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Original Article

Ethnomedicine Study of Tengger People of Ngadas Village in Malang, East Java, Indonesia: In Search of Antimicrobial Plants

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ABSTRACT

Background: New antimicrobial substances are increasingly needed to face issues of antibacterial resistance, and plants are one of the potential sources of these substances. The Tengger people of East Java, Indonesia empirically possess the knowledge of medicinal plants that need to be documented and assessed further for their potencies. **Objectives:** This study aimed to find plants with the potency of antimicrobial activity, by quantifying ethnomedicinal data from The Tengger people. **Materials and Methods:** In this study, snowball sampling was chosen as the sampling method. Information about medicinal plants was obtained by interview with a semi-structured questionnaire, and four indices namely: ethnobotanical richness, use-value index, fidelity level, and knowledge value index were used for quantifying the information gathered from the respondents. **Results:** The results showed that four plants had prominent values of indices, which were adas (*Foeniculum vulgare* Mill.), jambu wer (*Prunus persica* (L.) Batsch), sempretan (*Eupatorium* sp.), and *kayu ampet* (*Astronia macrophylla* L.). Those four plants were recognized by The Tengger people for their medicinal properties, which were anti-diarrhea (jambu wer *and* sempretan), cough reliever (*adas*), and wound remedies (*sempretan*). **Conclusion:** The plants had the potency to be explored further for their antimicrobial activity. Further exploration is needed to find new active compounds responsible for antimicrobial activity.

Key words: Antimicrobial Plants, Ethnomedicine, Ethnopharmacy, Tengger, Indigenous, Indonesia.

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INTRODUCTION

The usage of plants known as remedies by particular ethnic takes an important part in drug discovery. Approximately 80% of defined structure compounds used globally as medicine have had an ethnomedicinal use related to the current use of the active parts of the plants.[1] Recently due to increasing demands of modern lifestyle, accompanied by unplanned development programs of rural areas, has put the traditional knowledge of medicinal plants in the endangered state. Ethnomedicine/ethnopharmacy study is an important strategy to achieve recovery of the knowledge, which is being linked to the conservation of biodiversity, the discovery of new medicines, and the bettering of the quality of life of poor rural communities.[2]

Indonesia has a great potential to become one of the global main sources of ethnomedicinal-based remedies. Indonesia is a home for approximately 1300 ethnic groups, with diversity in cultural identity, as well as traditional knowledge of healing and medication, with a total number of known higher plant species is over 23,975 species.[3,4] Nevertheless, lacking documentation on traditional knowledge of medicinal plants makes this enormous resources less meaningful, whereas the challenge of biopiracy and patenting indigenous knowledge are more increasing. Therefore the necessity of documentation of such knowledge becomes crucial regarding the situation.[5-7]

Tengger people is one of the indigenous ethnic of Java Island, Indonesia. Since the fallen of the Majapahit Kingdom, they isolated themselves and prefer to live in their own environment.[8] Indigenous people of Tengger occupied mountainous areas of today's Bromo Tengger Semeru National Park (BTSNP). In the current time, they reside spread into four districts (Kabupaten) of East Java, which are Lumajang, Pasuruan, Probolinggo, and Malang. Ngadas Village in subdistrict (Kecamatan) Poncokusumo, Kabupaten Malang is one of the villages inhabited by the people of Tengger. Even right now it is the only village in Kabupaten Malang that the majority of the population are Tengger people and the one with the most rapid growth of tourism as well. Farming used to be the main livelihood of Tengger people in Ngadas, alongside their traditional way of life.[9] But then increasing tourism due to breathtaking panoramas around the Bromo Mountain, triggers the alteration of the lifestyle of Tengger people toward modernization, threatening their local knowledge conservation.

There are 181 species, belonging to 150 generas and 66 families were reported by Batoro and Siswanto to be used by Tengger people for their healing properties. The diseases that were claimed to be curable by those medicinal plants varied in a great range, from itch and cold to hypertension and diabetes mellitus.[10] Nonetheless, this precious information of medicinal plants cannot provide us the value of potency of the plants, due to the lack of indexing used in the research. Indices are empowered in social-related research such as ethnomedicine, to deepen the values of the obtained data by quantifying the use of plants and show their importance in the prevailing culture.[11]

This research aims to quantify the medicinal use of plants, known by the Tengger people of Ngadas Village, in Kecamatan Poncokusumo, Kabupaten Malang, specifically for indications that related to infectious diseases. This study is a part of efforts to find new lead compounds for the antimicrobial agent. The expected outcome of this study would not only increase our knowledge about medicinal plants used by the people of Tengger in Ngadas Village but would also leads to the discovery of a new antimicrobial lead compound that may be available for future research.

