

# Ethnobotanical study of medicinal plants in Wonorejo and Beruk Village, Karanganyar District, Central Java, Indonesia

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Department of Environmental Sciences, Faculty of Mathematics and Natural Sciences, Sebelas Maret University. Jl. Ir. Sutami 36A Surakarta 57 126, Central Java, Indonesia. Tel./Fax. +62-271-663375, ♥email: volatileoils@gmail.com

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**Abstract.** Mukarromah AN, Dzihni A, Azzam AK, Adiningsih AR, Nurcahyati M, Setyawan AD. 2025. Ethnobotanical study of medicinal plants in Wonorejo and Beruk Village, Karanganyar District, Central Java, Indonesia. *Asian J Environ* 1: 58-69. The use of medicinal plants is carried out in a special or limited manner, where medicinal plants are a legacy passed down from generation to generation. In Wonorejo and Beruk Villages, Karanganyar, some still maintain their habit of using medicinal plants. Therefore, this research aims to determine the knowledge of the community in Wonorejo and Beruk Villages, Jatiyoso Sub-district, Karanganyar District, Central Java, Indonesia regarding types of medicinal plants and document the use of medicinal plants by the local community. The research was conducted through interviews, questionnaires, documentation, and observations with the people living in those Villages. The data is collected in a tally sheet and analyzed descriptively and quantitatively to analyze their Use Value (UV), Informant Consensus Factor (ICF), and Fidelity Level (FL). The results of the research show that people in the villages of Wonorejo and Beruk use as many as 35 species from 24 families, with the most frequently used plant types being the Zingiberaceae family, such as *Zingiber trifolia* (Burm fil.) P. Wilson, *Curcuma caesia* Roxb, and *Curcuma longa* L.. Data from Wonorejo and Beruk Village communities shows the highest UV value for the Zingiberaceae family (4.53), while the lowest was for the Caricaceae family (0.15). The highest ICF is found in the type of skin category with a value of 0.95, where *Aloe vera* (L.) Burm.f. is a plant widely used to treat this disease. The highest FL is found in *Sechium edule* (Jacq.) Sw. and *Morinda citrifolia* L. plants with a value of 100, and the lowest was in the *A. vera* species (65.8%).

**Keywords:** Fidelity level, informant consensus factor, Jatiyoso, medicinal plants, use value

**Abbreviations:** FL = Fidelity Level; ICF = Informant Consensus Factor; UV = Use Value

## INTRODUCTION

Indonesia is known as one of the most biologically rich countries in the world, with approximately 30,000 plant species, of which around 9,600 are used for medicinal purposes, and another 300 serve as the basic ingredients for modern medicine (Santosa et al. 2023). Research by the World Health Organization (WHO) indicates that about 80% of the population in developing countries rely on plants as medicinal sources to treat various diseases (Ali et al. 2022). Furthermore, medicinal plants play a crucial role in ethnobotanical studies and contribute significantly to biological conservation efforts. Given their relevance to both health and conservation, it is essential to understand how medicinal plants are used in local communities, particularly in rural areas like Karanganyar, which is the focus of this study.

Ethnobotany examines the relationship between ethnic groups and plants (Destryana and Ismawati 2019), focusing on how culture influences plant use and the way traditional communities utilize plants both directly and indirectly to support various aspects of life (Maulana et al. 2023). Such studies are crucial as they preserve local wisdom and provide insights into how plants are used for daily needs, including medicinal purposes (Fransiska et al.

2022). By documenting this knowledge, ethnobotany not only helps conserve biological resources but also strengthens the community's role in maintaining their heritage and sustainability practices. Understanding these interactions is essential for informing both conservation efforts and sustainable agricultural practices, which are vital for the preservation of local ecosystems and the continued use of medicinal plants by future generations.

Medicinal plants have a wide range of properties that enable them to heal or prevent diseases (Apel et al. 2023). The plant parts most commonly used as medicine include leaves, roots, fruits, tubers, skins, seeds, stems, and sap (Hidayani et al. 2023). Medicinal plants can be categorized into three types: traditional, modern, and potential medicinal plants (Rubianti et al. 2022). While medicinal plants are available in hospitals or pharmacies, using natural remedies from plants offers an alternative solution that addresses cost barriers and promotes local resource utilization (Arif et al. 2022). Historically, medicinal preparations have been used in both simple forms, such as plant parts, and more complex forms, including crude extracts (Hidayah et al. 2022).

This ethnobotanical study was conducted in the Mount Lawu area, which spans two provinces Central Java (western slope) and East Java (eastern slope). This area,

with an altitude of 3,265 meters above sea level, covers approximately 15,000 hectares (Purwanto and Titasari 2019; Wulansari and Nugroho 2023). The focus of this study is on Jatiyoso District, located on the western slope of Mount Lawu, where the local community still practices the cultivation and use of medicinal plants. Many Jatiyoso residents grow these plants in their front yards and fields, especially those with high market value, and some even work as home-based traditional herbal practitioners. These practices reflect the ongoing importance of medicinal plants in their daily lives for healing, disease prevention, and generating income. The continuity of these practices highlights the resilience of local communities in maintaining their knowledge and adapting it to modern needs, thus supporting both cultural and economic sustainability.

The Mount Lawu area provides significant benefits to the surrounding communities, but conservation efforts must be made to preserve natural resources, including medicinal plants. As Veldpaus and Szemzo (2021) explain, conservation is about safeguarding resources not only for human use but also for the broader ecosystem, ensuring a balanced environment. However, conservation practitioners face challenges, including limited expertise and awareness in social sciences, which can hinder efforts (Dando et al. 2022). Ethnobotanical studies offer valuable empirical data on plant use and can serve as a foundation for conservation strategies implemented by local communities. Therefore, this research aims to explore and document the knowledge of the Wonorejo and Beruk Villages community in Jatiyoso District regarding medicinal plants and how these plants are used within their local context.

