* contain rich nutrition such as carbohydrate, protein, vitamin, fiber, essential amino acid, and some minerals. However, in Indonesia, *A. altilis* is only consumed as snack, not as stapple food. Other than for traditional medicine and food, *A. altilis* is also utilized as ornamental plant and firewood in particular area. Also, in Indonesia, *A. altilis* is easily found because it is planted at home garden, roadside, some parks, backyard, side of rice field, plantation, open space, urban green space, even school. Therefore, it is fair to say that *A. altilis* is capable and can be categorized as potential future medicine and alternative food source, despite more development about *A. altilis* particularly as medicine is still required.

Acknowledgments

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Conflicts of Interest

The author declares that there is no conflict of interest.

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