MATERIALS AND METHODS

The Research Site

Ngadas is the highest village in Java, which is located in the area of Bromo Tengger Semeru National Park (BTSNP), with an altitude of 2200 meters above sea level and an area of approximately 395 hectares. This village is located about 24 kilometers from the center of the Kecamatan Poncokusumo or about 45 kilometers east of the city of Malang. Geographically, Ngadas is located at coordinates between 112°53'50"-112°55'10" east longitude, and between 07°59'40" - 07°58'20" south latitude. The location map of the research site can be seen in Figure 1.

The soil profile of Ngadas consists of dust, sand, and clay which is a type of regosol and cytosol soil, an important factor in the vegetation distribution. In the dry season, surface water is difficult to obtain because of a radical drainage pattern. This is because rainwater seeps through the soil and mountain rocks. In the rainy season, river water flows (does not overflow), and some are stored in the lake (Ranu).

Plants

Plants that information was taken in this study were selected based on the preliminary field survey combined with literature review results. The field survey was conducted for two weeks, together with the period of key informant identification. The authors have screened the medicinal plants data claimed to be used by the Tengger people by the correlation with the antimicrobial properties, according to the indications that were mentioned. The screening resulted in four kinds of indications that related to antimicrobial properties, which were anti-diarrhea, wound remedy, toothache remedy, and cough reliever. There were 32 species of plants included in these classifications. Some of the plants were mentioned for more than one indication, which are *calingan, pulosari,* and *sempretan*. The plants explored in the research are listed in Table 1. The plant determination was done by the Indonesian Institute of Sciences (LIPI), *Kebun Raya Purwodadi* (Determination Letter No. 1140/IPH.06/HM/IX/2019).

Documentation of Plants Information

The Snowball technique was selected as the sampling method. The key informant was identified through the recognition by the authorities, both traditional leader (*dukun adat*) and head of local government (*Kepala Desa*). The respondents then appointed by the key informant, based on his recognition of people possessing traditional knowledge of medicinal plants. These respondents then appointed other respondents through the same recognition process. The number of respondents obtained from the snowball sampling method was not restricted. It was considered sufficient when there were no more new respondents mentioned by the previous respondents.

Figure 1: A map showing the research site at Ngadas, situated at Bromo Tengger Semeru National Park, East Java, Indonesia.[12]

Respondent's willingness and approval for their involvement in the research was an absolute requirement. Therefore informed consent must be understood prior to the interview and other processes in the research. The ethical clearance for the research was issued by The Ethical Commission for Health Research of Faculty of Medicine, Brawijaya University, through issue No. 56/EC/KEPK/03/2018. A semi-structured questionnaire and open interview were used to collect information about the plants. The following information was collected during the interview: knowledge of the plants; local name; medicinal use; part of the plants used as medicine; preparation and route of administration; regimentation; and economical value of the plants. A total of 14 respondents were interviewed to collect the information needed.

Literature survey for supporting claims

Literature surveys of published journal papers were accessed through Google Scholar, PubMed, and Scopus. The claims of therapy mentioned by respondents were validated based on there being any antibacterial laboratory result of each plant.