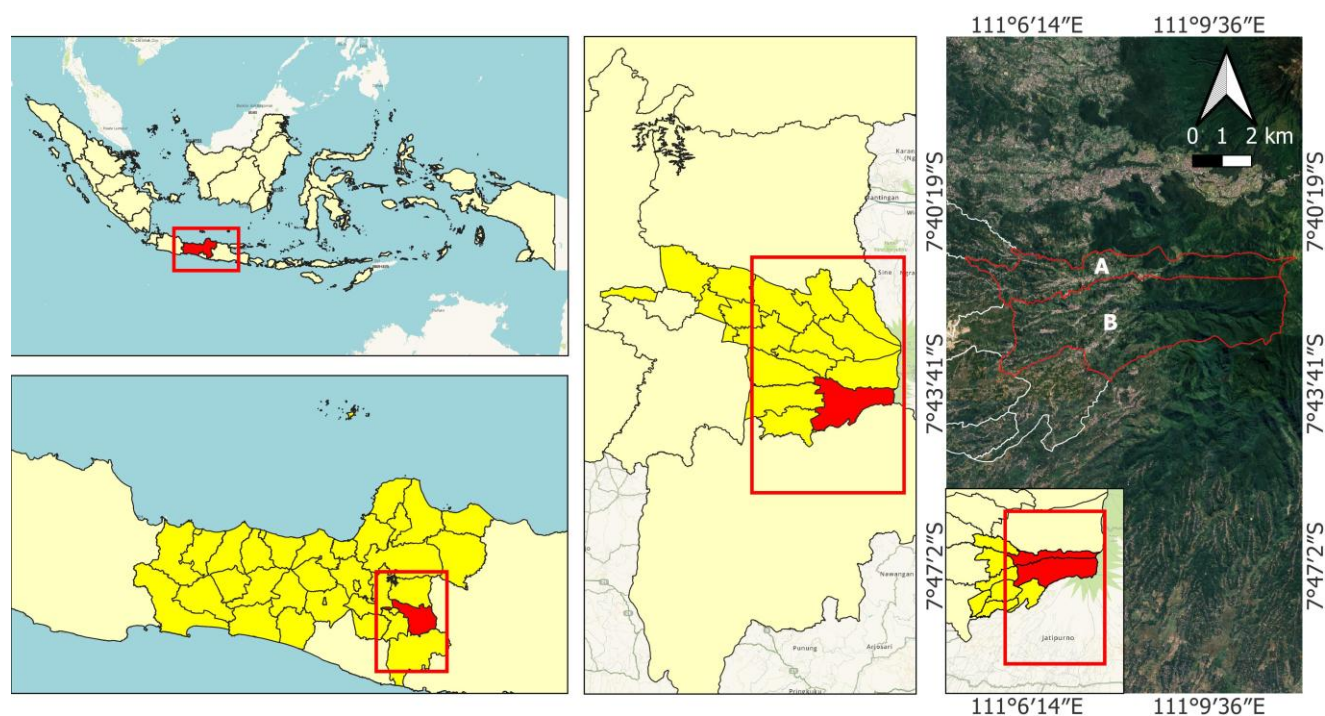
## MATERIALS AND METHODS

### Study area

Research on the ethnobotanical study of medicinal plants and their use was conducted in villages on the West Slope of Mount Lawu, namely in Jatiyoso Sub-district, Karanganyar District, Central Java Province, Indonesia. Geographically, Jatiyoso District is located between  $111^{\circ}2'54.01''$  to  $111^{\circ}11'12.51''$  East Longitude (EL) and  $7^{\circ}40'11.45''$  to  $7^{\circ}45'28.88''$  South Latitude (SL) (Figure 1).

Administratively, Jatiyoso Sub-district borders directly with Matesih and Tawangmangu Districts in the north, East Java Province in the eastern, Wonogiri District in the southern, and Jatipuro, Jumapolo and Jumantono Districts in the western. Jatiyoso District is a district in Karanganyar District, located at an altitude of 516 masl, with most of the population working as farmers. The district has agricultural commodity preferences such as vegetables, cloves, and medicinal plants (Pujiasmanto et al. 2021).

The hamlets used as study locations in Wonorejo Village are Kalimo and Kuryo Hamlets, known to most of the population as ginger producers. Meanwhile, in Beruk Village, the hamlet used as the study location is Selangkah, where many residents work as sellers of traditional herbal medicine. This research was carried out from October to November 2023 by examining types of medicinal plants and their use by local communities in the two villages were the focus of the research.



**Figure 1.** Map of the study area of A. Beruk Village and B. Wonorejo Village, Jatiyoso Sub-district, Karanganyar District, Central Java, Indonesia

### Data collection

The data in this research was obtained by conducting interviews, observation, documentation, and direct observation of the local community. This interview was conducted using a snowball sampling technique by asking for recommendations for the next informant from the main or core informant (Khuluq et al. 2021). Interviews are carried out by collecting data from one respondent to another who meets the criteria through in-depth interviews and stopping when there is no more new information, there is a lot of replication or variations in information, and the information saturation point is reached. The total number of people from Jatiyoso respondents in this research was 60, where 20 were taken from each hamlet to represent that hamlet. The data types collected are qualitative and quantitative from primary and secondary sources. The variables used include name, age, gender, occupation, name of the medicinal plant used, part of the medicinal plant that can be used, properties or uses of the medicinal plant used, and how to apply the medicinal plant.

### Data analysis

This study records the diversity and uses of medicinal plants in Wonorejo and Beruk Villages, including analysis of medicinal plants using qualitative and quantitative ethnobotany. Qualitative analysis in this research involves interviews with respondents to obtain the information to be researched. Meanwhile, quantitative analysis is used to calculate the values obtained from respondents. Botanical index analysis was used to calculate data obtained from interviews with local people.

### Use Value (UV)

The UV value can be obtained by the formula (Riadi et al. 2019):

$$UV = \frac{\sum U}{n}$$

Use Value used to evaluate the relative significance of a crop. The usage value index is calculated by adding the total usage reports from each informant for a particular species ( $\sum U$ ) and dividing it by the total number of informants ( $n$ ). A high-use value result reflects the high significance of a plant due to its high frequency of use. On the other hand, if a crop has few reported uses or its utilization activity is low, its use value will be close to zero.

### Informant Consensus Factor (ICF)

The ICF value can be obtained by the formula (Riadi et al. 2019):

$$ICF = \frac{(Nur - Nt)}{(Nur - 1)}$$

Informant Consensus Factor (ICF) determines the level of homogeneity between information provided by different informants in the research area for certain disease categories. ICF: Informant Consensus Factor Value, Nur: Number of users of plant species for each disease category, Nt: Number of species used in a particular category by all respondents.

### Fidelity Levels (%FL)

The %FL value can be obtained by the formula (Riadi et al. 2019):

$$FL(\%) = (Np/N) \times 100$$

Fidelity Level (%FL) is an index that describes the percentage of informants who report the benefits of a particular plant for a specific purpose, calculated based on the most frequently reported benefits. FL percentage provides data about the most popular plants or in demand by the public. In the formula, Np shows the number of plants used, divided by N, representing all plant parts used. If the %FL result is high, that part of the plant is frequently utilized, while a low yield indicates a lower utilization level.

## RESULTS AND DISCUSSION

### Socio-demographic characteristics

Research regarding the community's use of traditional medicinal plants was conducted using interviews. Of the 60 respondents, as in Table 1, the majority were women, with a percentage of 55%, and 45% of the sources were men. The majority of interviewees were in the age range of 50-59 years with a percentage of 40%, followed by the age range of 40-49 years (28.3%), age 30-39 years (18.3%), age more than 60 years (11.7%), and ages 20-29 years (1.7%) (Table 1). All interviewees referred their knowledge to information passed down from generation to generation through word of mouth and cultural practices. This is the basis for providing health services, the community economy, other activities that maintain society, and preserving knowledge. Public knowledge about medicinal plants and their benefits and uses, improving health, preventing disease, curing disease, and recovering, has existed since ancient times; the wider community has used that knowledge, and until now, people still use medicinal plants for health (Izzati et al. 2022).

