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Ethnobotanical study of wild medicinal plants in Serbajadi protected forest of East Aceh District, Indonesia

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Abstract. *Navia ZI, Adnan, Harmawan T, Suwardi AB. 2022. Ethnobotanical study of wild medicinal plants in Serbajadi protected forest of East Aceh District, Indonesia. Biodiversitas 23: 4959-4970.* The Serbajadi protected forest of East Aceh District has high biodiversity including medicinal plants which have been utilized by the community as traditional medicine. However, their knowledge of ethnobotanical uses of medicinal plants is threatened due to the lack of written records and the rapid socio-cultural changes as a consequence of economic development. Therefore, this study aims to study wild medicinal plants and traditional knowledge in the Serbajadi protected forest, East Aceh District, Indonesia. This study used a combination of data collection methods, namely field surveys, plant collections, and community interviews. The snowball sampling technique was used to select 320 interviewees. The results showed that local people use 88 different wild medicinal plant species from 78 genera and 46 families to treat 32 different diseases. The most common ailments to cure are fever, cough, and diarrhea. *Ageratum conyzoides* is the most known medicinal plant species with a relative frequency citation index of 0.97, while *Acorus calamus* is the most commonly used medicinal plant in the local community with a use value index of 0.99. Furthermore, locals identified leaves (75%) as the most commonly used plant part and decoction (55%) as the most common method of administering traditional medicine. The elders know more about medicinal plants than the younger generation, indicating that traditional knowledge is eroding as generations pass. In order to ensure the sustainability of medicinal plants and the preservation of traditional knowledge in the future, the initiative to preserve medicinal plants must be increased, particularly among the younger generation.

Keywords: Biodiversity, East Aceh, Serbajadi, traditional knowledge, wild medicinal plant

INTRODUCTION

Since the ancient period, medicinal plants have been widely used as medicine for a variety of diseases by people all over the world (Qureshi et al. 2016). Traditional wisdom regarding medicinal plants and their usage has been passed down from generation to generation and has proven to be effective in maintaining the health of local populations (Silalahi 2016). The information regarding the usage of traditional medicinal plants serves as a starting point to generate scientific data produced from ethnomedicine research, and this is one of the most efficient ways to discover new compounds in therapy, both in terms of time and money (Purwanto 2002). Such scientific effort makes medicinal plants continue to entice the pharmaceutical industry, particularly in the search for superior modern medications (Rivera et al. 2005).

Phytotherapy is used by an estimated 80 percent of the world's population (Miraldi and Baini 2018). Antiviral activity has been discovered in a variety of plants. According to Perez (2003), 20-30% of tropical plants have antiviral activity. Plants with medical uses have long been utilized to treat a variety of infectious and non-communicable disorders. Medicinal herbs have long been used in both developing and developed countries (Kidane et al. 2018; Hu et al. 2020; Elfrida et al. 2021; Pathy et al. 2021). According to the World Health Organization (WHO), herbal medications are utilized by roughly 80% of the world's population for health care systems particularly in rural regions (Hu et al. 2020), owing to the country's lack of modern health facilities. These traditional medicines have evolved into a source of low-cost primary health care (Aziz et al. 2018).

Indonesia has a high biodiversity with approximately 30,000 species of flowering plants, of which 7000 species are known to have medicinal potentials (Jumiarni and Komalasari 2017; Navia et al. 2021; Elfrida et al. 2021). For example, a study by Setiawati et al. (2016) found that many plants in the forest contain substances with pharmacological properties and bioactivity that can be utilized to cure mild, serious, and degenerative disorders, as well as cancer. The high diversity of plants is also important in terms of cultural aspect (Silalahi 2016; Sutrisno et al. 2020), as well as for the provision of food (Navia et al. 2020b; Sutrisno et al. 2021; Syamsuardi et al. 2022; Ramaidani and Navia 2022; Suwardi et al. 2022a), fuelwood, construction material and fodder (Elfrida et al. 2020; Noverian et al. 2020; Navia et al. 2020a; Suwardi et al. 2020).

Each ethnic group in Indonesia has its unique knowledge of how to use diverse biological resources, including for medication and health care. Ethnobotanical knowledge of medicinal plants has long been owned by local communities across Indonesia (Ani et al. 2021), and this tradition was established by the people of Kalimantan and subsequently promoted by the people of Java (Nurrani et al. 2015). The community's knowledge and skills in the usage of traditional medicinal herbs have been passed down through oral storytelling from generation to generation and have been preserved till now (Suwardi et al. 2021; Navia et al. 2021b). The use of medicinal plants and the collection of knowledge about traditional pharmaceutical methods is a rich cultural heritage that is an intrinsic part of local customs and culture, and it must be preserved in order to ensure its long-term usage. Yet, such traditional knowledge is threatened to be eroded or even lost or endangered (Pathy et al. 2021) due to various factors, including westernization, acculturation, and education; population reduction and extinction of medicinal plants caused by degradation and destruction of natural habitats; and a lack of passion among young people for traditional culture (Yineger et al. 2008; Merétika et al. 2010; Ianni et al. 2015; Bruschi et al. 2019; Weckmüller et al. 2019; Suwardi et al. 2021; Suwardi et al. 2022b).

The Acehnese, one of the biggest ethnic groups in Aceh Province, and the Jamee Anak Tribe in South Aceh have both used plants as medicine (Suwardi et al. 2021; Navia et al. 2020b; Navia et al. 2021b; Adnan et al. 2022). Red ginger (*Zingiber officinale* Roscoe), turmeric (*Curcuma longa* L.), temulawak (*C. xanthorriza* Roxb), guava (*Psidium guajava* L.), and garlic are among the plants used by the Acehnese and Anak Jamee. Antibacterial and antiviral activities are reported to exist in *Allium sativum* L. (Suwardi et al. 2021). Although the usage of medicinal plants in Indonesia has been reported in several locations, particularly in Aceh Province (Elfrida et al. 2021; Navia et al. 2020b; Navia et al. 2021b; Adnan et al. 2022), much of their knowledge data has not been recorded, including the community in East Aceh District. Furthermore, the lack of written records and conservative inheritance behavior poses a threat to traditional medicinal knowledge. Traditional knowledge can be used to help with on-the-ground conservation (conservation in natural habitats) (Suwardi et al. 2022b). Therefore, medicinal plants, as well as the related indigenous wisdom in this area, must be studied and documented.

