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Ethnobotany of medicinal plants used by the Javanese community of Mount Merapi National Park, Central Java, Indonesia

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Abstract. *Torimbanu AR, Saputra AF, Aulia AA, Utomo AN, Safira RN, Yasa A, Saensouk S, Setyawan AD. 2024. Ethnobotany of medicinal plants used by the Javanese community of Mount Merapi National Park, Central Java, Indonesia. Asian J Ethnobiol 7: 130-143.* The majority of medicines and health care come from plants. This research explores medicinal plants used by Javanese people on the eastern slopes of Mount Merapi National Park, Central Java, Indonesia, located in two districts, Klaten and Boyolali. This research was carried out by collecting data on respondents' socio-economics and ethnobotany regarding medicinal plants, and identified four key informants using the snowball sampling method. The interviews were also conducted using a questionnaire method to find out information on the use of medicinal plants by the 81 respondents. The data was analyzed using several quantitative ethnobotanical indices. In this research, 73 species of medicinal plants from 35 families were identified. Zingiberaceae dominates with 12 species, followed by Myrtaceae consist five species. Leaves are the most widely used part of the plant, namely around 34%, followed by fruit at 17.8% and tubers at 19.2%. *Cicer arietinum* L. (0.88) and *Vaccinium varingiaefolium* Miq. (0.64) have the most significant number of Relative Frequency Citations (RFC); the highest Informant Consensus Factor (ICF) value was for the SSA disease category (Symptoms, signs, and abnormal clinical and laboratory) with a value of 0.96, the highest Use Value (UV) value was *Allium cepa* and *Allium sativum* with the same value, namely 0.06. The highest Informant Agreement Ratio (IAR) value is 1.00, one of which is by fennel species or *Foeniculum vulgare*.

Keywords: Ethnobotany, health, ICF, medicinal plants, Mount Merapi, RFC, UV

INTRODUCTION

For centuries, humans on this earth have used wild medicinal plants (Al-Laith et al. 2019). The use of these plants is not limited to a specific region or culture but is a global practice that has been in place since ancient times, specifically in ancient Mesopotamia, around 3,000-5,000 years ago (Dafni et al. 2019). The most compelling evidence suggests that the earliest use of medicinal plants dates back 5,000 years, as recorded on Sumerian tablets from Iraq and clay tablets from Nagpur, India. These tablets document 12 medicinal recipes that mention over 250 species of medicinal plants, including several containing alkaloids like poppy, henbane, and mandrake (Cartwright and Armstrong 2020). According to the World Health Organization (WHO) (2013), 80% of the world's population, whether in developed or developing countries, still relies on medicinal plants for most medicines and health care. This global reliance on herbal medicine underscores its significance in every civilization's form of medicine (Salmerón-Manzano et al. 2020).

Recently, many types of medicinal plants have been researched and used further, ranging from minor ailments to even serious ailments (Hong et al. 2015). The use of herbal plants as medicines continues to increase nationally and internationally (Ekor 2015). This can encourage the growth of the traditional medicine industry and business, especially in Indonesia. Traditional medicinal plants, which have long been an integral part of people's lives, play an important role in maintaining health, maintaining stamina, and assisting in treating disease (Ullah et al. 2020). Therefore, the use of traditional medicinal plants has become a strong tradition in most people's lives today (Jamsidhi-Kia et al. 2017). For example, digoxin is used to treat chronic heart issues and comes from a flowering plant called *Digitalis purpure*a. Morphine is used to relieve high pain and comes from the sap of the fruit of *Papaver somniferum*; quinine is used to treat malaria, whereas the compound comes from isolating the bark of *Cinchona* sp. (Patocka et al. 2020).

However, despite their importance, the use and understanding of medicinal plants are often overlooked or

even threatened with extinction (Kaky and Gilbert 2019). Changes in modern lifestyles, urbanization, and the natural environment can threaten the existence of medicinal plants and people's knowledge of these plants. The loss of traditional knowledge from generation to generation regarding medicinal plants can cause significant harm to the health of society. Therefore, the need for conservation efforts and documentation of medicinal plant knowledge is crucial to prevent them from disappearing from the community (Chandra and Uniyal 2021). In this modern era, medicinal plants increasingly receive attention from the scientific and pharmaceutical industries.

Java Island, Indonesia is among the most populous major island in the world; over half of Indonesia's population of nearly 280 million lives on Java (MHA 2023). The population of Java Island mainly comes from Javanese and Sundanese tribes, Javanese dominate the central and eastern provinces, as well as the northern coast in the western provinces (Naim and Syaputra 2011). Central Java Province is dominated by the Javanese tribe (98%) (BPS 2010). According to Arinalhaq and Wibowo (2020), several threats cause land changes in Mount Merapi National Park, Central Java, including natural threats such as volcanic activity and human activities such as sand mining and land clearing for grass cultivation in forest areas. Sutomo and Fardila (2013) stated that natural disasters in the form of fires can affect the composition of plant species in MMNP; plants and grass dominate more in burnt areas, while in intact areas, shrubs and ferns dominate. The increase in land changes can decrease biodiversity, including medicinal plants (Sen and Samantha 2015). The lack of information regarding both species and benefits can reduce human awareness of the richness of medicinal plant species around them. Modernization in the form of switching from traditional medicine to modern medicine can narrow the area for medicinal plants. For this reason, it is important to carry out this research, namely related to providing a database of medicinal plant species, their benefits, and processing by the community.

This research explores medicinal plants on the eastern slopes of Mount Merapi, specifically in the villages of Musuk, Sruni, and Tegalmulyo, located in Boyolali and Klaten districts of Central Java, Indonesia.

MATERIALS AND METHODS

Study area

This research was carried out in three villages located on the eastern slope of Mount Merapi, Central Java, Indonesia namely Musuk Village (7°41'31.2"S to 110°34'45.5"E) and Sruni Village (7°42'09.0"S to 110°35'21.8"E) of Boyolali District as well as Tegalmulyo Village (7°41'53.2"S to 110°36'05.8"E) in Klaten District (Figure 1). These three villages are mostly used for agricultural land, settlement, forest, and agroforestry because the geographical conditions are influenced by their location on the slopes of Mount Merapi. They have fertile soil that is suitable for planting various types of plants and relatively cool air and temperatures, making them suitable for use as agricultural and residential land (Susilo and Rudiarto 2014). Musuk Villages is more than 600 meters above sea level (masl), and Sruni Village is more than 700 masl. Meanwhile, Tegalmulyo Village is located higher at an altitude of 1,300 masl and is only approximately 3 km from the peak of Mount Merapi (googleearth.com). Almost every house in the village has its home garden planted with fruit, vegetables, and herbal plants. Like other remote villages in Central Java, the population of this village is almost all Javanese, and their livelihood is in agriculture.

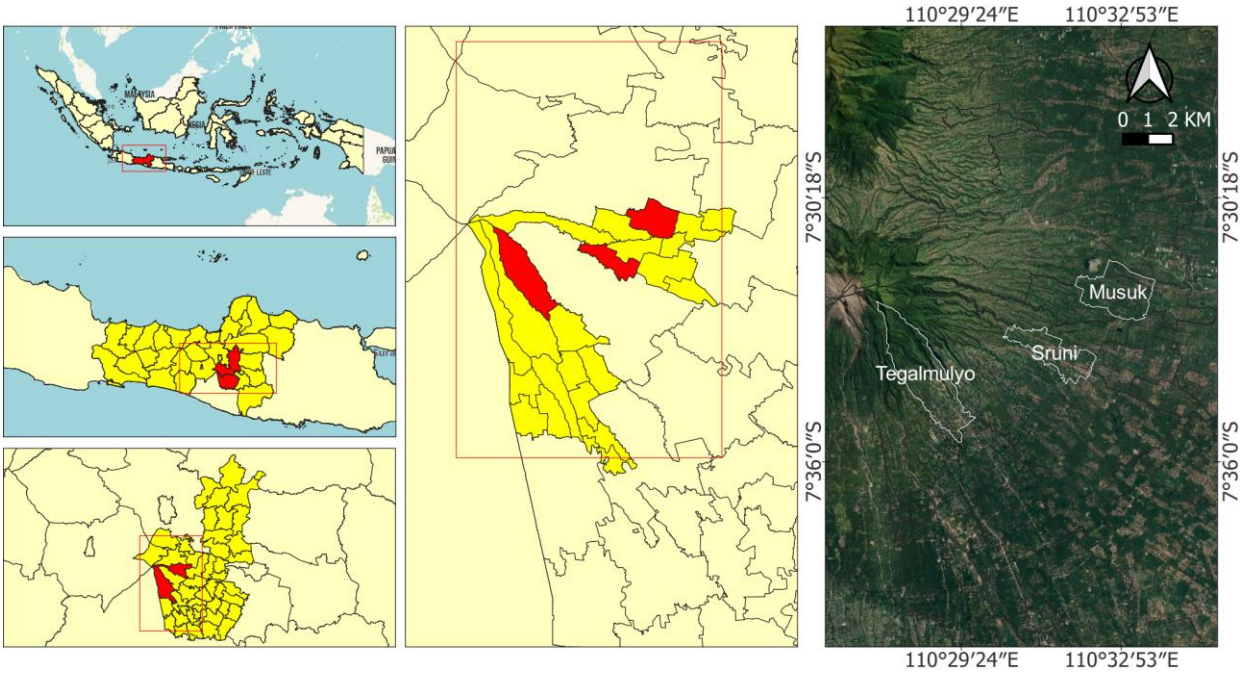

Figure 1. The study area in Tegalmulyo, Srunia, Musuk Villages, Kemalang and Musuk Sub-district, Boyolali, Central Java, Indonesia