**Table 1.** Demographic characteristics of informants

Variable	Amount	Percentage (%)	
Gender	Man	27	45
	Woman	33	55
Age	20-29	1	1.67
	30-39	11	18.33
	40-49	17	28.33
	50-59	24	40
	>60	7	11.67
Work	Housewife/not working	10	16.67
	Farmer	23	38.33
	Entrepreneur/self-employed	27	45
Education	No education	5	8.33
	Elementary school	24	40
	Junior high school	12	20
	Senior high school	15	25
	University	4	6.67

Most interviewees work as private employees (45%), with several people as makers or sellers of herbal medicine. Based on the results of the interview data that was conducted, 38.3% worked as farmers, and 16.7% did not work or were housewives. Most of these farmers are vegetable farmers, apart from that, several people in Wonorejo Village are ginger farmers as a side commodity. Of the total respondents, there were 8.33% of people who had not completed education or had no educational background, and 6.67% had completed education up to a bachelor's degree, where the majority of people had an education up to elementary school with 40%, the remaining 20% were junior high school graduates and 25% senior high school graduates. Apart from the level of public education, people's knowledge about medicinal plants is still maintained because it is a tradition passed down from their ancestors. The use of medicinal plants by the Jatiyoso community was that the use of medicinal plants tended to be among older people and some people who cultivated or produced herbal medicine. Only a few young people were aware of the use and potential of medicinal plants around them. However, people believe medicinal plants can prevent and cure various diseases. The use of medicinal

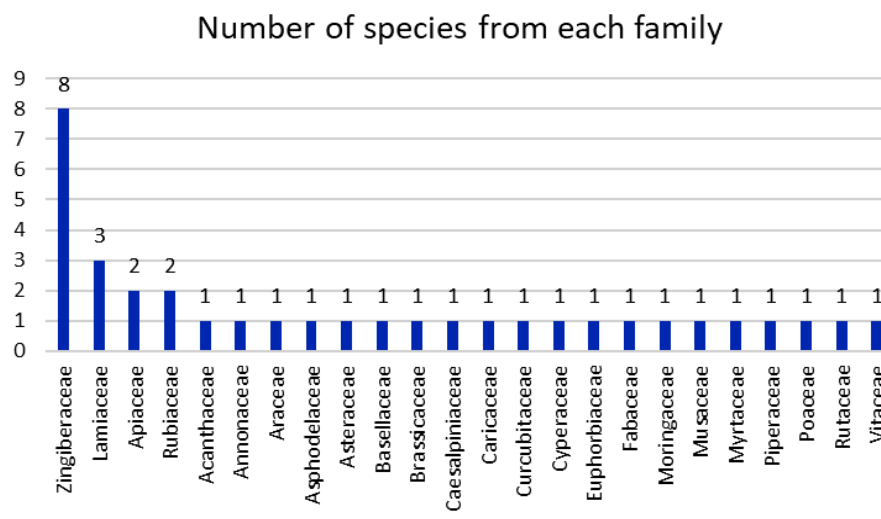
plants by local communities is intended as the first treatment to prevent minor and serious illnesses and reduce the consumption of chemical medicines. The research conducted by Ziraluo (2020) shows that medicinal plants are useful in maintaining health, improving nutritional status, greening the environment, and increasing income.

### Medicinal plant diversity

The research from observations in Wonorejo and Beruk Villages shows that people in these villages still use several types of plants as medicine. Moreover, 35 species from 24 plant families of medicinal plants were identified and used by the community for traditional medicine. Table 2 also contains ethnomedicinal information for each species, including family name, scientific name, local name, habitus, and location or community that uses the medicinal plant. Zingiberaceae contributed the most medicinal species, with 8 species, followed by Lamiaceae, which had 3 species. The Apiaceae and Rubiaceae families each have 2 species of medicinal plants, and the other families found only have 1 species of medicinal plants (Figure 2).

**Table 2.** Medicinal plant diversity in Wonorejo and Beruk Villages

Species	Local Name	Family	Villages			Habitus
			Wonorejo		Beruk	
			Kalimo	Kuryo	Selangkah	
<i>Acous calamus</i> L.	<i>Dlingo</i>	Araceae	-	√	-	Herb
<i>Aloe vera</i> (L.) Burm.f.	<i>Lidah Buaya</i>	Asphodelaceae	-	√	√	Herb
<i>Alpinia galanga</i> (L.) Willd.	<i>Lengkuas</i>	Zingiberaceae	√	√	√	Herb
<i>Andrographis paniculata</i> (Burm.fil.) Nees	<i>Sambiloto</i>	Acanthaceae	-	-	√	Herb
<i>Annona muricata</i> L.	<i>Sirsak</i>	Annonaceae	√	-	-	Tree
<i>Anredera cordifolia</i> (Ten.) Steenis	<i>Binahong</i>	Basellaceae	-	-	√	Shrubs
<i>Apium graveolens</i> L.	<i>Seledri</i>	Apiaceae	-	-	√	Herb
<i>Brassica rapa</i> L.	<i>Sawi Jepang</i>	Brassicaceae	-	-	√	Herb
<i>Caesalpinia sappan</i> L.	<i>Kayu Secang</i>	Caesalpinaceae	-	-	√	Shrubs
<i>Carica papaya</i> L.	<i>Pepaya</i>	Caricaceae	-	-	√	Herb
<i>Cayratia trifolia</i> L.	<i>Galing-galing</i>	Vitaceae	-	-	√	Climbing plants
<i>Centella asiatica</i> (L.) Urban.	<i>Pegagan</i>	Apiaceae	-	-	√	Herb
<i>Citrus lemon</i> L.	<i>Jeruk Lemon</i>	Rutaceae	√	√	√	Tree
<i>Curcuma aeruginosa</i> Roxb.	<i>Temuireng</i>	Zingiberaceae	-	-	√	Herb
<i>Curcuma caesia</i> Roxb.	<i>Kunyit Hitam</i>	Zingiberaceae	-	-	√	Herb
<i>Curcuma longa</i> L.	<i>Kunyit</i>	Zingiberaceae	√	√	√	Herb
<i>Curcuma zanthorrhiza</i> Roxb.	<i>Temulawak</i>	Zingiberaceae	√	√	√	Herb
<i>Cymbopogon citratus</i> (DC.) Stapf	<i>Serai</i>	Poaceae	-	-	√	Herb
<i>Cyperus rotundus</i> L.	<i>Rumput Teki</i>	Cyperaceae	-	-	√	Herb
<i>Elephantopus scaber</i> L.	<i>Tapak Liman</i>	Asteraceae	-	-	√	Bush
<i>Jatropha multifida</i> L.	<i>Tentir</i>	Euphorbiaceae	-	-	√	Herb
<i>Kaempferia galanga</i> (L.)	<i>Kencur</i>	Zingiberaceae	√	√	√	Herb
<i>Leucaena leucocephala</i> (Lam) De Wit.	<i>Mlanding</i>	Fabaceae	-	-	√	Shrubs
<i>Mentha x Piperita</i> L.	<i>Mint</i>	Lamiaceae	-	-	√	Herb
<i>Morinda citrifolia</i> L.	<i>Mengkudu</i>	Rubiaceae	-	-	√	Tree
<i>Moringa oleifera</i> Lam.	<i>Kelor</i>	Moringaceae	-	-	√	Shrubs
<i>Musa Paradisiaca</i> L.	<i>Pisang</i>	Musaceae	√	-	√	Herb
<i>Ocimum basilicum</i> L.	<i>Kemangi</i>	Lamiaceae	-	√	-	Shrubs
<i>Paederia foetida</i> L.	<i>Sembukan</i>	Rubiaceae	-	-	√	Bush
<i>Piper betle</i> L.	<i>Sirih</i>	Piperaceae	√	√	√	Shrubs
<i>Psidium guajava</i> L.	<i>Jambu Biji</i>	Myrtaceae	√	√	√	Tree
<i>Sechium edule</i> (Jacq.) Sw.	<i>Labu Siam</i>	Curcubitaceae	-	-	√	Shrubs
<i>Vitex trifolia</i> L.	<i>Legundi</i>	Lamiaceae	-	-	√	Bush
<i>Zingiber trifolia</i> (Burm fil.) P. Wilson	<i>Jahe</i>	Zingiberaceae	√	√	√	Herb
<i>Zingiber zerumbet</i> (L.) Roscoe ex Sm.	<i>Lempuyang</i>	Zingiberaceae	-	-	√	Bush