The aim of this study was to examine medicinal plants and traditional knowledge by local communities living around Serbajadi protected forest, East Aceh District, Indonesia. The Serbajadi protected forest is one area that still preserves biodiversity in Aceh Province. The multipurpose protected forest area is 167,317 Ha in size, with the Gayo Tribe being the majority of the population of the area (The Central Bureau of Statistics of East Aceh District 2021). The importance of the protected forest in terms of biodiversity and the uniqueness of the Gayo people provide an excellent context for the ethnobotanical study of medicinal plants since local communities living in the surrounding area still practice local wisdom, mainly using plants as food (Ramaidani and Navia 2022) and medicine.

MATERIALS AND METHODS

Study area

This study was conducted in fifteen villages of Serbajadi sub-district (4°37'42.3"N, 97°24'00.6"E, 1250 m a.s.l.), East Aceh District, Indonesia including Lokop, Tualang, Terujak, Leles, Ujung Karang, Umah Taring, Sunti, Sekualan, Loot, Nalon, Jering, Rampah, Mesir, Selemak, and Sembuang villages (Figure 1).

The area has a tropical humid climate with a dry season that lasts from January to July and a rainy season that lasts from August to December. The average annual rainfall is 6,369 mm, with an average of 255 rainy days, and the average rainfall is 455/18 mm/day. The average temperature is around 20.10°C, with an average humidity of 80%. The topography is generally mountainous and hilly, and the area is characterized by a cropping system dominated by rice and vegetables (The Central Bureau of Statistics of East Aceh District 2021).

Sample size and informant selection

Fifteen villages were sampled as presented in Table 1. To ensure a representative sample for the fifteen villages, the sample size was determined using Cochran's sample size formula as presented by Bartlett et al. (2001).

$$n = N/1 + N(e)2$$

Where: n is the research sample size, N is the total number of households in all fifteen selected villages, e is the maximum variability or margin of error of 5% (0.05), whereas 1 is the probability of the event occurring. As a result, a total sample size of:

$$n = 1{,}592/L + 1{,}592(0.05)2,\ n = 320$$

The sample size of informants for each village was determined based on the proportion of households (HH) in the respective villages. For example, the total number of households in Tualang was 125, yielding a number of 25 (n = 125 x 320/1,592 = 25). The same calculation was performed for the other villages as shown in Table 1.

Ethnobotanical data collection

Fieldwork was conducted for data documentation and plant collection. Before the interviews, all informants were provided formal written consent, including permission for publication. A total of 320 women informants were divided into six age groups (1) 15-25, (2) 26-35, (3) 36-45, (4) 46-55, (5) 56-65 and (6) > 65 years old. The selection of women respondents was based on the rationale that women are commonly responsible to give treatment when family members get health problems. Interviews and transect walks were the most common techniques of field surveys. Informants were asked to complete a semi-structured questionnaire about their traditional knowledge, plant use, disease treatment, plant's part used, and method of preparation and administration. All interviews were conducted in their native language (majority in Gayo language) with the assistance of native translators, and the data was then translated into English.

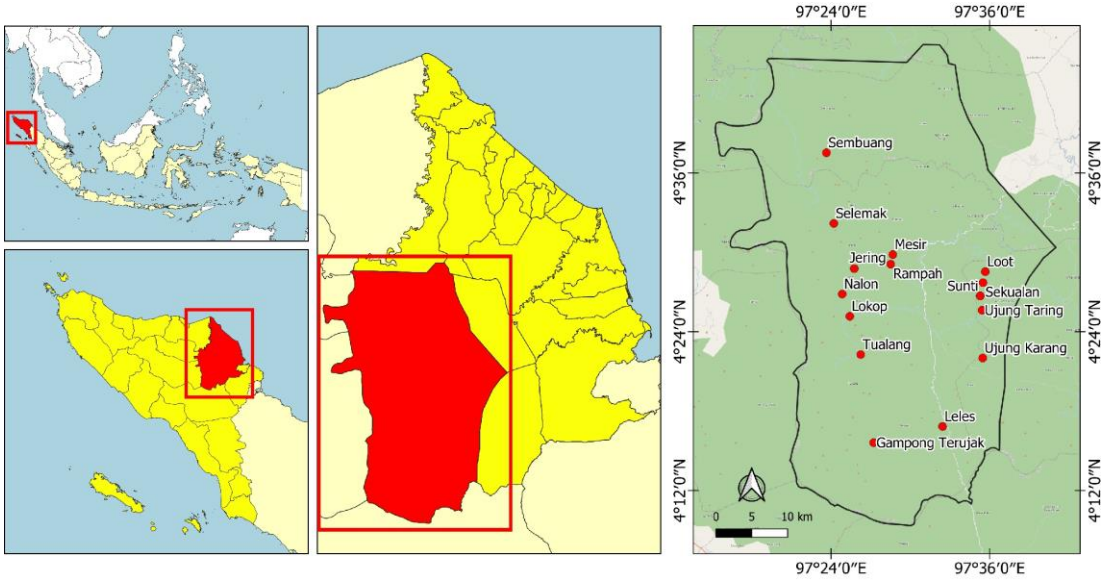

Figure 1. Shows the site of the studied area. Serbajadi Subdistrict, East Aceh, Indonesia

Table 1. The sample size of respondents of the selected villages

Name of village	Area in km^2	No. of population	No. of households	No. of respondents involved in the study
Jering	150	374	119	24
Leles	200	454	134	27
Lokop	81.71	659	195	39
Loot	75	421	128	26
Mesir	125	173	72	14
Nalon	125	384	104	21
Rampah	175	429	144	28
Sekualan	150	306	102	21
Selemak	74.72	251	78	16
Sembuang	135	243	76	15
Sunti	120	318	108	22
Terujak	150	332	101	20
Tualang	50.11	399	125	25
Ujung Karang	243.46	225	63	13
Umah Taring	115	133	43	9
Total	1,970	5,101	1,592	320

Species documentation and identification

During the field survey, plant specimens were collected. The voucher specimens were identified at the Laboratory of Biology, Universitas Samudra, Aceh, Indonesia. The botanical name was updated using the Plants of the World Online website (https://powo.science.kew.org/).