Ethnobotanical data collection

This research was carried out using documentation and interviews to collect names and species of medicinal plants. The collection methods used in this research were snowball sampling and purposive sampling. The snowball sampling method is used to find key informants with much information and is taken in a chain or continuously (Seran 2022). This research involved four key informants: (i) an in-depth interview method, and (ii) a questionnaire method with 81 respondents. Meanwhile, the purposive sampling method is used to obtain samples that represent the research objectives and meet the criteria for providing information. The sample limit used in the purposive sampling method was residents living in Musuk, Seruni, or Tegalmulyo Villages. The informants in this study consist of both genders, male and female, with several age groups (under 20 years old, 21-30 years old, 31-40 years old, 41-50 years old, 51-60 years old, and over 60 years old), and several education levels (no education, Elementary School, Junior High School, Senior High School, and University).

In-depth interview

The selection of informants is conducted through the snowball sampling method, which involves identifying key informants. These key informants then provide recommendations for the subsequent individuals to be interviewed (Ramadhani et al. 2023). When identifying key informants, we will gather input from previous informants and customize it to align with factors such as the informant's professional background and daily activities. This approach will enable us to gather comprehensive and well-supported information concerning the utilization of medicinal plants in the village. During the in-depth interview session, we were inquired about the species utilized by local communities, including the specific parts of the plants used and the methods by which they were processed. The insights gleaned from key informants can serve as a valuable guide for conducting interviews with the general respondents. Key informants with extensive knowledge of community habits and plants include the village head, community leader of the *Masyarakat Peduli Api* (Fire Care Society), shaman/herbal medicine seller, and head of the *Kelompok Tani Hutan Agni Mandiri* (Agni Mandiri Forest Farmers Group).

Questionnaire

Questionnaire data was collected from 81 respondents who were interviewed and selected via purposive sampling based on the research area's division, with a particular emphasis on the local villages located on Mount Merapi's east slope. Each respondent was asked questions about known medicinal plants, such as cultivation status (wild or cultivated), habitat found (forest, garden, yard, or rice field), habitus (tree, shrub, herb, climber), plant parts used (seeds, fruit, shoots, leaves, stems, rhizomes, tubers), how to use (raw or processed), and whether they were used to treat any disease.

Data analysis

Relative Frequency Citation (RFC)

The data collected was analyzed quantitatively to calculate the ratio between each type of medicinal plant received and the total number of respondents, using Relative Frequency Citation (RFC); RFC was calculated with the following formula (Butt et al. 2015):

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

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)

To estimate the measurement used to assess how valuable each species of medicinal plant is for local people, Use Value (UV) was computed using the following formula (Bano et al. 2014):

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

Where: UV represents the use-value of a given species; U represents the number of uses of species mentioned by respondents, and N is the number of informants who know the value per species. High UV indicates high-use reports for a plant important to the local community. Low UV indicates that there are few reports of its use.

Informant Agreement Ratio (IAR)

This research quantitatively analyzes medicinal plant data using the informant agreement ratio (IAR). IAR measures informants' level of agreement about using certain medicinal plants to treat certain diseases (Wildayati et al. 2016). This research involved 81 informants who provided information about medicinal plants commonly used by the community. The Informant Agreement Ratio (IAR) calculates how much respondents agree with using a medicinal plant for a particular use. IAR can be calculated using the following formula (Chaachouay et al. 2019):

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

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) was used to measure the level of agreement between informants regarding the use of certain plants; it was calculated using the following formula (Heinrich et al. 1998):

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

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

This research involved 81 respondents, including 15 community leaders as key informants. They are a 50-year-old male, neighborhood association head (Ketua RT) who graduated from elementary school, a 50-year-old male, an entrepreneur who graduated from high school, a 50-year-old male, a local farmer who also graduated from high school, and a 45-year-old female, local farmer, who graduated from elementary school. According to the study's findings, the majority of respondents share comparable gender, age, and educational backgrounds. Of the respondents, 62% were men, 39.51% were between the ages of 41 and 50, and 61.73% had completed elementary school. Meanwhile, respondents under the age of 20 and with a university education were rare, accounting for only 2.47 and 1.23%, respectively (Table 1). People with a low level of education, those who have not graduated from elementary, middle, or high school, are the most likely to practice traditional medicine. Adiyasa and Meiyanti (2021) discovered that those who are less knowledgeable about traditional medicine are more likely to take it because they continue to believe in their ancestors. A person's trust in therapy influences their ability to select a safe and beneficial treatment (Wahab et al. 2022). According to Afriliana's (2019) research, women comprehend traditional medicine better than men since they are more motivated to learn about a certain cure. Age also influences people's level of knowledge regarding local wisdom or local plants because it influences a person's mental development, which includes comprehension and thought patterns. Age also influences a person's attitudes and behavior toward existing and new knowledge (Hidayati et al. 2022).

The communities around MMNP rely on medicinal plants due to their access to natural resources and familiarity with local biodiversity. They utilize various plants, such as ginger, turmeric, and parijoto, which have been employed for generations. Limited access to modern healthcare and dependence on agriculture leads to a preference for affordable traditional medicine. Additionally, cultural values emphasizing respect for nature and ancestral knowledge reinforce the significance of these plants in daily life, particularly for treating minor ailments and maintaining health.

Plant diversity

In the area, 74 species of medicinal plants from 35 families were identified. Table 2 contains ethnomedicinal information for each species, including family name, scientific name, local name, plant part used, preparation, method of application, and disease. Zingiberaceae contributed the most medicinal species, with 12 species (Figure 2), followed by Myrtaceae with 5 species, and Euphorbiaceae, Fabaceae, Lamiacaea, and Poaceae with 4 species.

Table 1. Socio-demographics of respondents

Variable		Total	Percentage
Gender	Men	50	62%
	Women	31	38%
Age	<20	2	2.47%
	21-30	9	11.11%
	31-40	12	14.81%
	41-50	32	39.51%
	51-60	14	17.28%
	>60	12	14.81%
Education	No education	2	2.47%
	Elementary school	50	61.73%
	Junior High School	13	16.05%
	Senior High School	15	18.52%
	University	1	1.23%