**Figure 2.** Number of medicinal plant species from each family

The Zingiberaceae family is better known to the public as the ginger plant and is widely used as a cooking spice, beverage ingredient, traditional medicine, cosmetic ingredient, and ornamental plant (Sharifi-Rad et al. 2017). The dominance of this plant at the research location can be caused by the weather on the slopes of Mount Lawu, which tends to be cool, so ginger tea can be used to warm the body. Apart from that, the soil conditions in this area support the growth of ginger, which does not require too much water and is easy to care for. Good and fertile soil conditions also allow medicinal plants to grow, including ginger (Ziraluo 2020). Moreover, several Wonorejo Village people work as ginger farmers, a side commodity. Some people also deliberately plant this plant in front of the house as a living dispensary or in fields and gardens as a side crop.

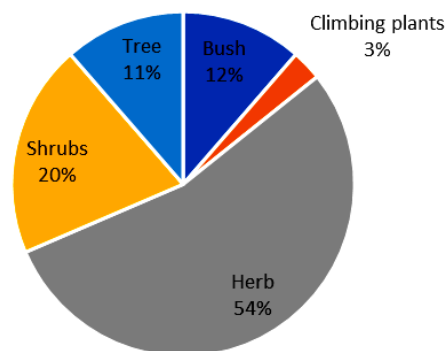
Ecologically, Zingiberaceae species are well-adapted to tropical and subtropical climates, conditions that are prevalent in many parts of the world (George 2024). As with the slopes of Mount Lawu, these plants thrive in areas with moderate rainfall, fertile soils, and temperate climates, conditions found in many Southeast Asian countries and other tropical regions globally. In countries like India, China, and Indonesia, Zingiberaceae species, especially ginger and turmeric, are integral to both agriculture and medicine, aligning with their use in the villages of Wonorejo and Beruk. These plants are widely cultivated in the tropics, where their rhizomes provide a stable and reliable resource. The global spread of these plants, from South America to Africa and Asia, further emphasizes their ecological suitability and importance (Gang and Ma 2008; Nair 2013; Zhao et al. 2022).

Culturally, the use of Zingiberaceae species has a rich history not only in Javanese traditions but also across the world (Wegener 2020). Turmeric, for instance, has been used in South Asian cultures for thousands of years, not only as a spice but also in traditional medicine to treat various ailments such as digestive disorders, inflammation, and skin conditions (Akaberi et al. 2021). Similarly, ginger has been a staple in Chinese medicine for its warming and

digestive properties, a use that mirrors its role in Jamu practices in Indonesia (Gollin 2001; Tilaar 2016). On a global scale, these plants are now widely recognized for their health benefits. The World Health Organization and various international health bodies acknowledge the importance of these plants in both conventional and traditional medicine. For instance, turmeric's curcumin has gained global attention for its anti-inflammatory and antioxidant properties, leading to its use in modern pharmaceutical products and nutraceuticals (WHO 2019, Razavi et al. 2021).

The number of medicinal plant species that could be identified at each research location was 11 in Kalimo Hamlet, 10 in Kuryo Hamlet, and 32 in Selangkah Hamlet. Figure 3 shows five forms of growth of medicinal plants, including herbs, bushes, shrubs, trees, and climbing plants (vines). The people of Wonorejo Village and Beruk Village mostly use medicinal plants in the form of herbs (54%). The community also uses medicinal plants with a habitus consisting of 20% shrubs, 12% trees, 11% bushes, and 3% climbing plants.

**Habitus of medicinal plant**



**Figure 3.** Habitus of medicinal plants in Wonorejo Village and Beruk Village

The habitus of these medicinal plants shows the properties of plants that are useful as traditional medicines. This habitus makes recognizing and classifying medicinal plants easier through their morphological characteristics. This shows that people at the research location prefer and utilize medicinal plants in herbal form because they are easier to obtain, plant, harvest, and process than other forms of medicinal plants. Ziraluo (2020) stated people use plants as traditional medicine because the processing is also simpler apart from the plant being easy to obtain.

The diversity of medicinal plants in Wonorejo and Beruk Village consists of 35 species from 24 families of medicinal plants identified and used by the community for traditional medicine. Zingiberaceae contributed the most medicinal species, it is dominant plant found throughout the yard. This plant is widely found because it is relatively easy to plant and uses its roots as rhizomes with shoots that can grow quickly (Lestari et al. 2021). Followed by Lamiaceae, which has 3 species: *Mentha x piperita* L., *Vitex trifolia* L., and *Ocimum basilicum* L. The Apiaceae and Rubiaceae families each have 2 species of medicinal plants; the species of Apiaceae is *Centella asiatica* (L.) Urban and *Apium graveolens* L.; the Rubiaceae family are *Paederia foetida* L. and *Morinda citrifolia* L. The other families found only have 1 species of medicinal plants (Table 2), such as Poaceae, Asphodelaceae, Piperaceae, Euphorbiaceae, Curcubitaceae, Musaceae, Asteraceae, Myrtaceae, Rutaceae, Araceae, Moringaceae, Brassicaceae, Caesalpiniaceae, Acanthaceae, Basellaceae, Cyperaceae, Fabaceae, Vitaceae, Caricaceae, and Annonaceae.