Data analysis

Relative Frequency Citation (RFC)

The ethnomedicinal data were quantitatively analyzed using a relative frequency citation (RFC) index to represent the local importance of each species (Vitalini et al. 2013) as formulated below:

$$RFC = FC/N \ (0 < RFC < 1)$$

Where: the frequency of citation (FC, the number of informants mentioning the use of the species) divided by the total number of informants participating in the survey (N).

Use Value (UV)

The relative importance of a given medicinal plant species was calculated using the Uvs (medicinal use-value) parameter developed by Evert et al. (2009):

$$UV_s = \sum_{i=1}^{n} \frac{U_{is}}{N_s}$$

Where: Uvs represents the use-value of a given species *s*; U represents the number of uses of species *s* mentioned by respondent I and Ns represents the total number of respondents. High UV indicates high use reports for a plant that is important to the local community. Low UV indicates that there are few reports of its use.

Informant Agreement Ratio (IAR)

The Informant Agreement Ratio (IAR) was calculated in the manner described by Nzuki et al. (2013):

$$IAR = \frac{Nr - Na}{Nr - 1}$$

Where: Nr is the total number of citations for the species and Na is the number of diseases for which the species has been cited.

Informant Consensus Factor (ICF)

The Informant Consensus Factor (ICF) is calculated as follows by Cornara et al. (2014):

$$ICF = \frac{N_{ur} - N_t}{N_{ur} - 1}$$

Where: Nur represents the number of useful reports in each category and Nt represents the total number of species used by all informants in a given category.

RESULTS AND DISCUSSION

Socio-demographic characteristics

A total of 320 informants were interviewed during this study, all of them are women between the ages of 15 and 90 years. The majority of them had an elementary level of education (36.88%), while the percentages of other levels (Junior, Senior, University, and no education) were 26.25%, 22.5%, 8.75%, and 5.63%, respectively (Table 2).

Diversity of wild edible fruit plants and their uses

In the study area, 88 medicinal plant species from 46 families were identified. Table 3 contains ethnomedicinal information for each species, including its family name, scientific name, vernacular name, growth form, plant parts used, preparation, application methods, and disease.

Asteraceae and Lamiaceae contributed the most medicinal species, with 8 species each (Figure 2), followed by Euphorbiaceae with 5 species, Fabaceae and Poaceae with 4 species each, Acanthaceae, Burseraceae, Cyperaceae, and Myrtaceae with 3 species each, and the remaining families each with one or two species. Another study found that Asteraceae and Lamiaceae were the dominant families with 5-15 medicinal plant species in South Aceh (Suwardi et al. 2021), Malaysia (Ramli et al. 2021), Pakistan (Hussain et al. 2022), Southwest Algeria (Bouafia et al. 2021), and Ethiopia (Bahadura et al. 2020; Chekole et al. 2015; Getaneh and Girma 2014; Meragiaw et al. 2016).

The Asteraceae family's dominance may be due to the fact that it contains a diverse range of biologically active compounds and is the largest family in the plant kingdom (Chijindu et al. 2020). Other studies, however, discovered that Zingiberaceae (Navia et al. 2021) and Euphorbiaceae (Jima and Megersa 2018; Tamiru and Asalfew 2016) were dominant over others. The use of the same plant species in different locations may be due to their widespread distribution, to serve a specific purpose, or to traditional knowledge becoming a closely guarded secret (Tugume and Nyakoojo 2019).

Growth form and plant parts used

The results of growth form analysis revealed that herbaceous plants represent the highest proportion (42 species), followed by the tree (27 species), shrub (14 species), and climber (5 species) (Figure 3).

Several previous studies show similar results that 39.9%-72.64% of respondents use herbaceous plants as traditional medicines both in Indonesia and in other countries (Amsalu et al. 2018; Ali et al. 2020; Hu et al. 2020; Kidane et al. 2018; Hussain et al. 2022). This is likely because the search and mode of use of this plant group are easy besides the therapeutic indication of its medicinal properties (Baydoun et al. 2015; Bahadura et al. 2020). However, a study conducted in Aceh Tamiang District reported that the dominant medicinal plants were shrubs (33%) and Ani et al. (2021) found that trees were the dominant medicinal plant species in Ndano village, West Nusa Tenggara. The variation in the use of ethnomedicine based on the growth form of this medicinal plant can depend on differences in environmental conditions, belief systems in socio-cultural aspects, and medical practices in various regions and countries.

Local communities in the study area use different plant parts to prepare traditional medicine (e.g., leaf, stem, root, bark, and fruit) (Figure 4).

Table 2. Socio-demographics of respondents

Variable		Total	Percentage
Gender	Women	320	100
Age	15-25	32	10
	26-35	63	19.69
	36-45	74	23.13
	46-55	61	19.06
	56-65	62	19.38
	>65	28	8.75
Education	No education	18	5.63
	Elementary school	118	36.88
	Junior High School	84	26.25
	Senior High School	72	22.5
	University	28	8.75

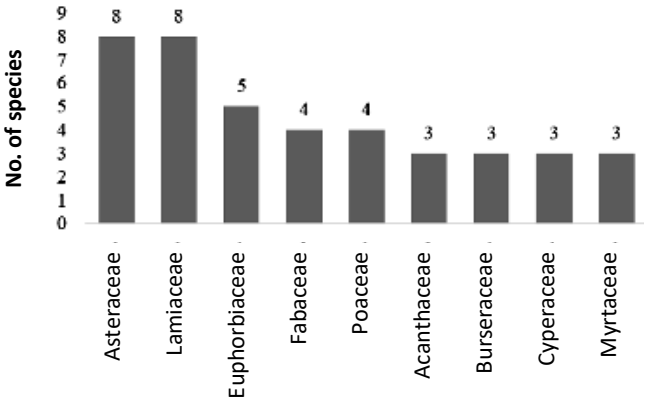

Figure 2. Number of plant species by the family of medicinal plants in Serajadi Sub-district, East Aceh, Indonesia