Data Analysis

Data obtained from this study were then analyzed by indices to assess the potency of the plants quantitatively. The assessment is based on the community reliability of the information. We used four indices namely: Ethnobotanical Richness (ER); Use Value Index (UVI); Fidelity Level (FL); and Knowledge Value Index (KVI). During the study, we found that all of the respondents were possessing knowledge of medicinal plants with lacking medication practices so that we applied modification for the calculation of the indices.

a. *Ethnobotanical Richness* (ER)

ER is a quantification of ethnic-specific usage of the plant.[13] ER value was obtained using the formula:

$$ER = \frac{Er}{n}$$

'Er' reflects the number of respondents knowing the plant for its medicinal property, while 'n' represents the total number of respondents.

b. Use Value Index (UVI)

UVI is a measure of the plant's importance level.[2,14] UVI was calculated using the formula as below:

$$UVI = \frac{\Sigma U}{ns}$$

Where 'U' is the number of uses of the plant mentioned by the respondents, and 'ns' is a number of respondents knowing and applying the medicinal use of the plant.

c. *Fidelity Level* (FL)

FL was calculated to determine the percentage of respondents who claim the use of the plant for the same major medicinal purpose.[15] FL was calculated using the formula:

$$FL = \frac{Np \times 100}{n}$$

'Np' is a number of respondents claiming specific medicinal use of the plant, and 'n' is a number of respondents knowing or applying the plant for any medicinal purpose.

d. *Knowledge Value Index* (KVI)

KVI determines the novelty level in local names not yet documented and further appraises the continued medicinal use of the plant.[16] KVI was calculated as below:

$$KVI = \frac{\Sigma A}{n}$$

'A' is the number of respondents who knows the plant without knowing its botanical name, and 'n' is the total number of respondents

RESULTS

Demographic Data

From the preliminary survey, we found that there was a total of 14 respondents from the village possessing information on medicinal plants. As many as 2 of them were recognized as the key informants (ST and TB) by both *Dukun Adat* and *Kepala Desa*. Most of the respondents were farmers (71.4%), while the other 38.6 % were varied in the professions which were tour guide, trader, teacher, and pensionary of forestry department (Figure 2).

All respondents were male, with ages varies between 35 to 83 years old. Two respondents had never been in any education, 7 respondents have finished their education at elementary school, 2 respondents at junior high school, 1 respondent at senior high school, and only 2 respondents went to higher educational level (Figure 3). It is interesting that the majority of the respondents were the elderly, some of them were middle-aged, and there was no younger generation recognized to possess knowledge of medicinal plants. Related to the knowledge conservation

Table 1: The plants to be analysed.

No	Indication	Plants Local Name	Species
1.	**Anti Diarrhea**	Cemara	*Cassuarina equisetifolia* J.R. and G. Forst
2.		Calingan	*Rubus alpestris* Hook.f.
3.		Jambu Wer	*Prunus persica* (L.) Batsch
4.		Jambu Jawa	*Psidium guajava* L.
5.		Manggis	*Garcinia mangostana* L.
6.		Pulosari	*Alyxia reinwardtii*
7.		Petungan	*Equisetum ramosissimum* (Roxb.ex Vaucher) Hauke
8.		Kayu Ampet	*Astronia macrophylla* L.
9.	**Wound remedy**	Suri Pandak	*Plantago mayor* L.
10.		Sempretan	*Eupatorium* sp.
11.		Klandingan	*Albizia lophanta* (Wild.) Bth.
12.		Ketiu	*Sonchus asper* (L.) Hill
13.		Kayu Kulit	*Cinnamomum burmanni* Ness ex BI.
14.		Menjari	*Sonchus oleraceus* L.
15.		Alang-alang	*Imperarata cylindrica* (Ness) C.E.
16.		Binahong	*Anredera cordifolia* (Tenore) Stenn.
17.		Grinting	*Cynodon dactylon* (L.) Pers
18.		Jamur Impes	*Calvatia bovista* (L.) Van Overeem
19.	**Toothache remedy**	Sirih	*Piper betle* L.
20.		Semboja	*Euphorbia pulcherrima* Willd.ex Klotzsch
21.		Tembakau	*Nicotiana tabacum* L.
22.		Bawang Putih	*Allium sativum* L.
23.		Jarak Jawa	*Ricinus communis* L.
24.		Jambe	*Areca catechu* L.
25.		Jahe Jawa	*Zingiber officinale*
26.	**Cough reliever**	Poo Lanang / Wedok	*Eucalyptus globulus* Labill.
27.		Pulosari	*Alyxia reinwardtii*
28.		Sempretan	*Eupatorium* sp.
29.		Adas	*Foeniculum vulgare* Mill.
30.		Asam	*Cryptocoryne pontederiifolia* Schott.
31.		Bawang Prei	*Allium fistulosum*
32.		Cimplukan	*Physalis peruviana* L.
33.		Calingan / Pagan	*Rubus alpestris* Hook.f.
34.		Jae Wono	*Zingiber* sp.
35.		Jeruk Nipis	*Citrus aurantifolia*