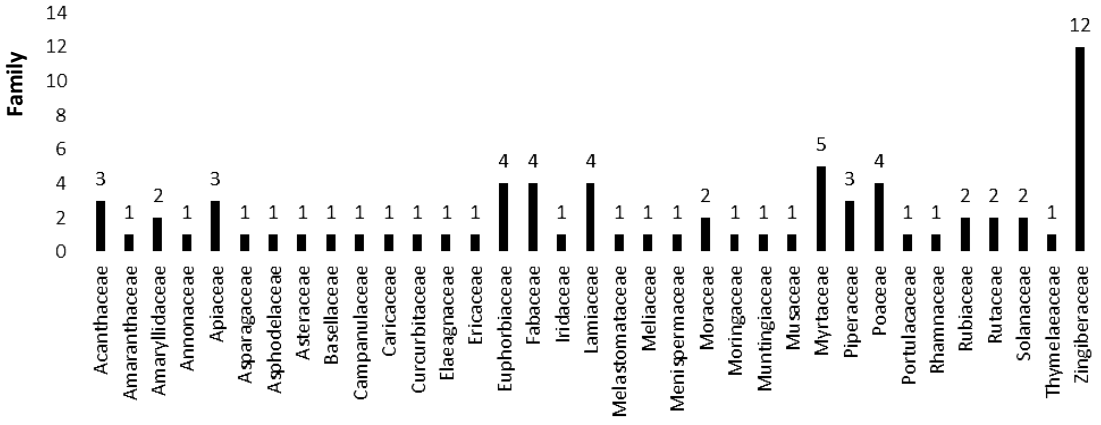

Figure 2. Number of plant species by the family of medicinal plants

Table 2. List of wild medicinal plants

Scientific name	Local name	Family	Habitats	Habitus	Plant parts used	Mode of preparation	Disease	RFC	UV
Acorus calamus L.	Dlingo	Acanthaceae	Yard	Herb	Leaf	Refined	Itching, fever	0.02	0.01
Allium cepa L.	Brambang	Amaryllidaceae	Yard	Herb	Tubers	Refined	Scraping cleans the lungs, improves heart function, flatulence, anti-cancer	0.02	0.06
Allium sativum L.	Bawang putih	Amaryllidaceae	Yard	Herb	Tubers	Eat straight away	Antibiotics, high blood pressure, coughs, colds, and medication for itching	0.57	0.06
Aloe vera (L.) Burm.f.	Lidah buaya	Asphodelaceae	Yard	Herb	Stem (sap)	Smeared	Burn medicine	0.02	0.01
Alpinia galanga (L.) wild.	Temugiring	Zingiberaceae	Yard	Herb	Tubers	Smeared	Tinea versicolor medicine, body endurance	0.02	0.02
Annona muricata L.	Sirsak	Annonaceae	Yard	Tree	Leaf	Boiled	High blood pressure medication	0.37	0.02
Anredera cordifolia (Ten.) Steenis	Binahong	Basellaceae	Yard	Climber	Leaf	Refined	Cut wound medicine	0.07	0.01
Apium graveolens L.	seledri	Apiaceae	Yard	Herb	Leaf	Boiled	High blood pressure medication	0.12	0.01
Artocarpus heterophyllus Lam.	Murbei	Moraceae	Yard	Tree	Fruit	Mixed with water	Children's smallpox medicine	0.01	0.01
Beta vulgaris subsp. *vulgaris*	Bit	Amaranthaceae	Yard	Herb	Tubers	Eat straight away, in juice	Facilitate digestion	0.02	0.01
Capsicum frutescens L.	Cabai	Solanaceae	Gardens and yards	Herb	Fruit	Smeared	Ulcer	0.02	0.01
Carica papaya L.	Gantung	Caricaceae	Yard	Bush	Leaf	Smeared	Anemia medication	0.09	0.01
Cicer arietinum L.		Fabaceae	Yard	Tree	Leaves, fruit	Brewed, eaten straight away	Lowers cholesterol	0.88	0.01
Cinchona sp.	cincau	Rubiaceae	Gardens and yards	Tree	Stem	Refined	Cut	0.22	0.01
Cinnamomum verum J.Presl	Manis jangan	Lamiaceae	Forest and yard	Tree	Tree bark	Boiled	Rheumatism medicine	0.01	0.01
Citrus aurantifolia (Christm.) Swingle	Jeruk nipis	Rutaceae	Yard	Tree	Fruit	Drink straight away	Cough	0.15	0.01
Citrus ×limon (L.) Osbeck	Lemon	Rutaceae	Yard	Tree	Fruit	Drink straight away	Cough, endurance	0.02	0.01
Clinacanthus nutans (Burm.fil.) Lindau	Ambeven /daun ungu	Acanthaceae	Yard	Bush	Leaf	Boiled	Diabetes	0.49	0.01
Clitoria ternatea L.	Telang	Fabaceae	Yard	Climber	Flower	Brewed	Eye, menstrual smoother	0.02	0.01
Cordyline fruticosa (L.) A.Chev.	Andong	Asparagaceae	Yard	Bush	Leaf	Brewed	High blood	0.06	0.01
Cuminum cyminum L.	Jinten putih	Apiaceae	Yard	Herb	Seed	Boiled	Indigestion	0.04	0.01
Curcuma aeruginosa Roxb.	Jahe merah	Zingiberaceae	Yard	Herb	Tubers	Boiled	Rheumatism	0.02	0.01
Curcuma heyneana Valeton & Zijp	Puyang	Zingiberaceae	Yard	Herb	Tubers	Boiled	Anthelmintic	0.21	0.01
Curcuma longa L.	White ginger	Zingiberaceae	Yard	Herb	Tubers	Smeared	Diarrhea medicine	0.04	0.01
Curcuma zanthorrhiza Roxb.	Temulawak	Zingiberaceae	Yard	Herb	Tubers	Boiled	Diarrhea, fever	0.54	0.01
Curcuma zedoaria (Christm.) Roscoe	Temu putih	Zingiberaceae	Yard	Herb	Tubers	Smeared	Diarrhea medicine	0.05	0.01

Cymbopogon sp.	Sereh	Poaceae	Yard	Herb	Stem	Boiled, drink straight away	Catch a cold and tongue freshener	0.04	0.01
Dendrocalamus asper (Schult.f.) Backer	Bambu	Poaceae	Garden	Tree	Young shoots	Cooked (processed with oil as food)	Cholesterol, heart	0.02	0.01
Elaeagnus latifolia L.		Elaeagnaceae	Forest and yard	Herb	Leaf	Eat straight away, boiled	Prevent hepatitis	0.02	0.02
Elephantopus scaber L.	Tapak liman	Asteraceae	Yard	Herb	Leaf	Boiled	Rheumatism medicine	0.26	0.01
Eleutherine bulbosa (Mill.) Urb.	Bawang dayak	Iridaceae	Yard	Herb	Tubers	Boiled	Asthma	0.02	0.01
Erythrina variegata L.	Dadap	Fabaceae	Yard	Tree	Leaf	Smeared	Heat reducer	0.01	0.01
Etlingera elatior (Jack) R.M.Sm.	Combrang	Zingiberaceae	Yard	Herb	Flower	Grated then boiled, brewed, and drunk	Heat medicine	0.06	0.01
Euphorbia pulcherrima Willd. ex Klotzsch	Singkong	Euphorbiaceae	Yard	Bush	Flower	Boiled	Blood sugar	0.02	0.04
Foeniculum vulgare Mill.	Adas	Apiaceae	Yard	Herb	Leaf	Boiled	Breast milk booster	0.02	0.02
Graptophyllum pictum (L.) Griff.	Dandang gendhis	Acanthaceae	Yard	Bush	Leaf	Brewed	Hemorrhoids	0.33	0.01
Hevea brasiliensis (Willd. ex A.Juss.) Müll.Arg.	Karet	Euphorbiaceae	Yard	Tree	Sap	Smeared	Cut wound medicine	0.02	0.02
Hippobroma longiflora (L.) G.Don	Kitolot	Campanulaceae	Yard	Herb	Leaf	Drink straight away	Sore eyes	0.01	0.01
Imperata cylindrica (L.) Raeusch.	Alang-alang	Poaceae	Yard	Herb	Root	Boiled, Mashed	Medicine for rheumatism, wounds	0.40	0.01
Jatropha multifida L.	Yodium/Penicilin	Euphorbiaceae	Forest and yard	Herb	Sap	Boiled, smeared	Cut wound medicine	0.58	0.04
Kaempferia galanga L.	Kencur	Zingiberaceae	Yard	Herb	Tubers	Eat straight away, boiled, grilled	Increasing children's appetite, cough medicine	0.02	0.01
Manihot esculenta Crantz	Singkong	Euphorbiaceae	Yard	Bush	Leaf	Boiled	Anemia medication	0.38	0.01
Medinilla speciosa (Reinw. ex Blume) Blume	Parijoto	Melastomataceae	Forest	Bush	Fruit	Eat straight away	Pregnancy program	0.06	0.02
Mentha sp.	Legundi	Lamiaceae	Yard	Herb	Leaf	Inhaled	Respiratory illness	0.01	0.01
Mimosa pudica L.	Putri malu	Fabaceae	Yard	Herb	Root	Boiled	Hypertension	0.01	0.01
Morinda citrifolia L.	Pace	Rubiaceae	Yard	Tree	Fruit	Brewed	Anti-cancer	0.16	0.01
Moringa oleifera Lam.	Moringa	Moringaceae	Yard	Tree	Leaf	Boiled	Medicine for aches	0.05	0.01
Morus sp.	Nangka	Moraceae	Yard	Herb	Fruit	Boiled	High blood	0.02	0.01
Muntingia calabura L.	Talok	Muntingiaceae	Yard	Tree	Leaf	Boiled	Itching medicine	0.56	0.01
Musa ×paradisiaca L.	Pisang	Musaceae	Yard	Herb	Sap	Smeared	Wound	0.04	0.01
Persea americana Mill.	Alpukat	Lamiaceae	Yard	Tree	Leaf	Boiled	High blood pressure medication	0.04	0.01
Phaleria macrocarpa (scheff.) Boerl.	Mahkota dewa	Thymelaeaceae	Yard	Tree	Fruit	Boiled	Body endurance	0.02	0.01
Physalis sp.	Ciplukan	Solanaceae	Garden	Herb	Fruit	Eat straight away	Facilitate urination	0.21	0.01
Piper betle L.	Pepper	Piperaceae	Yard	Climber	Leaf	Place it directly inside nose	Nosebleed	0.01	0.01
Piper nigrum L.	Sirih ungu	Piperaceae	Gardens and yards	Climber	Seed	Boiled	Indigestion	0.02	0.01
Piper ornatum N.E.Br.	Betel	Piperaceae	Yard	Climber	Leaf	Refined	Itching medicine	0.02	0.02
Portulaca sp.	Krokot	Portulacaceae	Yard	Herb	Leaf	Boiled	Antidote	0.02	0.01