#### The use of medicinal plants by the local community

Each medicinal plant has a different method of preparation and application for various types of disease treatment. There are several methods used by people in Wonorejo Village and Beruk Village to utilize medicinal plants. Most medicinal plant processing by the community is boiling (43%), especially for medicinal plants whose leaves are used. Some medicinal plants can also be used directly without processing such as *A. vera*, *J. multifida*, *M. paradisiaca*, and *P. guajava* can be eaten directly (Table 3).

Globally, the practice of boiling medicinal plants is prevalent in numerous traditional medicine systems (Astutik et al. 2019). In India, China, and other parts of Southeast Asia, herbs like ginger, turmeric, and holy basil are commonly boiled to treat a variety of ailments, including digestive disorders, respiratory issues, and inflammatory conditions (Nair and Groot 2021; Paswan and Singh 2021; Kumari 2025). The widespread use of boiling in these cultures highlights its role as a fundamental method in the preparation of traditional remedies. It is also important to note that boiling is often preferred over other methods due to its efficacy and safety. In comparison to other extraction techniques, boiling is perceived as a gentler method, which reduces the risk of destroying sensitive compounds through more aggressive processing. On a global scale, boiling remains one of the most prevalent methods of medicinal plant preparation. According to the World Health Organization (WHO),

approximately 80% of the population in developing countries still rely on traditional medicine, with decoctions being one of the most common forms of preparation (WHO 2019). In countries such as China and Thailand, boiling is the primary method of preparing medicinal herbs, which are consumed as teas, broths, or decoctions for their therapeutic properties. This widespread global practice underscores the universal recognition of boiling as an effective and practical method for extracting medicinal properties from plants (Fu et al. 2018; Pathaw et al. 2022).

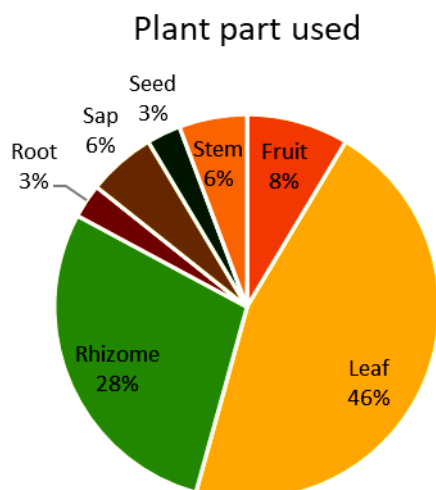
The methods for applying this medicinal plant in treating and preventing disease are divided into oral and topical. Oral is the most popular route of administration of botanical medicines. Drugs taken orally will become active in the bloodstream and work only after passing through the digestive tract and liver; their effects are usually systemic, although some oral drugs work locally (Astana and Nisa 2018). Herbal preparations usually include boiling, pureing, or juicing, applying directly, eating directly, cooking, grating, cutting, and squeezing. For some unprocessed plants, there are variations in the topical use of plant preparations (Nofrianti et al. 2021). Topical administration is the route for treating anterior segment diseases, often with a non-invasive, non-invasive, painless local therapeutic effect. It offers many advantages: fast effect, small dose requirement, and not induce systemic adverse effects (Djebli et al. 2017). Some of the applications of medicinal plants carried out by the community in Wonorejo Village and Beruk Village are oral or consumed, but medicinal plants can also be applied in two ways, either orally or topically, namely *A. cordifolia* and *P. betle*.

The use of boiling as a method of extraction also aligns with its cultural significance. The process of boiling medicinal plants is often embedded in the local traditions, where it is seen not only as a method of obtaining medicinal properties but also as a ritualistic practice. For example, in Javanese culture, boiling plants for medicinal use is intertwined with beliefs about the purity and effectiveness of the remedy. The simplicity of boiling, combined with the ritual of preparing and consuming these boiled plants, reinforces the cultural connection to the medicine and the environment. All parts of medicinal plants can be used to treat various diseases. Medicinal plants are plants whose parts can be used. The parts of medicinal plants that can be used are leaves, roots, stems, and fruit, which can treat various diseases (Lestari et al. 2021).

Based on existing results, the parts most widely used are leaves (46%), then rhizomes (29%), fruit (9%), stems (6%), sap (6%), roots (3%), and seeds (3%). The leaves are widely used because their use is relatively simple and does not harm the survival of medicinal plants (Meisia et al. 2020) (Figure 4). The leaf is the most commonly utilized part of medicinal plants in Wonorejo and Beruk villages for a variety of reasons related to its biological composition, ease of access, and cultural practices. These factors contribute to the leaves' predominant role in traditional medicine both locally and globally.