Table 3. List of wild medicinal plants in Serajadi Sub-district, East Aceh, Indonesia

Family Species name	Vernacular name	Growth form	Plant part used	Mode of preparation	Disease	RFC	UV
Acanthaceae							
Clinacanthus nutans (Burm.f.) Lindau	Daun gajah	Herb	Leaf	Decoction	Fever	0.63	0.90
Pseuderanthemum variabile (R.Br.) Radlk.	Bunga lede	Herb	Leaf	Decoction	Hypertension, diarrhea, rheumatoid, dysentery, constipation, flu	0.94	0.94
Strobilanthes phyllostachya Kurz	Keji beling	Shrub	Leaf	Powder Decoction	Wound, swelling Stomachache	0.81	0.87
Acoraceae							
Acorus calamus L.	Jerangau	Herb	Rhizome	Decoction	Stomachache, diarrhea	0.75	0.99
Amaryllidaceae							
Crinum asiaticum L.	Bakung	Herb	Rhizome, Leaf	Powder Decoction	Wound, animal bite, Headache, fever, skin disease, ulcer	0.42	0.33
Annonaceae							
Meiogyne virgata (Blume) Miq.	Bunga selanga	Tree	Leaf	Powder Decoction	Wound Stomachache	0.45	0.45
Maasia glauca (Hassk.) Mols, Kessler & Rogstad	Pete jawa	Tree	Leaf	Powder	Wound	0.27	0.27
Apiaceae							
Centella asiatica (L.) Urb.	Daun pegege	Herb	Leaf	Powder Decoction	Skin diseases, wound Headaches, ulcers	0.72	0.98
Aquifoliaceae							
Ilex cymosa Blume	Unknown	Tree	Leaf	Powder	Skin disease	0.11	0.11
Asparagaceae							
Dracaena angustifolia (Medik.) Roxb.	daun nongkal/ daun suji/bulat lepat	Shrub	Leaf	Powder	Allergy	0.14	0.14
Asteraceae							
Acmella uliginosa (Sw.) Cass.	Jotang	Herb	Leaf	Decoction	Mouth ulcers, toothache, sore throat, stomach ache, toothache	0.91	0.91
Ageratum conyzoides L.	Karpe Bau	Herb	Leaf	Decoction	Stomachache, fever, flu	0.82	0.97
Austroeupatorium inulifolium (Kunth)	Daun kaper/daun kirinyuh	Herb	Leaf	Decoction	Cough	0.97	0.95
Bidens biternata (Lour.) Merr. & Sherff	Korpe kerebu/subang	Herb	Bark Leaf	Decoction Infusion Powder	Malaria, Leprosy, ulcers, diarrhea, digestive disorders, flu Wound	0.13	0.38
Chromolaena odorata (L.) R.M.King & H.Rob.	Minjangan	Shrub	Leaf	Powder	Flatulence, skin disease	0.31	0.25
Clibadium surinamense L.	Kerpe kucing	Shrub	Leaf	Decoction	Fever	0.27	0.23
Crassocephalum crepidioides (Benth.) S.Moore	Kerpe kapas	Herb	Leaf	Powder Decoction	Wounds Stomachache	0.38	0.38
Dichrocephala integrifolia (L.f.) Kuntze	Kerpe sosom/ bandutan	Herb	Leaf	Decoction	Malaria, pains, asthma, worm infections	0.28	0.46
Aspleniaceae							
Diplazium esculentum (Retz.) Sw	Kloang	Herb	Leaf	Powder, Decoction	Itch, Cough, diarrhea, fever, postpartum care	0.72	0.72
Basellaceae							
Anredera cordifolia (Ten.) Steenis	Kerpe kekurian/ daun binahong	Herb	Leaf	Powder Decoction	Wound, Appetite	0.31	0.66
Burseraceae							
Dacryodes incurvata (Engl.) H.J.Lam	Kedondong	Tree	Leaf	Powder, Decoction	Wounds, Ringworms	0.09	0.12
Dacryodes rugosa (Blume) H.J.Lam	Daun loupok	Tree	Leaf	Powder	Wounds	0.03	0.03
Santiria rubiginosa Blume	Pasak bumi	Tree	Leaf	Decoction	Stomachaches	0.02	0.02
Campanulaceae							
Hippobroma longiflora (L.) G.Don	Katarak	Herb	Leaf	Decoction	Eye ache	0.55	0.59
Caryophyllaceae							
Drymaria cordata (L.) Willd. ex Schult.	Daun complonan	Tree	Leaf	Decoction	Cold, headache, ulcer	0.35	0.35
Clusiaceae							
Garcinia bancana Miq.	Mundu	Tree	Fruit	Juice	Cough, sore throat, diarrhea	0.91	0.90
Garcinia xanthochymus Hook.f. ex T.Anderson	Asam kandis	Tree	Fruit	Juice	Cough, fever, sore throat, diarrhea	0.90	0.91