Psidium guajava L.	Jambu biji	Myrtaceae	Yard	Tree	Leaf	Eat straight away	Diarrhea medicine	0.01	0.01
Sechium edule (jacq.) Sw.	Jipan	Curcurbitaceae	Gardens and yards	Tree	Fruit	Smeared	Heat reducer	0.07	0.01
Swietenia mahagoni (L.) jacq.	Mahogany	Meliaceae	Yard	Tree	Fruit, seeds	Eat straight away	Hypertension, healthy heart	0.37	0.01
Syzygium aqueum (Burm.fil.) Alston	Jambu air	Myrtaceae	Yard	Tree	Fruit	Boiled	Diarrhea	0.21	0.01
Syzygium aromaticum (L.) Merr. & L.M.Perry	Cengkeh	Myrtaceae	Yard	Tree	Stalk	Boiled, Distilled	Cough	0.20	0.01
Syzygium cumini (L.) Skeels	Duwet putih	Myrtaceae	Yard	Tree	Fruit	Eat straight away	Cough, digestion	0.04	0.01
Syzygium polyanthum (Wight) Walp.	Daun salam	Myrtaceae	Yard	Bush	Leaf	Vegetables	Body endurance	0.01	0.01
Tinospora cordifolia (Willd.) Miers	Brotowali	Menispermaceae	Yard	Herb	Leaf	Boiled	Body endurance	0.01	0.01
Vaccinium varingiaefolium Miq.	Centigi	Ericaceae	Forest and yard	Bush	Fruit	Eat straight away	Diabetes	0.64	0.02
Vitex trifolia L.	Mint	Lamiaceae	Forest	Bush	Leaf	Boiled	Itching medicine	0.02	0.01
Zea mays L.	Jagung	Poaceae	Yard	tree	Seed	Boiled	Constipation, diarrhea	0.02	0.01
Zingiber officinale Roscoe	Laos	Zingiberaceae	Yard	Herb	Tubers	Boiled	Stones, colds, endurance	0.12	0.01
Zingiber officinale var *officinarum* Roscoe	Jahe merah	Zingiberaceae	Garden	Herb	Tubers	Boiled	Stones, colds, endurance	0.07	0.02
Zingiber officinale var *rubrum* Roscoe	Jahe putih	Zingiberaceae	Yard	Herb	Tubers	Boiled, grilled, drink straight away	Cough medicine	0.26	0.01
Zingiber zerumbet (L.) Roscoe ex Sm.	Kunyit	Zingiberaceae	Forest and yard	Herb	Buds, flowers	Boiled, eat straight away	Inflammation	0.02	0.01
Ziziphus mauritiana Lam.	Bidara	Rhamnaceae	Yard	Tree	Leaves, seeds	Mixed with water	Facilitate digestion, burns	0.14	0.01

Note: Yard means *pekarangan,* Garden means *kebon, forest garden or taungya*

The Zingiberaceae family is better known to the public as the ginger plant and has been used as cooking spices, traditional medicine in the form of herbal medicine, cosmetic ingredients, and ornamental plants. The factor that causes this plant to dominate on the slopes of Mt. Merapi is cool weather (Setyawati and Ashari 2017), so these plants can act as body warmer for humans. The Zingiberaceae family is known to have great economic potential, so the cultivation of this plant can generate financial benefits for local communities. As noted by Syamsuri and Alang (2021), numerous ethnic groups in Indonesia have gained valuable insights into the uses of this family through generations of traditional knowledge. This rich cultural heritage underscores the importance of preserving and promoting such practices for both economic and social development.

Aprilianti et al. (2021) add that the soil on these slopes is highly fertile, well-drained, and rich in organic matter, conditions influenced by volcanic activity that releases ash and nutrient-rich lava. This plant also thrives in wet, cool areas with frequent rainfall. The climate of Mt. Merapi's slopes, characterized by high elevation, humidity, and abundant rainfall, effectively meets the plant's needs.

The Myrtaceae family, or what is usually called the guava family, is known for its medicinal properties. In various regions, especially tropical areas such as Central Java, Indonesia, plants from this family are used to treat digestive disorders. Well-known species include guava (*Psidium guajava* L.), water apple (*Syzygium aqueum* (Burm. fil.)), clove (*Syzygium aromaticum* (L.) Merr. & L.M. Perry), white duwet (*Syzygium cumini* (L.) Skeels), and laurel (*Syzygium polyanthum* (Wight) Walp). According to Gunawan et al. (2015), Bay (*Syzygium polyanthum (*Weight) Walp) is growing naturally in TNMM. The Myrtaceae family is widespread in tropical areas and is characterized by rough leaves that contain oil glands so that this plant can survive relatively cold weather; habitus can facilitate the recognition and classification of medicinal plants according to their morphological characteristics.

Habitats

Indonesia boasts the highest number of vascular plants, with over 29,375 species of indigenous plants thriving in diverse settings, including forests, yards, and gardens (Long et al. 2018). Based on the data collected from the respondents (Figure 3), yards are habitats located near human settlements. They are home to 82% of plant species, including mango trees, guava trees, rambutan trees, and coconut trees. Rural populations persist in utilizing traditional remedies through their cultivation, which facilitates convenient access to the plants, is cost-effective, and promotes self-sufficiency within their households (Lestari et al. 2021). Forests are lush, shaded, and fertile ecosystems that support 10% of plant species, including cinnamon, mint, and iodium/penicillin. Gardens are human-created environments that support 8% of plant species, including bamboo shoots, ginger, pepper, and chile. Various factors, particularly demand factors, can influence the habitat of these plants. For instance, plants grown in home gardens are often used for medicinal purposes, particularly as a first-aid remedy. On the other hand, plants grown in gardens or forests typically require less usage or are seldom used. A likely explanation for the scarcity of plant species is the prevalence of monocultures in plantations, where only a single crop type, such as palm oil, rubber, or coffee, is cultivated. This diminishes the variety of plant species that can thrive in the vicinity since they are compelled to vie for resources and territory with the prevailing crop. Plantations frequently employ pesticides and fertilizers that have the potential to impact the indigenous flora and soil microorganisms negatively.

In addition, the establishment of plantations can result in deforestation and the destruction of habitats for several plant species that are native to the rainforests of Indonesia. These rainforests are known for their very high levels of biological variety (Su et al. 2023). As a result, plantations in Indonesia have the potential to support more plant diversity and contribute to conservation efforts. Alamgir and Alamgir (2017) conducted a study that identified two primary classifications of medicinal plants depending on their habitat: cultivated and wild. Humans deliberately develop and sustain cultivated plants, but wild plants grow spontaneously without human intervention. These plants exhibit variations in their traits and attributes due to variables such as natural selection, environmental stress, and genetic variety. Figure 3 presents an overview of the habitats of the observed plant species. The majority of these species, comprising 80.8%, are found in yard habitats. Notable examples include *Acorus calamus* L., *Allium cepa* L., and *Allium sativum* L. The remaining 9.6% of the species are associated with forest habitats, with representative species such as *Vitex trifolia* L., *Cinnamomum verum* J. Presl, and *Elaeagnus latifolia* L. The plants identified in yard habitats are predominantly cultivated varieties, actively maintained by the community. In contrast, the plants observed in forest habitats are primarily wild species that thrive naturally in their surroundings. Furthermore, the species found in garden habitats comprise a blend of cultivated plants and those that grow wild. This distinction highlights the varying interactions between human cultivation and natural ecosystems.

Habitus

The finding revealed the medicinal plant habitus most widely used by the community is herbs (47.9%), followed by trees (31.5%), shrubs (13.7%), and climbers (6.8%) (Figure 4). Bana et al. (2016) observed that herbaceous plants are frequently employed as therapeutic plants because of their pervasive presence in individuals' yards and gardens. This indicates that people prefer medicinal plants that are easy to cultivate, harvest, and process, such as herbs and trees, compared to plants that require additional support, such as climbers. Additionally, climbers are more challenging to utilize medicinally due to their reliance on other plants for support and growth, distinguishing their characteristics from other plant types (Lestari and Ningrum 2021).