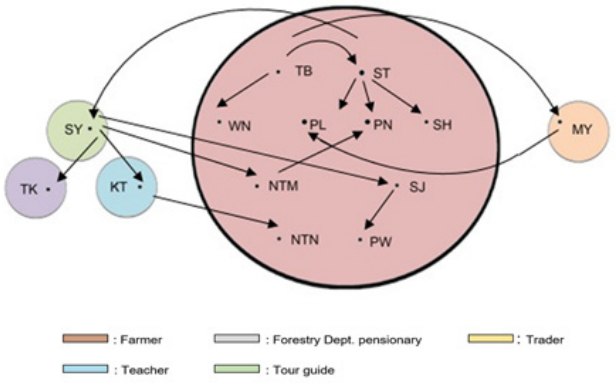

Figure 2: Sample map of the respondents.

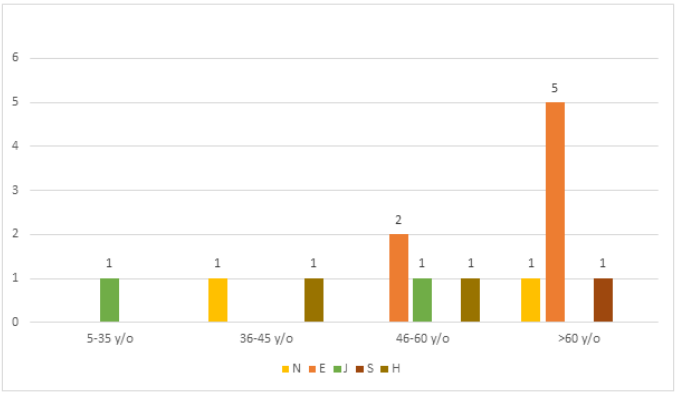

Figure 3: Age and education distribution among the respondents. N = No Educational background; E = Finished at elementay school; J = Finished at junior high school; S = Finished at senior high school; H = Finished at higher education level

issue, it seemed that transferring the knowledge down to the younger generation remains a challenge for the Tengger people.

The Medicinal plants

The plants were spread into 24 families. There were 2 plants that belonged to the family Asteraceae, Euphorbiaceae, Liliaceae, Myrtaceae, Poaceae, Rosaceae, Solanaceae, and Zingiberaceae. The other plants belonged to the family Agaricaceae, Apiaceae, Apocynaceae, Araceae, Arecaceae, Basellaceae, Casuarinaceae, Clusiaceae, Compositae, Equisetaceae, Lauraceae, Melastomataceae, Mimosaceae, Piperaceae, Plantaginaceae, and Rutaceae. There were various parts of the plants used as traditional medicine by The Tengger. The leaf is the most frequent part used for medicine (58.3%), the other parts were fruit (13.9%), root (11.1%), sap (8.3%), whole parts (8.3%), seed, nut, rhizome, and bulb (5.5%), flower, stalk (mushroom), rind, stem, and stem bark, (2.7%). The Tengger also uses mixtures of some parts of plants for medication, there were 4 mixtures noted in this research. Those parts of the plants are prepared mostly in the form of decoction or concoction (36.1%) and then used orally. Other preparation methods were brewing, pounding, or straightly applied by eaten or smeared. The regimentation of the plants for the treatments varied and some of the respondents had difficulties in specifying the information needed. Most of the duration of the treatments were 1 to 3 days.

81.25% of 32 species were reported in the literature to have antimicrobial activities. The authors also determined the information about other uses of the plants, whether medical or non-medical. The results showed that 77.8% of the plants possessed other medical uses, some of them were mentioned to possess three other medical uses or even more, which were sempretan, menjari, adas, and cimplukan. 30.5% of the plants were utilized by The Tengger for non-medical uses such as food and beverage, building material, firewood, ceremonial plant, and animal feed. Some of the plants (55.5 %) also had economical value. This information was gained by asking whether the respondents had any experience in trading the plants or recognize other residents trade the plants. The price of the economically valuable plants was in wide variation, it depends on the availability of the plants (Table 2).