Costaceae							
Hellenia speciosa (J.Koenig) S.R.Dutta	Unknown	Herb	Leaf, stem, rhizome	Decoction	Cough, diabetes, fever, stomachache	0.55	0.55
Cyperaceae							
Cyperus rotundus L.	Rumput teki	Herb	Stem	Decoction	Diarrhea, diabetes, malaria stomachache	0.66	0.83
Scleria levis Retz.	Kerve teles	Herb	Stem	Decoction	Cough	0.41	0.41
Scleria harlandii Hance	Berdung	Herb	Stem	Decoction	Cough	0.40	0.40
Euphorbiaceae							
Claoxylon indicum (Reinw. ex Blume) Hassk.	Daun rampu	Shrub	Leaf	Decoction	Laxative, asthma	0.64	0.37
Homalanthus populneus (Geiseler) Pax	Daun kareumbi	Tree	Leaf	Dried, Decoction	Fever, Diarrhea	0.38	0.38
Mallotus philippensis (Lam.) Müll.Arg.	Kayu kapit	Tree	Fruit Leaf	Powder Decoction Infusion	Skin disease Stomach ulcers Diarrhea	0.86	0.86
Macaranga gigantea (Rchb.f. & Zoll.) Müll.Arg.	Mahang	Tree	Leaf, bark	Infusion	Diarrhea, dysentery	0.38	0.38
Mallotus paniculatus (Lam.) Müll.Arg.	Balik angin	Tree	Leaf	Infusion	Fever	0.42	0.42
Fabaceae							
Mimosa pudica L.	Putri malu	Herb	Leaf	Powder Infusion	Wound Dysentery, hypertension, urinary problem	0.35	0.35
Senna alata (L.) Roxb.	Gelingan		Leaf	Powder	Skin disease	0.54	0.54
Spatholobus ferrugineus (Zoll. & Moritzi) Benth.	Akar kayu bajakan	Climber	Leaf Bark	Decoction Powder	Intestinal worms Snake poisoning	0.31	0.31
Uraria lagopodioides (L.) DC.	Unknown		Leaf	Decoction	Dysentery, diarrhea, fever	0.11	0.24
Hypoxidaceae							
Curculigo latifolia Dryand. ex W.T.Aiton	Buah tapus		Leaf	Infusion	Coughs	0.28	0.24
Lamiaceae							
Clerodendrum calamitosum L.	Bunga katarak	Shrub	Root Leaf	Decoction	Fever, menstrual disorders, jaundice, hypertension	0.89	0.69
Coleus amboinicus Lour.	Daun porbangun/ sebangun	Herb	Leaf	Decoction Powder	Cold, asthma, constipation, headache, cough, fever Skin diseases	0.91	0.90
Coleus scutellarioides (L.) Benth.	Celala	Herb	Leaf	Decoction	Fever	0.23	0.06
Mentha spicata L.		Herb	Leaf	Infusion	Fever, headache, digestive disorder	0.10	0.10
Ocimum tenuiflorum L.	Rerukui	Herb	Leaf	Infusion	Flatulence	0.13	0.13
Paraphlomis javanica (Blume) Prain	Daun suyuk	Shrub	Leaf	Decoction	Fever	0.07	0.07
Pogostemon auricularius (L.) Hassk.	Bunga nilam	Herb	Leaf	Decoction	Coughs, asthma	0.10	0.10
Vitex pinnata L.	Kayu laban/ leban	Tree	Leaf	Decoction	Fevers, wounds	0.08	0.14
Lauraceae							
Cinnamomum burmanni (Nees & T.Nees)	Daun pucuk meran / kayu manis	Tree	Leaf	Powder Decoction	Skin disease Diabetes	0.63	0.90
Linderniaceae							
Torenia crustacea (L.) Cham. & Schltdl.	Unknown	Herb	Leaf	Infusion Decoction	Dysentery, leprosy Boils, itches	0.05	0.10
Lythraceae							
Lawsonia inermis L.	Bunga henna/ bunga inai	Shrub	Leaf	Powder	Skin diseases	0.04	0.04
Malvaceae							
Hibiscus similis Blume	Wani	Tree	Leaf	Decoction	Coughs, fever	0.17	0.13
Urena lobata L.	Kelolot	Herb	Leaf	Infusion	Fever, rheumatic	0.11	0.20
Marantaceae							
Donax canniformis (G.Forst.) K.Schum.	Bamban	Herb	Leaf	Decoction	Fever, sore eyes	0.24	0.24
Melastomataceae							
Melastoma malabathricum L.	Sengganen	Shrub	Leaf	Decoction Powder	Stomach aches, diarrhea, Dysentery, wounds, swellings	0.63	0.63
Miconia crenata (Vahl) Michelang.	Unknown	Tree	Leaf	Infusion	Fever, headache	0.28	0.28

Meliaceae							
Aglaia odoratissima Blume	Ukat	Shrub	Leaf	Decoction	Fever, diarrhea	0.18	0.24
Meliaceae							
Toona sureni (Blume) Merr.	Bunga seruni	Tree	Leaf	Decoction	Fever, diarrhea	0.05	0.24
Menispermaceae							
Arcangelisia flava (L.) Merr.	Akar kuning	Climber	Stem	Decoction	Gout arthritis	0.07	0.14
Musaceae							
Musa acuminata Colla	Awal/ kepok	Herb	Fruit	Decoction	Gout arthritis, diabetes	0.10	0.10
Myrtaceae							
Syzygium polyanthum (Wight) Walp.	Daun salam	Tree	Leaf	Decoction	High cholesterol, hypertension	0.45	0.63
Syzygium incarnatum (Elmer) Merr. & L.M.Perry	Daun kedindiman	Tree	Leaf	Decoction	Cough	0.56	0.63
Syzygium cerasiforme (Blume) Merr. & L.M.Perry	Klampok	Tree	Leaf	Decoction	Antiinflamasi, antidiabetes	0.63	0.94
Oxalidaceae							
Oxalis corniculata L.	Lela	Herb	Whole plants	Decoction	Cough, cold, fever, stomachache	0.88	0.88
Phyllantaceae							
Phyllanthus niruri L.	Meniran hijau	Herb	Whole plants	Decoction	Pre and postpartum treatments	0.60	0.60
Phyllanthus urinaria L.	Meniran merah	Herb	Whole plants	Decoction	Pre and postpartum treatments, malaria, fever, hypertension	0.59	0.83
Piperaceae							
Piper ornatum N.E.Br.	Sirih merah	Climber	Leaf	Decoction	Fever	0.94	0.94
Piper crocatum Ruiz & Pav.	Sirih hutan	Climber	Leaf	Powder	Wounds, skin disease	0.93	0.93
Plantaginaceae							
Plantago major L.	Daun sendok	Herb	Leaf	Decoction	Antidiabetes, cough	0.88	0.88
Poaceae							
Imperata cylindrica (L.) P.Beauv.	Alang-alang	Herb	Leaf, rhizome	Decoction	Fever, coughs, nephrolithiasis	0.72	0.72
Leersia hexandra Sw.	Rumput darat	Herb	Leaf	Decoction	Asthma	0.12	0.12
Lophatherum gracile Brongn.	Rumput bambu	Herb	Leaf	Decoction	Fever, headache, cold	0.17	0.17
Paspalum conjugatum P.J.Bergius	Rumput kerbau	Herb	Leaf	Powder	Wounds	0.13	0.13
Polygalaceae							
Polygala paniculata L.	Rumput wangi	Herb	Leaf	Decoction	Coughs, fever, cold	0.14	0.14
Xanthophyllum amoenum Chodat	Langir	Tree	Leaf	Powder	Skin disease	0.28	0.28
Rosaceae							
Rubus moluccanus L.	Cengkenir	Shrub	Leaf	Decoction	Diarrhea, fever, stomachache, dysentery	0.24	0.24
Rubus pyrifolius J. E. Smith	Beri	Shrub	Leaf	Decoction	Diarrhea, fever	0.29	0.29
Rubiaceae							
Neonauclea calycina (Bartl. ex DC.) Merr.	Sang	Tree	Leaf	Powder	Wounds	0.04	0.04
Rubia cordifolia L.	Araparap	Climber	Leaf	Decoction	Nephrolithiasis	0.07	0.07
Rutaceae							
Murraya koenigii (L.) Spreng	Temurui	Tree	Leaf	Decoction	Stomachache, fever	0.31	0.31
Sapotaceae							
Palaquium walsurifolium Pierre ex Dubard	Balam	Tree	Leaf	Powder	Skin disease	0.20	0.20
Simaroubaceae							
Eurycoma longifolia Jack	Tongkat Ali	Tree	Root, stem	Decoction	Stomachache, fever, malaria, male aphrodisiac	0.92	0.90
Solanaceae							
Physalis angulata L.	Ciplukan	Herb	Leaf, fruit	Decoction infusion	Cold, fever, hypertension	0.86	0.86
Stemonuraceae							
Stemonurus secundiflorus Blume	Sembasah	Tree	Leaf	Decoction	Stomachache	0.18	0.18
Theaceae							
Laportea decumana (Roxb.) Wedd.	Daun gatal	Shrub	Leaf	Powder	Skin disease	0.19	0.19
Urticaceae							
Elatostema strigosum Hassk.	Sisik naga	Herb	Leaf	Decoction	Fever, asthma, stomachache	0.08	0.08
Zingiberaceae							
Etlingera elatior (Jack) R.M.Sm.	Terpuk	Herb	Rhizome	Decoction	Stomachache	0.27	0.27