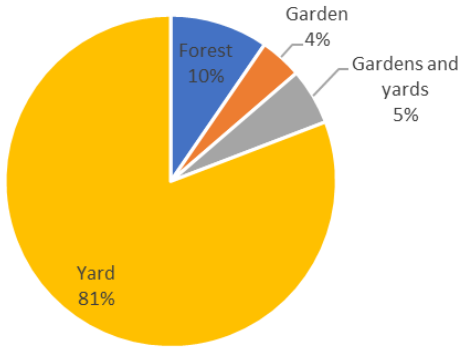

Figure 3. habitat for medicinal uses

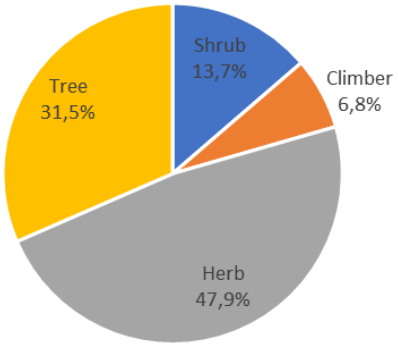

Figure 4. The habitus of medicinal plants

Plant part used

The local communities in the research area utilize several plant components, including leaves, stems, roots, bark, and fruit, for the production of traditional medicine (Figure 5). Leaves are the most commonly utilized plant components, present in 25 species. They are followed by tuber which is found in 14 species, and fruit which is found in 13 species, and. Leaves are commonly utilized as herbal remedies due to their accessibility and consistent availability. Furthermore, the process of extracting and utilizing leaves is straightforward and uncomplicated. Leaves possess numerous health advantages that have been recognized for centuries, providing knowledge about traditional medicine. This recognition of health benefits sets leaves apart from other components of the plant (Mais et al. 2018).

Preparation

There are multiple methods to extract therapeutic properties from plants, each yielding distinct compounds and health advantages. According to Figure 6, the predominant approach involves boiling medicinal herbs like jahe (*Z. officinale*), kunyit (*Z. zerumbet*), and *sereh* (*Cymbopogon* sp.) in hot water. The resulting boiled water is then used as a remedy for many ailments, such as colds, coughs, fever, ulcers, and inflammation. Boiling is a commonly employed technique in 37% of medicinal plant species. It is a classic and easily achievable method to extract medicinal properties from plants, as highlighted by Widayati and Wulandari (2018). However, the world of herbal medicine is not limited to boiling. Another prevalent method is eat straight away medicinal herbs such as garlic (*Allium sativum* L.), parijoto (*Medinilla speciosa* (Reinw. ex Blume) Blume), guava (*Psidium guajava* L.), and *duwet* (*Syzigium cumini)*, either in their raw form or combined with other meals. This approach can enhance the body's immunity, thwart infection, heal wounds, or cleanse the oral cavity; this technique is employed in 9.6% of the total number of species of medicinal plants. One prevalent method involves steeping therapeutic herbs, such as purple leaves, noni, and horseradish, in warm water and thereafter consuming the resulting infusion (brewed process) as a medicinal remedy for ailments such as hemorrhoids, hypertension, anti-cancer properties, and menstruation relief. This technique is employed for 5.5% of the total number of species of medicinal plants. In addition to that, several techniques are employed with multiple species of medicinal plants, including pulverizing and topically applying them, boiling them as a vegetable, ingesting the liquid or sap and applying it, directly applying it to the body, extracting juice from it, or incorporating it into bath water. The versatility of these methods is sure to intrigue and inspire our curiosity about the possibilities of herbal medicine.

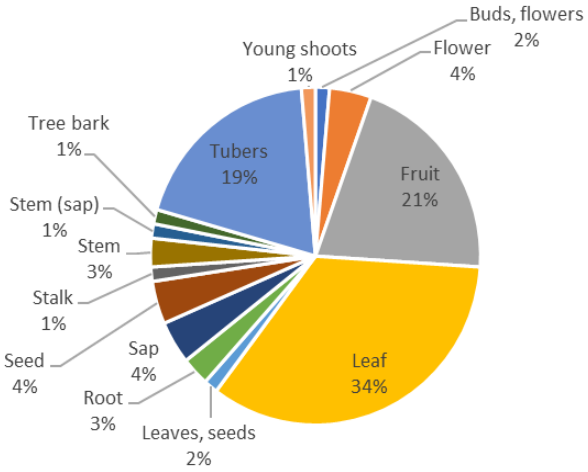

Figure 5. Plant parts are used for medicinal uses

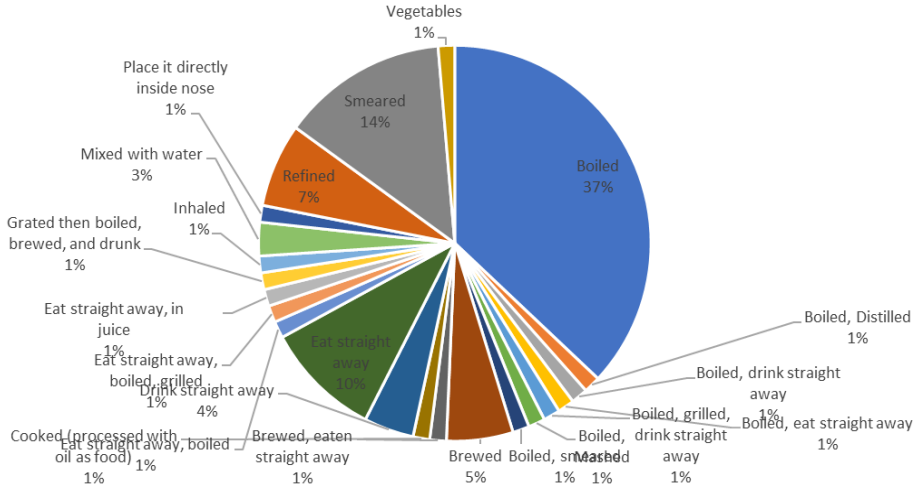

Figure 6. Preparation methods of medicinal plants

Moreover, the many techniques employed in the preparation of medicinal plants demonstrate that each method has distinct merits and drawbacks. The traditional method has several benefits, including simplicity, affordability, and the absence of any need for specialized gear. When performed correctly and in accordance with the required dosage, this approach can also preserve or enhance the effectiveness of medicinal herbs. Nevertheless, older methods have drawbacks such as reduced hygiene, lack of standardization, and susceptibility to contamination or damage. This approach may also lead to the depletion of certain chemical constituents in medicinal plants, particularly those that are volatile or susceptible to decomposition caused by heat or water (Elisma et al. 2020). Hence, it is imperative to innovate and enhance the techniques for processing medicinal plants, ensuring they are contemporary, effective, and of superior quality while still preserving their traditional significance.

Disease treatment

The study found medicinal plants for several diseases, including Respiratory System Diseases (RSD) such as asthma, laryngitis, and lung infections; the most commonly used medicinal plants are garlic (*A. sativum*), *dadap* (*E. variegata*), and *cengkeh* (*S. aromaticum*). Also, medicinal for skin and subcutaneous tissue (DS) diseases such as itching and endocrine diseases, the most commonly used drugs are *dlingo* (*A. calamus*), sirsak (*A. muricata*), and *sirih ungu* (*P. nigrum)*. In addition, there are also medicinal for endocrine, nutritional, and metabolic diseases (ENM) such as diabetes, mastitis, anti-cancer, hepatitis, low immunity, and low appetite; the most commonly used medicinal plants are *dandang gendhis (G. pictum)*, and *pace* (*M. citrifolia*). There are medicinal for symptoms and signs related to the circulatory and respiratory system (DCR), such as cough and nosebleed; jeruk nipis (*C. aurantifolia*), jeruk lemon (*C. limon*), and betel (*P. ornatum*) are the most commonly used medicinal plants. Moreover, for symptoms, signs, and abnormal clinical and laboratory (SSA) such as fever, headache, and oral infections, the most commonly used medicinal plants are *temulawak (C. zanthorrhiza)*, *kunyit* (*Z. zerumbet*), and garlic (*A. sativum*). There are also medicines for Diseases of the musculoskeletal system and connective tissue (DMC), such as rheumatism. The most commonly used medicinal plants are manis jangan (*C. verum*), tapak liman (*E. saber*), and *alang-alang* (*I. cylindrica*), and drugs for symptoms and signs involving the skin and subcutaneous tissue (SCT) such as burns and skin wounds; the most commonly used medicinal plants are lidah buaya (*A. vera*), *binahong (A. cordifolia)*, and *karet* (*H. brasiliensis*).