The Indices

The indices describe how reliable information is confirmed by the community. It measures the level of agreement among the respondent, about the information related to the usage of medicinal plants. The result showed that 4 species were well recognized as medicinal plants by ≥70% of respondents, which were *Foeniculum vulgare, Prunus persica*, *Eupatorium* sp., and *Astronia macrophylla* L. The UVI values showed that among those four plants *Eupatorium* sp. (sempretan) had the most indication of medical usage (11), compared to *Foeniculum vulgare* (8), *Astronia macrophylla* L. (7), and *Prunus persica* (2). Meanwhile, the FL index showed that among those 4 plants, *Foeniculum vulgare, Prunus persica*, and *Astronia macrophylla* L. were well known for their specific medicinal use which were cough remedy and anti-diarrhea. While there were only 41.7% of respondents agreed that *Eupatorium* sp. were plant used for wound remedy. Nevertheless, some plants were poorly recognized as medicinal plants such as *Equisetum ramosissimum, Albizia lophanta, Euphorbia pulcherrima, Cassuarina equisetifolia, Psidium guajava, Cynodon dactylon,* and *Areca catechu*. Generally, the plants were recognized by their vernacular name, which showed that the knowledge of the plants was less affected by any influence outside the local environment, as can be seen from the KVI values. The more detailed results are shown in Table 3.

DISCUSSION

The knowledge of medicinal plants is distributed in a certain gender, ages, occupations, and education level. Interestingly, only men are recognized as having knowledge about medicinal plants. It seemed that the men of Tengger have a unique standing in society. This finding is the opposite of many other studies, that generally women possess more traditional knowledge especially related to medicinal plants.[46,47] It is still unclear whether the knowledge of medicinal plants is passed down to men only or not. It can be assumed that health and the healing process are considered as a spiritual-related matter, and as most local wisdom in Indonesia, only men can be chosen as the spiritual leader. However, it is an interesting issue to be further explored regarding the need for medicinal plant knowledge conservation.

Most of the respondents were older than 60 years old, and the second most respondents were aged between 46 and 60 years old. It is common in much rural society, that elders tend to know more about traditional knowledge compared to the younger one.[48,49] Lesser knowledge in the younger population can be caused by the reason that younger people of Tengger are relatively more receptive to modern medication than traditional medication of their elders. This pattern of socio-cultural phenomena is also reported in other communities across the world.[50–52] On the other hand, there seemed no correlation between education level and knowledge about medicinal plants. People who are recognized to have knowledge of medicinal plants have various levels of formal education level. This finding is not surprising since traditional knowledge has been a context of cultural aspect. Thus the length of time spent in

Table 2: Medicinal plants information.