**Table 3.** Preparation and application of medicinal plants in Wonorejo and Beruk Villages

Species	Local name	Part used	Types of diseases treated	Preparation method	Application method
<i>Andrographis paniculata</i> (Burm.fil.) Nees	<i>Sambiloto</i>	Leaf	Diabetes	Boiled	Orally
<i>Annona muricata</i> L.	<i>Sirsak</i>	Leaf	Gout, cancer	Boiled	Orally
<i>Apium graveolens</i> L.	<i>Seledri</i>	Leaf	High blood pressure	Pureed (juiced)	Orally
<i>Centella asiatica</i> (L.) Urban.	<i>Pegagan</i>	Leaf	Gout	Boiled	Orally
<i>Acous calamus</i> L.	<i>Dlingo</i>	Rhizome	Fever, pain relief	Dried	Topical
<i>Aloe vera</i> (L.) Burm.f.	<i>Lidah Buaya</i>	Leaf	Burns, hair	Apply directly	Topical
<i>Elephantopus scaber</i> L.	<i>Tapak Liman</i>	Leaf	Gout	Boiled	Orally
<i>Anredera cordifolia</i> (Ten.) Steenis	<i>Binahong</i>	Leaf	Gout burns	Boiled, pounded	Oral, topical
<i>Brassica rapa</i> L.	<i>Sawi Jepang</i>	Leaf	Constipation	Boiled	Orally
<i>Caesalpinia sappan</i> L.	<i>Kayu Secang</i>	Stem	Skin infections	Boiled	Topical
<i>Carica papaya</i> L.	<i>Pepaya</i>	Root	Malaria	Boiled	Orally
<i>Sechium edule</i> (Jacq.) Sw.	<i>Labu Siam</i>	Fruit	Reduces fever and high blood pressure	Cooked	Orally
<i>Cyperus rotundus</i> L.	<i>Rumput Teki</i>	Rhizome	Skin diseases, toothache, wounds	Pounded	Topical
<i>Jatropha multifida</i> L.	<i>Tentir</i>	Sap	Incision wounds	Apply directly	Topical
<i>Leucaena leucocephala</i> (Lam) De Wit.	<i>Mlanding</i>	Seed	Overcoming constipation	Cooked	Orally
<i>Mentha x piperita</i> L.	<i>Mint</i>	Leaf	Have a cold	Brewed	Topical
<i>Ocimum basilicum</i> L.	<i>Kemangi</i>	Leaf	Stomach cramps, body odor, fever	Boiled	Orally
<i>Vitex trifolia</i> L.	<i>Legundi</i>	Leaf	Heat reducer	Brewed	Orally
<i>Moringa oleifera</i> Lam.	<i>Kelor</i>	Leaf	Blood pressure	Boiled	Orally
<i>Musa Paradisiaca</i> L.	<i>Pisang</i>	Sap	Wound	Apply directly	Topical
<i>Psidium guajava</i> L.	<i>Jambu Biji</i>	Leaf	Diarrhea	Eat directly	Orally
<i>Piper betle</i> L.	<i>Sirih</i>	Leaf	Nosebleeds, removes vaginal discharge, eye medication	Boiled, pounded	Oral, topical
<i>Cymbopogon citratus</i> (DC.) Stapf	<i>Serai</i>	Stem	Reduces fever	Boiled	Orally
<i>Morinda citrifolia</i> L.	<i>Mengkudu</i>	Fruit	Gout, arthritis	Grated, squeezed	Orally
<i>Paederia foetida</i> L.	<i>Sembukan</i>	Leaf	Stomach acid	Boiled	Orally
<i>Citrus lemon</i> L.	<i>Jeruk lemon</i>	Fruit	Cough	Squeezed	Orally
<i>Cayratia trifolia</i> L.	<i>Galing-galing</i>	Leaf	Lowers blood sugar, diabetes wounds	Pounded	Topical
<i>Alpinia galanga</i> (L.) Willd.	<i>Lengkuas</i>	Rhizome	Cough, fever, diabetes	Boiled	Orally
<i>Curcuma aeruginosa</i> Roxb.	<i>Temuireng</i>	Rhizome	Hemorrhoid	Boiled	Orally
<i>Curcuma caesia</i> Roxb.	<i>Kunyit Hitam</i>	Rhizome	Abdominal pain, cough	Boiled	Orally
<i>Curcuma longa</i> L.	<i>Kunyit</i>	Rhizome	Relieves menstrual pain, stomach acid	Grated, boiled	Orally
<i>Curcuma zanthorrhiza</i> Roxb.	<i>Temulawak</i>	Rhizome	Stomach ache	Cut, boiled	Orally
<i>Kaempferia galanga</i> (L.)	<i>Kencur</i>	Rhizome	Stomach ache	Cut, boiled	Orally
<i>Zingiber trifolia</i> (Burm fil.) P. Wilson	<i>Jahe</i>	Rhizome	Immune, cough, cold allergies	Grated, boiled	Orally
<i>Zingiber zerumbet</i> (L.) Roscoe ex Sm.	<i>Lempuyang</i>	Rhizome	Diarrhea, malaria	Boiled	Orally



**Figure 4.** Graph of plant parts used for medicinal plants in Wonorejo and Beruk Villages

From a biological perspective, leaves are rich in a variety of bioactive compounds that are often sought after for medicinal use. Leaves typically contain higher concentrations of alkaloids, flavonoids, terpenoids, glycosides, and essential oils, which are all known for their therapeutic properties (Daniel 2006). These compounds play significant roles in antioxidant, anti-inflammatory, antimicrobial, and analgesic activities, making the leaves of many plants particularly effective for treating a wide range of ailments. For example, *C. asiatica* (*pegagan*) leaves are widely used for their wound-healing and skin health-promoting properties, while *Mentha x piperita* (peppermint) leaves are commonly boiled to alleviate digestive issues. The bioactive compounds in the leaves are typically more concentrated than in other parts of the plant, such as the roots or stems, which makes the leaves a valuable resource for medicinal purposes (Dar et al. 2023).

Additionally, leaves are often the most accessible part of the plant. Unlike roots or bark, which may require more time to harvest or might damage the plant if over-harvested, leaves are continuously regenerated and can be harvested sustainably without harming the plant. This makes them an ideal renewable resource for traditional medicine, ensuring a constant supply of plant material without compromising the plant's overall health or longevity. The ease of harvest and minimal disruption to the plant make leaves the most convenient and sustainable option for community-based health practices, particularly in rural settings where access to commercial medicines or advanced harvesting techniques is limited.

The cultural significance of leaves in medicinal practices also contributes to their frequent use. In many cultures, leaves are considered to be the most accessible and versatile part of the plant for medicinal purposes (Beyene et al. 2016). In the case of Javanese herbal medicine (*jamu*), boiling leaves is a common method of preparation due to their ease of extraction and readily available bioactive properties. In many traditional healing systems, leaves are viewed as representing vitality and

health, as they are the primary site of photosynthesis in plants, which sustains the plant's growth. The cultural association of leaves with life and healing further strengthens their use in treating a variety of diseases, from respiratory to digestive issues.

Globally, the leaf is the most commonly used part of plants in traditional medicine systems. According to the WHO (2003), leaves from a wide variety of plants are used worldwide for their medicinal properties. For instance, in Chinese traditional medicine, ginseng leaves are used for their adaptogenic qualities (Lal et al. 2020; Kang and Kim 2023), while moringa leaves have gained popularity worldwide due to their high nutritional value and antioxidant properties (Islam et al. 2021). Similarly, in Indian Ayurvedic practices, leaves such as those of tulsi (holy basil) are boiled and used for their anti-inflammatory and immune-boosting properties. The global prevalence of leaf-based remedies emphasizes the universal recognition of the leaf as a valuable medicinal resource.

The existence of ethnobotanical studies of medicinal plants in a region can produce discoveries based on empirical data that can be scientifically tested because ethnobotany includes economic, anthropological, pharmacological, botanical, and other aspects (Naz et al. 2022). Ethnobotany benefits humans and the environment and protects knowledge and plant use types (Helmina and Hidayah 2021). So, the local community can prevent and cure various types of diseases by using medicinal plants. This is also evidence of active community participation by highlighting conservation's social, economic, cultural, and biophysical aspects for future generations, including those related to medicinal plants (Al-Idrus et al. 2021).

There are several uses of medicinal plants by the community in treating and preventing disease. Research results show that 18 types of diseases can be cured with various medicinal plants. The types of diseases that can be treated are classified into 7 disease categories based on the type of body system disorders: (i) respiratory system, including coughs, flu, and colds; (ii) digestive system consisting of stomach aches, ulcers, and appetite; (iii) infectious system including infections such as fever and dengue fever; (iv) the skin category consists of types of diseases such as wounds, itching, beriberi, and skin infections; (v) musculoskeletal system including gout, rheumatism, and joints; (vi) pain category like menstrual pain; and (vii) cardiovascular and hematological system including hypertension, heart disease, and anemia.