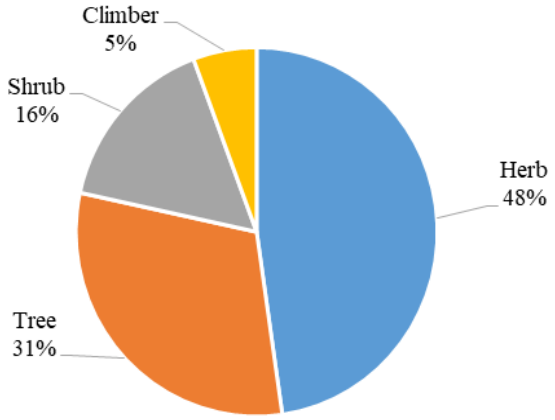

Figure 3. The growth form of medicinal plants in Serajadi Sub-district, East Aceh, Indonesia

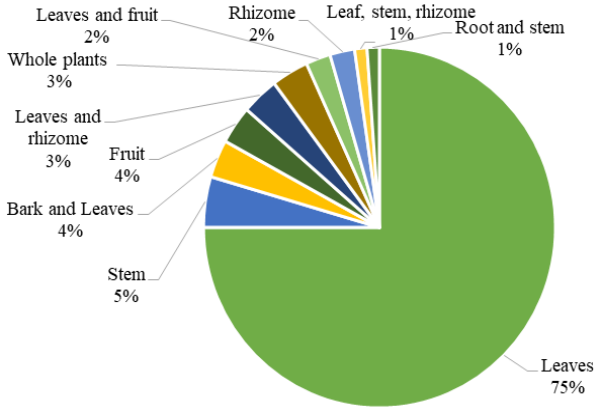

Figure 4. Plant part used for medicinal uses by the Gayo tribe in Serajadi Sub-district, East Aceh, Indonesia

The community in the study area used the leaves most often in their daily ethnomedicine practice (75%). This is consistent with other ethnomedicine research in several locations, including Kota Bahagia, South Aceh (28%) (Suwardi et al. 2021), Aceh Tamiang (50%) (Navia et al. 2021), Nigeria (46%) (Mukaila et al. 2022), and the Philippines (80%) (Belgica et al. 2021). Leaves are known as part of photosynthesis to occur because they contain many active compounds that are used to synthesize most herbal medicines in high concentrations (Odchimar et al. 2017). Tantengco et al. (2018) discovered secondary metabolite compounds in the leaves, including alkaloids, saponins, and phenolic compounds. People believe that leaves are easy to find in large quantities and that they can help plants survive for a long time. A prominent example of medicinal plants with uses of leaves is *Centella asiatica*, which contains pentacyclic triterpenes, primarily asiaticoside, madecassoside, asiatic and madecassic acids, and is effective in treating small wounds, hypertrophic wounds, burns, psoriasis, and scleroderma (Bylka et al. 2013; Gray et al. 2018). The use of *C. asiatica* aqueous leaf extract in the treatment of skin diseases has been shown to reduce photoaging, cellulite, and striae while having no toxic effect (Bylka et al. 2013). In addition, *C. asiatica* also contains bioactive compounds such as flavonoids (rutin, quercetin, kaempferol, catechin, luteolin) and phenolic acid (gallic acid) which have antioxidant activity (Azmin and Mat Nor 2020).

Mode of preparation

There are numerous methods for preparing medicinal plants for use in treating human diseases. The most common method of preparing traditional medicines from plant material in the study area was decoction (55%), followed by powder (15%), infusion (8%), and juice (2%) (Figure 5).