No	Species	Family	Part Used	Method of Preparation	Route	Other Medical Uses	Non-Medical Uses	Economic value (IDR)	Antimicrobial activity support from the literature
Anti Diarrhea									
1.	*Cassuarina equisetifolia* J.R. and G. Forst	Casuarinaceae	L	The leaves are boiled to make a decoction	Oral, 1-3 times a day	None	Firewood	None	17,18
2.	*Rubus alpestris* Hook.f.	Rosaceae	F	The raw fruits are eaten	Oral, 1-3 times a day	None	Food	None	19
3.	*Prunus persica* (L.) Batsch	Rosaceae	F	The raw fruits are eaten	Oral, 1-3 times a day	Asphyxia treatment	Food	None	20,21
4.	*Psidium guajava* L.	Myrtaceae	L	The leaves are dried and then boiled to make a decoction	Oral, 2-3 times a day	Wound remedies	Food	None	2
5.	*Garcinia mangostana* L.	Clusiaceae	Rn	The rinds are pounded or burned	Oral, 2-3 times a day	None	Food	20.000/kg	23
6.	*Alyxia reinwardtii*	Apocynaceae	P	Whole parts of plants are dried, then pounded, and brewed with hot water	Oral, 2-3 times a day	Cough and headache reliever;	None	None	-
7.	*Equisetum ramosissimum* (Roxb.ex Vaucher) Hauke	Equisetaceae	P	Whole parts of plants are boiled to make a decoction	Oral, 3 times a day	Pain reliever	Animal feed	None	-
8.	*Astronia macrophylla* L.	Melastomataceae	SB	Stem Barks are boiled to make a decoction	Oral, 2-3 times a day	Pain reliever; tonic	None	None	-
Wound Remedy									
9.	*Plantago mayor* L.	Plantaginaceae	L	Leaves are pounded and smeared on the wound	Topical, once a day	Pain reliever; tonic;	None	7.000–20.000/kg	24
10.	*Eupatorium* sp.	Compositae	R	Roots are pounded and smeared on the wound	Topical, once a day	Pain reliever; reduce blood pressure, blood sugar level, cholesterol	None	25.000-100.000/kg	25,26
			L	Leaves are boiled to make a decoction	Oral, once a day				
			P	Whole parts of the plants (fresh or dried) are boiled to make a decoction	Oral, once a day				
			R; L	Roots and leaves are dried, then pounded and smeared on the wound	Topical, once a day				
11.	*Albizia lophanta* (Wild.) Bth.	Mimosaceae	-	-	-	Appetite enhancer	Food; building material	2.000-35.000/kg	-
12.	*Sonchus asper* (L.) Hill.	Asteraceae	S	Sap from the stem are smeared on the wound	Topical, once a day	Acne and boil treatment; pain reliever	Food	None	27
13.	*Cinnamomum burmanni* Ness ex BI.	Lauraceae	-	-	-	None	None	-	28

14.	*Sonchus oleraceus* L.	Asteraceae	L	Fresh or dried leaves are pounded and smeared on the wound	Topical, 1-2 times a day	Pain reliever; flatulency treatment; tonic	Ceremony; food	7.000-20.000/kg	27
			L	Dried leaves are eaten	Oral, 1-2 times a day				
			S	The sap of the leaves or stem are smeared on the wound	Topical, 1-2 times a day				
15.	*Imperarata cylindrica* (Ness) C.E.	Poaceae	St	The fresh stem of the grass are pounded and applied to the wound	Topical, Once a day	flatulency treatment; pain reliever	None	None	-
			R	Fresh roots are pounded and applied to the wound	Topical, 3 times a day				
16.	*Anredera cordifolia* (Tenore) Stenn.	Basellaceae	L	Fresh leaves are boiled to make a decoction	Oral	Pain reliever; reduce blood pressure;	None	None	29
			L	Fresh leaves are applied to the wound	Topical				
			L; F	Fresh leaves and fruits are pounded and applied to the wound	Topical, 1-3 times a day				
17.	*Cynodon dactylon* (L.) Pers	Poaceae	P	Whole plants are pounded and smeared on the wound	Topical	Itch treatment; pain reliever;	Ceremony; animal feed	None	30
18.	*Calvatia bovista* (L.) Van Overeem	Agaricaceae	M	The stalks are pounded and applied to the wound	Topical, Once a day	Swelling treatment	None	15.000-60.000/kg	-
Toothache Remedy									
19.	*Piper betle* L.	Piperaceae	L	The leaves are boiled to make a decoction for a gargle or drank	Oral	Cough reliever	Beverage	2.000-20.000/kg	31,32
			L	The leaves are pounded and chewed	Topical				
20.	*Euphorbia pulcherrima* Willd.ex Klotzsch	Euphorbiaceae	S	Fresh sap is dripped to the site of toothache	Topical	None	None	None	33
21.	*Nicotiana tabacum* L.	Solanaceae	L/Fl	Fresh leaves or flowers are applied on the site of toothache	Topical	Itch treatment	Smoke	None	34
22.	*Allium sativum* L.	Liliaceae	B	The bulbs are sliced and applied to the site of the toothache	Topical	Reduce blood pressure; pain reliever	Food seasoning	7.500-40.000/kg	35,36
			B	The Bulbs are mixed with fresh egg and drank	Oral				
23.	*Ricinus communis* L	Euphorbiaceae	Sd	The seeds are burned then applied to the site of the toothache	Topical	Skin moisturizer	Ceremony; food; building material	1.000-5.000/kg	37
24.	*Areca catechu* L.	Arecaceae	N; F	Fresh fruit and nuts are mixed with betel leaves and tobaccos, then chewed	Topical	None	Ceremony; food seasoning	1.000/seed	38
25.	*Zingiber officinale*	Zingiberaceae	Rh	Fresh rhizome are sliced and soaked with water	Oral	Cough reliever	Beverage	20.000/kg	39