Respiratory, especially asthma, is one of the many diseases Indonesians suffer from. It was recorded by the Ministry of Health that in 2020, 12 million Indonesians had asthma. Garlic is a natural medicine used to treat asthma (Suharti and Yuliyana 2022). Garlic contains allicin ($C_6H_{10}OS_2$), an anti-inflammatory compound that can help relieve asthma. Next is a skin disease. For example, Based on Health Service data, Banjarmasin City's incidence of skin disease (another dermatitis, unspecified/eczema) is included in the top 10 diseases in 8th place with a total of 7,584 incident cases (Purwaningsih 2021). One natural medicine that can cure or reduce skin diseases is purple betel leaves, which contain phenol (C6H6O), a compound with anti-bacterial properties.

Coughing is one of the most common diseases in the world, and almost all people have experienced it worldwide. Lime is medicinal because it contains vitamin C, which can soothe the throat when coughing. Fever is also a disease that all humans most often suffer from, a symptom where people will feel a high body temperature above 36^{o}C, the body feels sore, and the tongue feels bitter when eating. *Kunyit* is one of the many natural medicines used to relieve fever, and it contains COX-2 compounds, enzymes that can mediate the increasing temperature in fever. Therefore, the curcumin contained in turmeric has an antipyretic effect. Older people often experience rheumatism, and *manis jangan (C. verum)* is one of the medicines for rheumatism because it contains ingredients such as protein, fiber, phosphorus, etc. Burns or skin

wounds are diseases that affect the outer and inner skin tissue. One of the medicines is *binahong* (*A. cordifolia*) because it contains saponin, which is useful as an antiseptic. In previous research, there was an alternative to healing atopic dermatitis wounds with natural extracts. *Binahong* (*A. cordifolia*) leaf extract is used to treat various diseases, one of which is various kinds of wounds, including external wounds caused by scratches from sharp weapons, after surgery, after childbirth, friction scars, and itching (Musyaropah and Supriyatna 2023). However, no specific research has used *binahong* (*A. cordifolia*) leaf extract to heal atopic dermatitis wounds.

Medicinal plants utilized in traditional medicine exhibit a range of specific therapeutic properties, such as antimicrobial, anti-inflammatory, analgesic, antipyretic, immunomodulatory, and antioxidant effects. These properties stem from bioactive compounds, including alkaloids, flavonoids, terpenoids, and tannins. Consequently, these plants are valuable in combating infections, alleviating inflammation and pain, reducing fever, enhancing immune function, and assisting the body in managing stress. This diverse array of benefits underscores the significant role that medicinal plants play in traditional medicine for both the prevention and treatment of various diseases.

The use of medicinal plants should be complemented by scientific validation to ensure safety and efficacy. While many have demonstrated traditional benefits, it is essential to consult healthcare professionals to minimize risks, such as incorrect dosages or drug interactions. Ethnobotanical studies provide valuable insights from empirically validated local knowledge, serving as a foundation for further research and the integration of these plants into formal health systems.

Relative Frequency Citation (RFC)

Species with low Relative Frequency Citation (RFC), such as *Piper betle* L., *Cinnamomum verum* J.Presl, and *Piper ornatum* N.E.Br., (Table 2) suggest that their frequency of occurrence or references in ethnobotanical literature is relatively low. This indicates that, while they may have specific uses in local culture, these species may be less common or less significant in a broader cultural context. However, their unique role in the local culture commands respect. Species with high Relative Frequency Citation (RFC), such as *Allium sativum* L. and *Jatropha multifida* L., indicate that they have a high frequency of occurrence in ethnobotanical surveys or are frequently referenced in ethnobotanical literature. This underscores the important role of these species in everyday life and the sustainability of local culture.

Use Value (UV)

Species with low Use Value (UV), such as *P. betle, C. verum,* and *P. ornatum* (Table 2), suggest that their use or practical utility in local culture may be limited to specific contexts or uses. While these species may have specialized roles or uses in local culture, their relatively low frequency in ethnobotanical surveys indicates that their contribution to everyday life may not be as significant as other species. Conversely, species with high Use Value (UV), such as *A. sativum* and *J. multifida*, indicate that they play an important role in local culture and tradition. Their high frequency in ethnobotanical surveys reflects their widespread use and significance in daily life.

The view that modern medicine offers superior reliability and established standards compared to traditional herbal medicine is well-founded, as it undergoes rigorous clinical trials for safety and efficacy. However, it is essential to recognize that many modern medical practices are rooted in processed medicinal plants. While traditional herbal medicine may lack standardization, its diverse and holistic approaches can effectively complement modern treatments, particularly for chronic and preventive care. Thus, integrating both methods, supported by scientific evidence, can enhance overall health outcomes.

ICF Value

In the observation results in Table 3, the highest ICF value with the specific disease name fever, headache and mouth infection, disease classification, symptoms and signs of clinical and laboratory abnormalities (SSA), is 0.96. People there rarely use medicinal plants to treat constipation and cholesterol. Based on this table, there are only 3 respondent statements and 2 species of medicinal plants related to eye inflammation with the eye and adnexa diseases (EAD) classification, so the lowest total ICF value is 0.50. Based on the results of interview reports, many people there often suffer from hypertension, heart disease, and anemia, with the disease classification being certain infectious and parasitic diseases (CID) and diseases of the skin and subcutaneous tissue (DS) with a total of 89 statements from respondents. Respiratory problems threaten health (Salsabila 2021), so 16 medicinal plants can solve disease with an ICF value of 0.95. Then, the people there are also often affected by diabetes, mastitis, anti-cancer, hepatitis, low immunity, and low appetite, with the classification of endocrine, nutritional, and metabolic (ENM) diseases, and 16 types of medicinal plants can be used, with a total ICF value of 0.93.

IAR Value

The research results showed that the informants agreed upon 52 species of medicinal plants, including *Foeniculum vulgare* Mill, *Persea americana* Mill, *Graptophyllum pictum* (L) Griff, *Cordyline fruticosa* (L.) A. Chew, *Eleutherine bulbosa* (Mill.) Urb, *Anredera cordifolia* (Ten.) Steenis, *Tinospora cordifolia* (Wild.) Mie rs, *Beta vulgaris subsp*. vulgaris, *Capsicum frutescens* L., and *Syzygium aromaticum* (L) Merr. & L.M.Perry. with an IAR value of 1.00. A high IAR value indicates that all informants agree that the medicinal plant is used to treat the same disease (Figure 7). The advantages of using traditional medicine are that it is relatively safer than conventional medicine, the side effects are relatively low, obtaining these medicinal plants is easy, and they can even be cultivated at home (Melviani et al. 2022).

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

Classification of diseases	Specific disease name	Number use report	Species number	ICF
Certain infectious and parasitic diseases (CID)	Diarrhea, fungal skin, smallpox, bloated intestinal worms	256	13	0.95
Diseases of the circulatory system (CSD)	Hypertension, heart disease, anemia	294	16	0.95
Diseases of the digestive system (DSD)	Constipation, cholesterol	72	8	0.90
Diseases of the eye and adnexa (EAD)	Eye inflammation	3	2	0.50
Diseases of the genitourinary system (GD)	Bladder infection, menstrual pain, fertility disorder	21	4	0.85
Diseases of the respiratory system (RSD)	Asthma, sore throat, lung infection	52	4	0.94
Diseases of the skin and subcutaneous tissue (DS)	Itch	89	5	0.95
Endocrine, nutritional, and metabolic diseases (ENM)	Diabetes, mastitis, anti-cancer, hepatitis, low immunity, low appetite	230	16	0.93
Symptoms and signs involving the circulatory and respiratory systems (DCR)	Cough, nose bleeding	87	6	0.94
Symptoms, signs, and abnormal clinical and laboratory (SSA)	Fever, headache, mouth infection	143	7	0.96
Diseases of the musculoskeletal system and connective tissue (DMC)	Rheumatism, hemorrhoids	16	6	0.67
Symptoms and signs involving the skin and subcutaneous tissue (SCT)	Skin burns, incision wounds	51	9	0.84

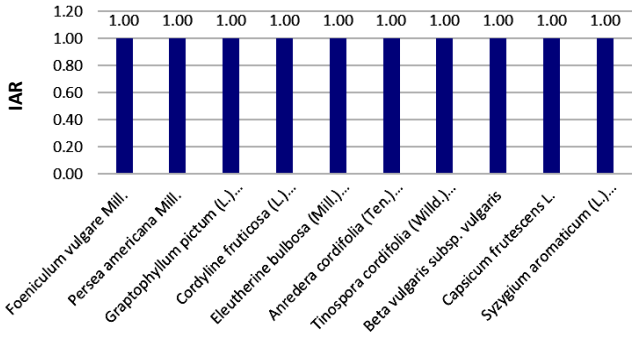

Figure 7. IAR (Informant Agreement Ratio) ranks the most important medicinal plant species

Research on medicinal plants in the Mount Merapi region has important implications for conservation efforts. It aids in preserving biodiversity by identifying key species and promotes sustainable management through cultivation to prevent over-exploitation. Additionally, it empowers local communities to protect natural resources and preserves traditional knowledge through the documentation of local wisdom. The findings may also foster the development of medicinal plant-based ecotourism, providing economic benefits to the community and raising awareness about the importance of safeguarding the Mount Merapi ecosystem. it is important to consider criticism of medicinal plant use, we must also acknowledge that it respects traditional knowledge and supports modern medicine. The wide array of pharmaceutical compounds derived from these plants demonstrates their potential to enhance medical science. The challenge is to ensure that their use is backed by rigorous scientific research to validate their benefits and prevent substandard practices. By merging traditional wisdom with modern innovation, we can effectively advance global health.