Table 3 shows many medicinal plants that were used by the people of Wonorejo Village and Beruk Village to treat diseases related to digestive system problems, such as stomach ache, diarrhea, constipation, stomach acid, and hemorrhoids. Stomach ache can be treated using *C. zanthorrhiza* and *K. galanga*, while stomach acid can be treated using *C. Longa* and *P. foetida*, diarrhea can be treated using *P. guajava* and *Z. zerumbet*. Constipation can be treated using *B. rapa* and *L. leucocephala* can be treated using *C. aeruginosa*. The interviews show that the type of disease that was least common was pain, and this disease is identical to women, mainly occurring during menstrual cycles. Generally Wonorejo and Beruk people use *A.*

*calamus L.*, *O. basilicum*, *C. caesia*, and *C. longa* to reduce pain. Ramli and Santy (2017) revealed the plant that can reduce pain is *Z. officinale*; the rhizome functions as an analgesic, antipyretic, and anti-inflammatory, and the rosella plant can also reduce pain and inflammation during dysmenorrhea.

### Use Value

The interviews with respondents show that the types of plants with the highest UV are plants from the Zingiberaceae family, such as *A. galanga*, *C. aeruginosa*, *C. caesia*, *C. longa*, *C. zanthorrhiza*, *K. galanga*, *Z. trifolia*, and *Z. zerumbet* with a total value of 4.53. The large number of Zingiberaceae family plants cannot be separated from the role of the community in cultivating these plants in the fields as a side commodity or planted in front of the house. This plant is believed to cure coughs, stomach acid, diarrhea, and fever. The medicinal plant families with the next highest UV values are Lamiaceae (0.90), Piperaceae (0.78), Myrtaceae (0.77), Rutaceae (0.75), Poaceae (0.73), and Asphodelaceae (0.72) (Figure 5). Meanwhile, the lowest UV with a value of 0.15 is a plant from the Caricaceae family, namely *C. papaya*. This plant root is used for malaria, but it is rarely found in society, so only a few people who have this plant use it, and also people rarely suffer from malaria. Almost all types of plants are planted around the yard or home yard. Most medicinal plants are used by boiling (43%) and by oral (71%). Medicinal plants have proven their efficacy, are safe to consume, and treat diseases without causing side effects (Melviani et al. 2022).

A high Use Value (UV) indicates that a particular plant species is frequently used by the local community for various purposes, such as medicinal, nutritional, or cultural applications. A high UV score suggests that the plant is considered important, reliable, and valuable in daily life,

and its use is deeply integrated into the community's traditions and practices.

In the context of the Zingiberaceae family in the Wonorejo and Beruk villages, the high UV reflects that these plants are used consistently and for multiple purposes, such as treating common ailments, preparing traditional medicines, and participating in cultural ceremonies. The high frequency of use makes them central to the community's healthcare system and cultural practices. It also implies that the plants play a significant role in local sustainability, as they are easily accessible and often cultivated within the community.

In essence, a high Use Value means the plant is a vital resource for the community, relied upon not just for one specific use but for a variety of daily needs, contributing to the well-being, health, and cultural identity of the people. This high UV can also signify the plant's economic importance, as its frequent use enhances its presence in the market or local trade systems. Therefore, a high UV score highlights both the cultural integration and practical significance of a plant species within the community.

### Informant Consensus Factor

The ICF value or informant consensus factor is calculated based on differences in the level of homogeneity of information provided by the informants. The ICF value ranges from 0.7 to 0.9. Based on the calculation results, one type of disease was found with the highest level of homogeneity (ICF=0.95), namely wound disease, itching and beriberi with aloe vera species as the medicine (Figure 6). *A. vera* is a medicinal plant that has antiseptic properties and contains saponin compounds which have the ability to clean (Mardiana and Solehah 2020). Other ICF values from high to low, namely the cardiovascular and hematological system disorders, pain, infection, musculoskeletal, respiratory system, and digestive system groups with the lowest level of homogeneity.

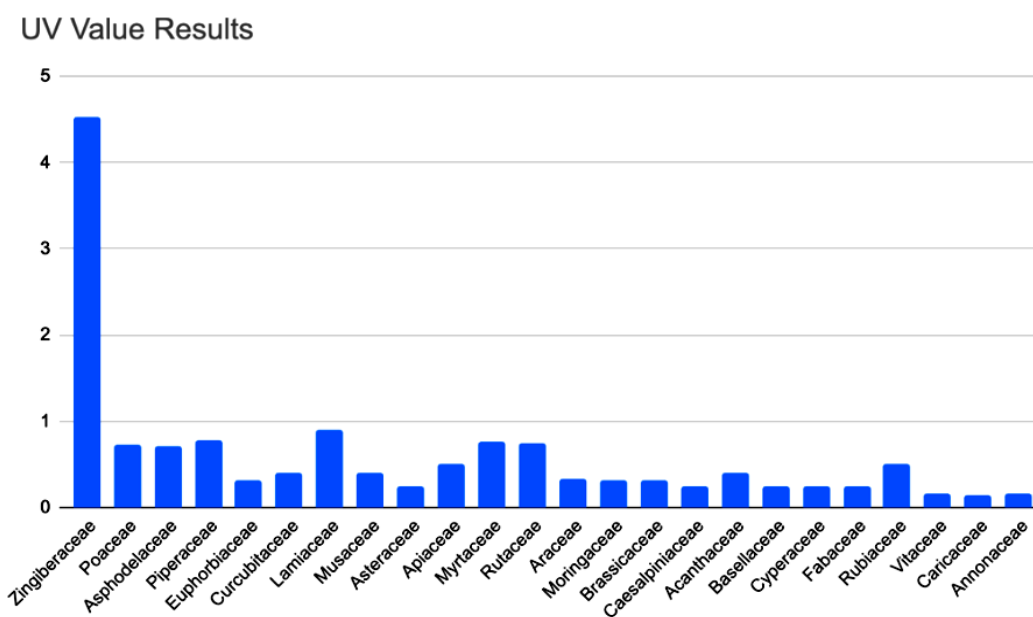


Figure 5. Graph of Use Value (UV) of medicinal plants in Wonorejo and Beruk Villages

Digestive diseases are the lowest number of diseases because most people consume healthier natural foods, such as fresh vegetable farming products and rarely eat fast food because they have limited access. Apart from that, in this area there is very little exposure to pollutants and chemicals so that the water that is drunk or used for cooking is still clean and has not been polluted. Usually, people in this area use ginger rhizomes, kencur rhizomes, lempuyang bushes, guava leaves, and mlanding seeds to cure diseases such as stomach aches, stomach ulcers, and appetite.