Cough Reliever								
26.	*Eucalyptus globulus* Labill.	Myrtaceae	L	Fresh leaves are poured with boiled water	Oral	Stomachache and headache reliever	None	40
27.	*Alyxia reinwardtii*	Apocynaceae	L	Fresh leaves are mixed with *adas*, *sempretan*, and *menjari* then boiled to make a concoction	Oral	Asphyxiate reliever	20.000/kg	-
28.	*Eupatorium* sp.	Compositae	R	Fresh roots are dried then boiled with water to make a decoction	Oral	Reduce blood pressure and sugar level	50.000 – 100.000/ kg	25,26
			L	Fresh leaves are eaten or can be mixed with adas or menjari and boiled to make a concoction.	Oral			
29.	*Foeniculum vulgare* Mill.	Apiaceae	L	Fresh leaves are dried, then poured with boiled water, or can be mixed with *sempretan* and *menjari* and boiled to make a concoction.	Oral	Flatulency and stomachache treatment; flu reliever	10.000 – 25.000/kg	41
30.	*Cryptocoryne pontederiifolia* Schott.	Araceae	L	Fresh leaves are eaten	Oral	None	1.000 – 5.000/kg	-
31.	*Allium fistulosum*	Liliaceae	P	The whole plant is burned and eaten	Oral	flu reliever; sore throat treatment	4.000 – 10.000/kg	42
32.	*Physalis peruviana* L.	Solanaceae	L	Fresh leaves are eaten or can be boiled with water to make a decoction	Oral	Nosebleed, itch treatment; reduce blood pressure	3.000 – 5.000/ kg	43,44
33.	*Rubus alpestris* Hook.f.	Rosaceae	L	Dried leaves are boiled with water to make a decoction	Oral	Nausea, stomachache treatment	None	19
34.	*Zingiber* sp	Zingiberaceae	Rh	Rhizomes are boiled with water	Oral	Stomachache, headache treatment	75.000 – 150.000/ kg	39
35.	*Citrus aurantifolia*	Rutaceae	F	Fresh fruits are squeezed and drank	Oral	None	5.000 – 15.000/kg	45

the classroom will not affect the quality of traditional knowledge. In other studies, the results even showed a contrary, where the length of the formal study had a negative correlation with the possession of traditional knowledge.[53,54]

Indexation will help in quantifying the potential of a medicinal plant. In this study, the value of ethnobotanical richness (ER) shows how much a plant is known for its medical benefits. The value of ER=1 means that all respondents are aware that these particular medicinal plants have medical benefits. The Use Value Index (UVI) and Fidelity Level (FL) values are correlated with ER. The greater the value of UVI means the more medical benefits mentioned by the respondents. But the small UVI value does not mean that the plant's potential is getting lower, it is actually possible that all respondents only recognize a fewer number of medical benefits from particular medicinal plants. In such cases, it can be interpreted that the value of medical benefits from plants is more specific. A high FL value indicates the higher potential of the plant, even though it can be caused by the small number of respondents who recognize the medical benefits of a plant. Meanwhile, the value of KVI shows whether knowledge of medicinal plants possessed by respondents is obtained from within or outside their environment. Analysis of four indices indicated that the conformity among respondents about the use of medicinal plants was weak. The ER values described that there were only 4 plants that were recognized by more than 70% of respondents as medicinal plants, which were *Foeniculum vulgare*, *Prunus persica*, *Eupatorium sp*., and *Astronia macrophylla* L. Among those 4 plants, *Prunus persica* has the most interesting indices profile for its low UVI score. The value shows that *Prunus persica* has the most specific usage for medicinal purposes, which is anti-diarrhea. Several studies support the claim for its antibacterial property. On the contrary, there were no studies found on a literature survey that reported anti-bacterial activity of *Astronia macrophylla* L. It is challenging to explore the plant further

Table 3: Medicinal plants indexations.