In conclusion, based on the research results, 73 species from 35 families were found for medicinal plants used by the community in Mount Merapi National Park, Central Java, Indonesia, with the Zingiberaceae family with the most members, namely 12 species. The part of the plant body that is most widely used for medicine is the leaves. The type of habitat that is widely planted is home gardens (yards), so it is a type of cultivated plant with a habit of herbs and processing by boiling. The index calculated as the highest RFC is *A. sativum* reflects their widespread use and significance in daily life. The highest UV is *A. cepa* (0.06), which indicates the species has the highest use; the highest IAR is *F. vulgare* (1.00), which indicates many people who agree with the use of this species as a medicinal plant, and the highest ICF value is SSA (Symptoms, signs, and abnormal clinical and laboratory) disease 0.96, people there rarely use medicinal plants to treat constipation and cholesterol.

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REFERENCES

Adiyasa MR, Meiyanti M. 2021. Utilization of traditional medicine in Indonesia: distribution and influential demographic factors. J Biomed Health 4 (3): 130-138. DOI: 10.18051/JBiomedKes.2021.v4.130-138.

Al-Laith AA, Alkhuzai J, Freije A. 2019. Assessment of antioxidant activities of three wild medicinal plants from Bahrain. Arabian J Chem 12(8): 2365-2371. DOI: 10.1016/j.arabjc.2015.03.004.

Alamgir ANM, Alamgir ANM. 2017. Pharmacognostical Botany: Classification of medicinal and aromatic plants (MAPs), botanical taxonomy, morphology, and anatomy of drug plants. Therapeutic Use of Medicinal Plants and Their Extracts: Volume 1: Pharmacognosy 177-293. DOI: 10.1007/978-3-319-63862-1_6.

Anand U, Jacobo-Herrera N, Altemimi A, Lakhssassi N. 2019. A comprehensive review on medicinal plants as antimicrobial therapeutics: Potential avenues of biocompatible drug discovery. Metabolites 9 (11): 258. DOI: 10.3390/metabo9110258.

Aprilianti AN, Ba'it AA, Azizah RA, Miranda D, Rachmayani M, Ummah AA. 2021. Analisis vegetasi di Lereng Selatan Taman Nasional Gunung Merapi. Bioma: Jurnal Biologi dan Pembelajaran Biologi 6 (2): 144-159. DOI: 10.32528/bioma.v6i2.2965. [Indonesian]

Astutik S, Pretzsch J, Ndzifon Kimengsi J. 2019. Asian medicinal plants' production and utilization potentials: A review. Sustainability 11 (19): 5483. DOI: 10.3390/su11195483.

Bano A, Ahmad M, Hadda TB, Saboor A, Sultana S, Zafar M, Khan MP, Arshad M, Ashraf MA. 2014. Quantitative ethnomedicinal study of plants used in the skardu valley at high altitude of Karakoram-Himalayan range, Pakistan. J Ethnobiol Ethnomed 10 (1): 1-18. DOI: 10.1186/1746-4269-10-43.

BPS. 2010. Sensus Penduduk Indonesia 2010. Badan Pusat Statistik, Jakarta. [Indonesian]

Brontowiyono W, Boving T, Asmara AA, Rahmawati S, Yulianto A, Wantoputri NI, Lathifah AN, Andriansyah Y. 2022. Communal wastewater treatment plants' effectiveness, management, and quality of groundwater: A case study in Indonesia. Water 14 (19): 3047. DOI: 10.3390/w14193047.

Butt MA, Ahmad M, Fatima A, Sultana S, Zafar M, Yaseen G, Ashraf MA, Shinwari ZK, Kayani S. 2015. Ethnomedicinal uses of plants for the treatment of snake and scorpion bites in Northern Pakistan. J Ethnopharmacol 168: 164-181. DOI: 10.1016/j.jep.2015.03.045.

Cartwright AC, Armstrong NA. 2020. A history of the medicines we take: From ancient times to present day. Pen and Sword History.

Chaachouay N, Benkhnigue O, Fadli M, El Ibaoui H, Zidane L. 2019. Ethnobotanical and ethnopharmacological studies of medicinal and aromatic plants used in the treatment of metabolic diseases in the Moroccan Rif. Heliyon 5 (10): 1-9. DOI: 10.1016/j.heliyon.2019.e02191.

Chandra R, Uniyal VP. 2021. An ethnobotanical study of wild medicinal plants among the mountain communities of the Western Himalayas: A case study of Govind wildlife sanctuary and national park. Med Plants-Intl J Phytomed Relat Ind 13 (2): 251-265. DOI: 10.5958/0975-6892.2021.00028.9.

Damastuti E, de Groot R, Debrot AO, Silvius MJ. 2022. Effectiveness of community-based mangrove management for biodiversity conservation: A case study from Central Java, Indonesia. Trees For People 7: 100202. DOI: 10.1016/j.tfp.2022.100202.

Elisma E, Rahman H, Lestari U. 2020. Ppm pemberdayaan masyarakat dalam pengolahan tanaman obat sebagai obat tradisional di desa mendalo indah jambi luar kota. SELAPARANG: Jurnal Pengabdian Masyarakat Berkemajuan 4 (1): 274-277. DOI: 10.31764/jpmb.v4i1.2736. [Indonesian]

Gunawan HE, Heriyanto NM, Subiandono E, Mas'ud AF, Krisnawati H. 2015. Invasi jenis eksotis pada areal terdegradasi pasca erupsi di Taman Nasional Gunung Merapi. Pros Sem Nas Masy Biodiv Indon 1 (5): 1027-1033. DOI: 10.13057/psnmbi/m010511. [Indonesian]

Guo CA, Ding X, Hu H, Zhang Y, Yang H, Wang Y. 2022. An ethnobotanical study on wild plants used by Tibetan people in Gyirong Valley, Tibet, China. J Ethnobiol Ethnomed 18 (1): 1-20. DOI: 10.1186/s13002-022-00565-1.

Heinrich M, Ankli A, Frei B, Weimann C, Sticher O. 1998. Medicinal plants in Mexico: healers' consensus and cultural importance. Soc Sci Med 47: 1859-1871. DOI: 10.1016/S0277-9536(98)00181-6.

Helmina S, Hidayah Y. 2021. Kajian etnobotani tumbuhan obat tradisional oleh masyarakat kampung Padang kecamatan Sukamara Kabupaten Sukamara. Jurnal Pendidikan Hayati 7 (1). [Indonesian]

Hidayati IR, Almadani MY, Yunita SL. 2022. Factors affecting proper self-medication behavior of gastritis drugs. KnE Med 2022: 685-694. DOI: 10.18502/kme.v2i3.11923.

Hu R, Lin C, Xu W, Liu Y, Long C. 2020. Ethnobotanical study on medicinal plants used by Mulam people in Guangxi, China. J Ethnobiol Ethnomed 16 (1): 1-50. DOI: 10.1186/s13002-020-00387-z.

Kaky E, Gilbert F. 2019. Assessment of the extinction risks of medicinal plants in Egypt under climate change by integrating species distribution models and IUCN Red List criteria. J Arid Environ 170: 103988. DOI: 10.1016/j.jaridenv.2019.05.016.

Kaky E, Nolan V, Alatawi A, Gilbert F. 2020. A comparison between Ensemble and MaxEnt species distribution modeling approaches for conservation: A case study with Egyptian medicinal plants. Ecol Inf 60: 101150. DOI: 10.1016/j.ecoinf.2020.101150.