The people of Wonorejo and Beruk Villages rarely suffer from diseases related to the respiratory system. This is because the quality of the environment in these two villages is still maintained, shown by the abundance of trees, green forests, no heavy motor vehicle traffic, and no industry, so there is little pollution, which is one of the factors causing respiratory system problems. According to Kantipudi et al. (2016), air pollution indoors and in the surrounding environment contributes to several heart and respiratory diseases, which can affect age distribution due to changes in immune responses. Digestive diseases are the least common diseases because most people consume healthier natural foods, such as fresh vegetable farming products, and rarely eat fast food because of access limitations. Apart from that, these sites have very little exposure to pollutants and chemicals in this area; the water is still clean, has not been polluted, and is suitable for drinking or cooking. According to Livovsky et al. (2020),

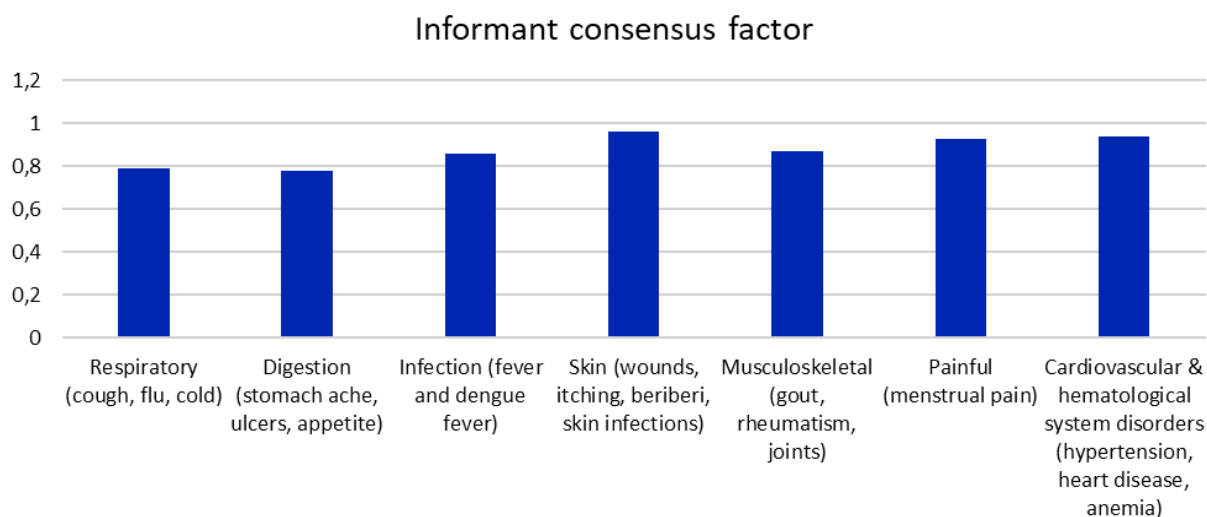
eating food affects the digestive system; therefore, a healthy diet is needed by consuming nutritious and balanced food so that the digestive system responds well and digestive disorders do not occur. Usually, people in Wonorejo and Beruk Villages use ginger rhizomes, turmeric rhizomes, lempuyang bushes, guava leaves, and seeds to cure diseases such as stomach aches, stomach ulcers, and appetite boosters.

#### Fidelity level

The FL or fidelity level value is used to determine which species are most popular in treating certain types of disease. This Value will be high if respondents widely use the species. Of the 35 types of medicinal plant species used by respondents, there were the highest FL values, namely 100%, for 2 species, *labu siam* or chayote *S. edule* and *mengkudu* or noni (*M. citrifolia*) (Table 4). *Labu siam* or chayote is the fruit of *S. edule* and known for its culinary and traditional medicinal applications (Díaz-de-Cerio et al. 2019). Apart from treating fever, according to Lombardo-Earl et al. (2014), this plant is traditionally used as a source of therapy against kidney disease and controlling high blood pressure. *M. citrifolia*, commonly called as *mengkudu*, has a long history as a medicinal plant, and its use as supplementary food has grown rapidly in recent years (Singh 2012). This plant is very valuable as a medicine in tropical areas and is usually cultivated for its roots, leaves, and fruit. (Zin et al. 2002).

**Table 4.** Fidelity Level (FL) of medicinal plants in Wonorejo and Beruk Villages

Scientific name	Common name	Local name	Types of diseases treated	FL (%)
<i>Sechium edule</i> (Jacq.) Sw.	Chayote	<i>Labu siam</i>	Fever	100
<i>Morinda citrifolia</i> L.	Noni	<i>Mengkudu</i>	Hypertension	100
<i>Zingiber trifolia</i> (Burm fil.) P. Wilson	Ginger	<i>Jahe</i>	Cough	94
<i>Curcuma zanthorrhiza</i> Roxb.	Curcuma	<i>Temulawak</i>	Appetite	85
<i>Centella asiatica</i> (L.) Urban.	Gotu kola	<i>Pegagan</i>	Gout	83
<i>Curcuma longa</i> L.	Turmeric	<i>Kunyit</i>	Menstrual pain	80
<i>Aloe vera</i> (L.) Burm.f.	Aloe vera	<i>Lidah buaya</i>	Wound	66



**Figure 6.** Graph of Informant Consensus Factor (ICF) of medicinal plants in Wonorejo and Beruk Villages

According to Wang et al. (2002), this plant has broad therapeutic effects, including antibacterial, antiviral, antifungal, antitumor, antihelminthic, analgesic, hypotensive, anti-inflammatory, and immune-boosting effects. Next, the order of FL values from high to low is for the species of ginger (*Z. trifolia*) at 94%, curcuma (*C. zanthorrhiza*) at 85%, gotu kola (*C. asiatica*) at 83%, turmeric (*C. longa*) at 80%, and *A. vera* at 66%. *A. vera* has the lowest FL plant value because it is rarely used, and only a few houses are planted in their yards. Aloe vera is a perennial shrub plant commonly known as *nature's healer*, *lily of the desert*, *immortality plant*, *miracle plant*, *paradise scepter*, with enormous therapeutic uses without ignoring its potential significance in the cosmetic and food industries (Datta et al. 2012); is also traditionally been used for healing in natural medicinal (Cristiano et al. 2016).

In conclusion, medicinal plants are still used by the people in Wonorejo and Beruk Villages because most still believe in their medicinal benefits. There are 35 species of medicinal plants used in Wonorejo and Beruk Villages from 24 families. The most widely used medicinal plant parts are the leaves (46%), prepared by boiling (43%). The highest use value (UV) is from the Zingiberaceae family plant with a value of 4.53. The highest Informant Consensus Factor (ICF) is found in the type of skin category with a value of 0.95. The highest Fidelity Level (FL) is found in *Sechium edule* (Jacq.) Sw. And *Morinda citrifolia* L. plants with a value of 100. Therefore, many efforts must be made to increase the awareness and knowledge of Wonorejo and Beruk Villages regarding the use of medicinal plants. Those efforts include holding outreach aimed at educating the public about types of medicinal plants, how to cultivate them, their properties and processing, and management of the use of medicinal plants. This outreach can encourage the community to preserve the medicinal plants they used to last for future generations. Apart from that, cooperation between communities and local government support is needed in cultivating medicinal plants and using them daily.

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