No.	Species	ER	UVI	FL	KVI
Anti Diarrhea					
1.	*Cassuarina equisetifolia* J.R. and G. Forst	0.143	0.500	1	0.929
2.	*Rubus alpestris* Hook.f.	0.571	0.250	1	1
3.	*Prunus persica* (L.) Batsch*	0.857	0.167	1	1
4.	*Psidium guajava* L.	0.143	1.500	0.500	0.643
5.	*Garcinia mangostana* L.	0.214	0.333	1	1
6.	*Alyxia reinwardtii*	0.429	0.833	0.333	0.929
7.	*Equisetum ramosissimum* (Roxb.ex Vaucher) Hauke	0.071	2	1	0.929
8.	*Astronia macrophylla* L.*	0.786	0.636	0.818	0.929
Wound Remedy					
9.	*Plantago mayor* L.	0.500	1.143	0.286	1
10.	*Eupatorium sp.**	0.857	0.917	0.417	1
11.	*Albizia lophanta* (Wild.) Bth.	0.071	1	0	0.857
12.	*Sonchus asper* (L.) Hill	0.357	1.400	0.400	0.643
13.	*Cinnamomum burmanni* Ness ex BI.	0.214	0.667	0	0.500
14	*Sonchus oleraceus* L.	0.643	1	0.555	1
15.	*Imperarata cylindrica* (Ness) C.E.	0.643	0.889	0.333	0.929
16.	*Anredera cordifolia* (Tenore) Stenn.	0.500	0.714	0.429	0.643
17.	*Cynodon dactylon* (L.) Pers	0.143	2	0.500	0.929
18.	*Calvatia bovista* (L.) Van Overeem	0.429	0.833	0.333	1
Cough Reliever					
19.	*Piper betle* L.	0.428	1.166	0.333	0.785
20.	*Euphorbia pulcherrima* Willd.ex Klotzsch	0.071	1	1	0.571
21.	*Nicotiana tabacum* L.	0.285	0.500	0.750	0.929
22.	*Allium sativum* L.	0.428	1.166	0.333	1
23.	*Ricinus communis* L.	0.285	1	0.50	1
24.	*Areca catechu* L.	0.143	0.500	1	0.929
25.	*Zingiber officinale*	0.428	0.333	0	0.929
Tooth Ache Remedy					
26.	*Eucalyptus globulus* Labill.	0.210	1.670	0.330	0.210
27.	*Alyxia reinwardtii*	0.500	0.710	0.710	0.930
28.	*Eupatorium sp.*	0.640	1.220	0.570	1
29.	*Foeniculum vulgare* Mill.*	1	0.570	1	1
30.	*Cryptocoryne pontederiifolia* Schott.	0.071	1	1	0.860
31.	*Allium fistulosum*	0.430	0.500	1	1
32.	*Physalis peruviana* L.	0.500	1.140	0.430	1
33.	*Rubus alpestris* Hook.f.	0.500	0.860	0.140	0.930
34.	*Zingiber sp*	0.430	1	0.500	0.860
35.	*Citrus aurantifolia*	0.290	0.250	1	0.640

since the indices values showed a strong consensus among respondents for the use of *Astronia macrophylla* L.

CONCLUSION

Even though there were many plant species were mentioned by the Tengger People to have medical properties, this study showed that only a few of them were agreed communally. This wide variation of information can be caused by various factors that needed to be studied more in-depth. Nevertheless, there were four plants that were highly recognized by the Tengger people as medicinal plants, that is need to be further explored for their antimicrobial properties, among them *Prunus persica* and *Astronia macrophylla* L. were the most interesting ones. Several studies supported the claim, however, more in-depth laboratory researches are needed to discover substances that are potential as an antibacterial lead compound.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

ABBREVIATIONS

ER: Ethnobotanical Richness; **UVI:** Use Value Index; **FL:** Fidelity Level; **KVI:** Knowledge Value Index; **L:** Leaf; **F:** Fruit; **Fl:** Flower; **R:** Root; **Rn:** Rind; **Rh:** Rhizome; **P:** Whole Plant; **S:** Sap; **Sd:** Seed; **N:** Nut; **St:** Stem; **SB:** Stem Bark; **B:** Bulb; **M:** Mushroom.

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