Lestari DA, Ningrum LW. 2021. Karakter penciri morfologi dan tipe panjatan koleksi tumbuhan memanjat Annonaceae. BIOEDUSAINS: Jurnal Pendidikan Biologi dan Sains 4 (2): 117-128. DOI: 10.31539/bioedusains.v4i2.2425. [Indonesian]

Lestari D, Koneri R, Maabuat PV. 2021. Keanekaragaman dan pemanfaatan tanaman obat pada pekarangan di Dumoga Utara, Kabupaten Bolaang Mongondow, Sulawesi Utara. Jurnal Bios Logos 11 (2): 82-93. DOI: 10.35799/jbl.11.2.2021.32017.

Long C, Chen Z, Zhou Y, Long B. 2018. Conservation for ornamental breeding. Ornamental Crops 11.

Mais M, Simbala HE, Koneri R. 2018. Pemanfaatan tumbuhan obat oleh etnis sahu dan loloda di Halmahera Barat, Maluku Utara. Jurnal MIPA 7 (1): 8-11. DOI: 10.35799/jm.7.1.2018.18811. [Indonesian]

Mechaala S, Bouatrous Y, Adouane S. 2022. Pengembangan kawasan konservasi tanaman obat berbasis biodiversitas unggulan lokal sebagai daya tarik wisata. JMM (Jurnal Masyarakat Mandiri) 42 (1): 33-45. DOI: 10.31764/jmm.v6i6.11298. [Indonesian]

Melviani M, Rohama R, Noval N. 2022. Penggunaan tanaman sebagai obat pada masyarakatan Suku Banjar, Dayak, dan Bugis di Kalimantan Selatan. Jurnal Surya Medika (JSM) 8 (2): 171-177. DOI: 10.33084/jsm.v8i2.3882. [Indonesian]

Ministry of Home Affairs (MHA). 2023. Indonesian Population June 2023. Ministry of Home Affairs (Indonesia), Jakarta. [Indonesian]

Mistriani N, Helyanan P. S. 2022. Development of medicinal plant conservation areas based on local superior biodiversity as a tourist attraction. JMM (Independent Community Journal) 6 (6): 4955-4967.

Musyaropah R, Supriyatna A. 2023. Efektivitas daun binahong (*Anredera scandens* (L.) Moq) sebagai obat penyembuhan berbagai luka: Review literature. An Idea Health J 3 (02): 49-54. [Indonesian]

Naim A, Syaputra H. 2011. Kewarganegaraan, Suku Bangsa, Agama, dan Bahasa Sehari-Hari Penduduk Indonesia: Hasil Sensus Penduduk 2010. Badan Pusat Statistik, Jakarta. [Indonesian]

Navia ZI, ADNAN A, Harmawan T, Suwardi AB. 2022. Ethnobotanical study of wild medicinal plants in Serbajadi protected forest of East Aceh District, Indonesia. Biodiversitas 23 (10): 4959-4970. DOI: 10.13057/biodiv/d231001.

Patocka J, Nepovimova E, Wu W, Kuca K. 2020. Digoxin: Pharmacology and toxicology—A review. Environ Toxicol Pharmacol 79: 103400. DOI: 10.1016/j.etap.2020.103400.

Petrovska BB. 2012. Historical review of medicinal plants' usage. Pharmacognosy Rev 6 (11): 1.

Purwaningsih D. 2021. Hubungan personal hygiene dan sumber air dengan kejadian penyakit kulit di Pulau Bromo Kelurahan Mantuil Tahun 2021. [Doctoral dissertation]. Universitas Islam Kalimantan MAB, Banjarmasin. [Indonesian]

Ramadhani AA, Munir A, Samai S. 2023. Etnobotani dalam upacara adat pernikahan Suku Tolaki Kabupaten Konawe Sulawesi Tenggara. Jurnal Educatio FKIP UNMA 9 (2): 472-477. [Indonesian]

Salmerón-Manzano E, Garrido-Cardenas JA, Manzano-Agugliaro F. 2020. Worldwide research trends on medicinal plants. Intl J Environ Res Public Health 17 (10): 3376. DOI: 10.3390/ijerph17103376.

Salsabila A. 2021. Hubungan derajat merokok dengan gejala gangguan sistem pernapasan pada pegawai Universitas Islam Bandung. Jurnal Riset Kedokteran 100-106. DOI: 10.29313/jrk.v1i2.562. [Indonesian]

Seran AAJJ. 2022. Analisis solusi masalah perambahan di Kawasan Hutan Dengan Tujuan Khusus (KHDTK) Diklat Sisimeni Sanam. Wana Lestari 4 (02): 437-445. DOI: 10.35508/wanalestari.v7i02.9480. [Indonesian]

Setyawati S, Ashari A. 2017. Geomorfologi lereng baratdaya gunungapi merapi kaitannya dengan upaya pengelolaan lingkungan dan kebencanaan. Geo Media: Majalah Ilmiah dan Informasi Kegeografian 15 (1): 45-60. DOI: 10.21831/gm.v15i1.16235. [Indonesian]

Shedoeva A, Leavesley D, Upton Z, Fan C. 2019. Wound healing and the use of medicinal plants. Evidence-Based Complement Altern Med 2019 (1): 2684108. DOI: 10.1155/2019/2684108.

Silalahi M, Wakhidah AZ. 2023. The food plants trade in the Kranggan Mas traditional market, West Java Province, Indonesia: Food security and local cuisine. J Ethnic Foods 10 (1): 27. DOI: 10.1186/s42779-023-00192-5.

Ssenku JE, Okurut SA, Namuli A, Kudamba A, Tugume P, Matovu P, Wasige G, Kafeero HM, Walusansa A. 2022. Medicinal plant use, conservation, and the associated traditional knowledge in rural communities in Eastern Uganda. Trop Med Health 50 (1): 39. DOI: 10.1186/s41182-022-00428-1.

Su H, Ma L, Chang T, Qin R, Zhang Z, She Y, Wei J, Zhou C, Hu X, Shi Z, Adi H. 2023. Effects of main land-use types on plant and microbial diversity and ecosystem multifunctionality in degraded alpine grasslands. Land 12 (3): 638. DOI: 10.3390/land12030638.

Suharti S, Yuliyana R. 2022. Sosialisasi manfaat minuman jahe merah dan bawang putih pada keluarga yang menderita asma bronkial. Jurnal Pengabdian Masyarakat Anugerah Bintan (JPMAB) 3 (2): 46-53. [Indonesian]

Susilo AN, Rudiarto I. 2014. Analisis tingkat resiko erupsi gunung merapi terhadap permukiman di Kecamatan Kemalang, Kabupaten Klaten. Teknik PWK (Perencanaan Wilayah Kota) 3 (1): 34-49. DOI: 10.14710/tpwk.2014.4352. [Indonesian]

Syarifuddin S, Damayanti RA. 2019. Biodiversity accounting: Uncovering environmental destruction in Indonesia. Soc Responsibility J 16 (6): 809-825. DOI: 10.1108/SRJ-11-2018-0291.

Ullah R, Alqahtani AS, Noman OM, Alqahtani AM, Ibenmoussa S, Bourhia M. 2020. A review on ethno-medicinal plants used in traditional medicine in the Kingdom of Saudi Arabia. Saudi J Biol Sci 27 (10): 2706-2718. DOI: 10.1016/j.sjbs.2020.06.020.

Utami NR, Rahayuningsih M, Abdullah M, Haka FH. 2019. Ethnobotany of medicinal plants of local communities on Mount Ungaran, Central Java. In Proc Natl Seminar Indones Biodivers Soc 5 (2): 205-208. DOI: 10.13057/psnmbi/m050210.

Vaou N, Stavropoulou E, Voidarou C, Tsigalou C, Bezirtzoglou E. 2021. Towards advances in medicinal plant antimicrobial activity: A review study on challenges and future perspectives. Microorganisms 9 (10): 2041. DOI: 10.3390/microorganisms9102041.

Wahab S, Hatria N, Idrus I, Muliana H, Azzahra N. 2022. Description of the knowledge level of RT 22 community in Tangga Takat Village, Palembang about the use of traditional medicines during the covid-19 pandemic. J Health Sci 2 (1): 28-34. DOI: 10.54816/jhs.v2i1.514.

Widayati A, Wulandari ET. 2018. Edukasi manfaat tanaman obat dan pengolahannya dengan metode CBIA di Desa Bulusulur, Kabupaten Wonogiri, Jawa Tengah. ABDIMAS ALTRUIS: Jurnal Pengabdian Kepada Masyarakat 1 (1): 25-30. DOI: 10.24071/aa.v1i1.1215. [Indonesian]

Wildayati T, Lovadi I, Linda R. 2016. Etnomedisin penyakit dalam pada suku Dayak Tabun di Desa Sungai Areh Kecamatan Ketungau Tengah Kabupaten Sintang. Jurnal Protobiont 4 (3): 1-7. DOI: 10.26418/protobiont.v4i3.13222. [Indonesian]