During the fieldwork, respondents stated that decoction improves the taste of medicinal plants and eases the absorption of herbal remedies. The decoction method is widely used by other ethnic groups around the world and is considered the primary method of preparing herbal remedies. After boiling, a decoction is taken, and there is also used for bathing after being boiled. According to Mela et al. (2022), most medicinal plants are boiled before being combined in the form of herbal medicine. All nutritious substances contained in medicinal plants can be dissolved into the water during the boiling process (Efremila et al. 2015).

The research area implements internal and external administration strands to treat disease. Most species of plants are used singly to treat disease, while others are used in combination with other species. For example, *Ageratum conyzoides* is used alone to treat stomachaches, and *C. asiatica* is mixed with honey to treat coughs in children. *Oldenlandia corymbosa* is used alone in the treatment of hepatitis in the Aneuk Jamee, whereas *C. asiatica* is given orally in combination with honey to treat coughs (Suwardi et al. 2021). *C. asiatica* is used in traditional Indian medicine to treat asthma, skin disorders, stomach ulcers, and aches, kidney disorders, leprosy, gastric disorders, cure dysentery, and improve memory (Jamil et al. 2007), whereas, in Nepal, leaf raw to indigestion in animals (Dhital et al. 2021) and leaf juice mixed with palm leaves are used to cool the body and stomach (Mahato and Chaudhary 2005).

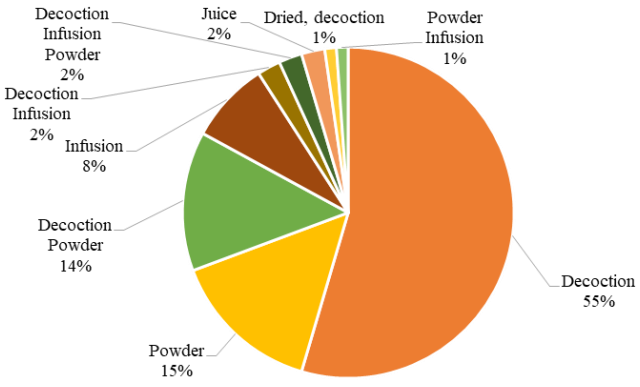

Figure 5. Preparation methods of medicinal plants by the Gayo tribe in Serajadi Sub-district, East Aceh, Indonesia

The local importance of wild medicinal plants

Ageratum conizoides had the highest value of RFC with 0.97, followed by *Pseuderanthemum variabile* (0.94), *Piper cronatum* (0.94), *P. ornatum* (0.93), *Eurycoma longifolia* (0.92), *Garcinia bancana* (0.91), *Coleus amboinicus* (0.91), *Diplazium esculentum* (0.91), *G. xanthochymus* (0.90), and *Clerodendrum calamitosum* (0.89) (Figure 6). Medicinal plant use values ranged from 0.02 to 0.99. *Acorus calamus* (0.99), *C. asiatica* (0.98), *Acmella uliginosa* (0.97), *A. conyzoides* (0.95), *Syzygium polyanthum* (0.94), *Piper cronatum* (0.94), *P. variabile* (0.94), *Piper ornatum* (0.93), *G. xanthochymus* (0.91), and *D. esculentum* (0.91) were the most important species in the traditional medicine of local communities, with UVs > 0.90 (Figure 6). The UV of medicinal plants ranged from 0.02 to 0.99, indicating that *Santiria rubiginosa* of the Burseraceae family had the lowest relative importance and *A. calamus* of the Acoraceae family had the highest. The *A. calamus* plant's rhizome is widely used as a remedy for stomachaches and diarrhea. This plant was discovered growing in the wild at the research site. This is consistent with the findings of Jadid et al. (2020), who discovered that *A. calamus* has a high value as a fever medicine among the Tengger tribe.

The level of agreement among informants on plant use ranged from 0.75 to 1.0. The maximum IAR value for 77 percent of the species was 1 (Figure 7). As a therapy for fever, gout arthritis, stomachache, diarrhea, wound, asthma, cough, flatulence, allergy, and skin diseases, these species have the highest level of agreement.

Diseases reported by respondents were classified using the International Classification of Diseases - 10th Edition (https://icd.who.int). In the study area, 32 diseases in 14 categories were documented (Table 3).

The most common use-report categories were certain infectious and parasitic diseases (821 use-reports, 33 species), followed by symptoms, signs, and abnormal clinical and laboratory (743 use-report, 51 species), diseases of the digestive system (678 use-reports, 31 species), and diseases of the circulatory system (264 use-reports, 6 species). The ICF values ranged from 0.8 to 0.992. Most of the disease categories had a high ICF value. They were diseases of mental and behavioral disorders (0.992), diseases of the musculoskeletal system, and connective tissue (0.981), while the lowest was for diseases of the respiratory system (0.800).

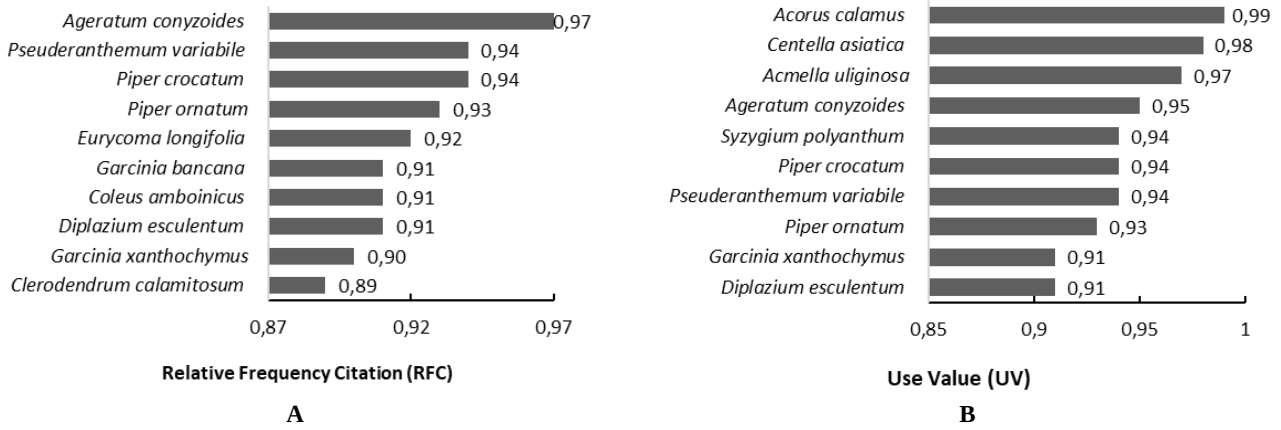

Figure 6. Plant species with the highest Relative Frequency Citation (RFC) (A) and Use Value (B)

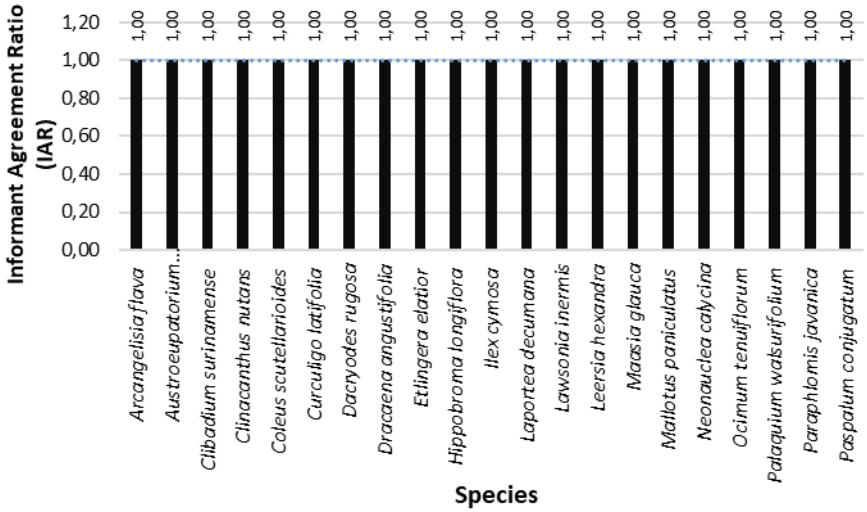

Figure 7. Ranking of most important medicinal plant species according to IAR (Informant Agreement Ratio)

Table 3. Categories of disease in the study area and the Informant Consensus Factor (ICF)

Classification of diseases	Specific disease name	Number use-report	Number species	ICF
Certain infectious and parasitic diseases (CID)	Diarrhea, ringworm, intestinal worm, malaria, dysentery, leprosy	821	33	0.961
Diseases of the circulatory system (CSD)	Hypertension	264	6	0.981
Diseases of the digestive system (DSD)	Constipation, gastric ulcer, mouth ulcer, stomachache, toothache, indigestion, cholesterol	678	31	0.956
Diseases of the eye and adnexa (EAD)	Eye inflammation, sore eyes	24	2	0.957
Diseases of the genitourinary system (GD)	Menstrual pain, urinary, nephrolithiasis	42	7	0.854
Diseases of the respiratory system (RSD)	Asthma, influenza, sore throat	41	9	0.800
Diseases of the skin and subcutaneous tissue (DS)	Itch, swelling, boils, allergy	121	5	0.967
Endocrine, nutritional and metabolic diseases (ENM)	Diabetes	64	6	0.921
Symptoms and signs involving the circulatory and respiratory systems (DCR)	Cough, nose bleeding	87	18	0.802
Symptoms, signs, and abnormal clinical and laboratory (SSA)	Fever, cold, flatulence, pimple, jaundice, headache, pains	743	51	0.933
Diseases of the musculoskeletal system and connective tissue (DMC)	Gout arthritis, Rheumatism	163	4	0.981
Symptoms and signs involving the skin and subcutaneous tissue (SCT)	Skin burn	98	13	0.876
Mental and behavioral disorders (MBD)	Appetite	34	1	1.000
Injury, poisoning, and certain other consequences of external causes (IPD)	Wound, snack poisoning	210	17	0.923

Appetite was a specific disease that had a high ICF value. According to respondents, appetite was common in children under the age of five. The leaf ethanol extract of *Anredera cordifolia* contains phenolic compounds, flavonoids, alkaloids, and tannins and has a high antioxidant activity with an IC50 value of 87.423 g/mL. (Souhoka et al 2021). *A. cordifolia* contains flavonoid compounds that are useful as antioxidants and can also increase appetite, while saponins can improve nutrient absorption by increasing the permeability of cell walls in the intestine (Irwani and Candra 2020).

The threat of wild medicinal plants

The Gayo tribe has passed down traditional knowledge of medicinal plants from generation to generation. Each respondent age group's average number of species identified ranged from 20.14 ± 1.12 (15-25 years) to 80.28 ± 1.21 (over 65 years). The statistical analysis revealed a significant difference between the elders and the younger generation in traditional knowledge of medicinal plants (P 0.05; n = 320). This indicates that traditional knowledge is eroding across generations. This study strengthens the findings of Sujarwo et al. (2014) and Weckmüller et al. (2019), who discovered that older generations have more knowledge of medicinal plants than younger generations. Unfortunately, this traditional knowledge is not well documented as the transfer of knowledge is still done orally. It was discovered during discussions with respondents that many children were interested in learning medicinal plants from healers or elders in their village. This is in line with a study on medicinal plants in the Aneuk Jamee tribe, where the younger generation learns a lot of medicinal plants from their parents (Suwardi et al. 2022a). This traditional knowledge must be safeguarded by involving the Indonesian government's Education Office in the integration of traditional knowledge into the basic education curriculum. This practice could be part of an effort to safeguard traditional knowledge, natural resources, and biodiversity. According to Ramadoss and Moli (2011), biodiversity education programs can increase students' knowledge, motivation, and expertise in conserving and protecting local natural resources and biodiversity in India.

In conclusion, the community surrounding the Serbajadi protected forest in East Aceh District still has a strong botanical knowledge of the diversity of wild plants used as traditional medicines to maintain family health. The protected forest in their area contains a wide variety of potential wild medicinal plants for daily use. Culture and local wisdom preserve plant diversity by creating local wisdom to preserve plants and good practices in their use. This study's documentation of the diversity of traditional wild medicinal plants for family health contributes to the preservation of traditional knowledge while also providing information about the potential of these plants to be developed further as herbal medicines.

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