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Ethnomedicinal knowledge of traditional healers on medicinal plants in Sukoharjo District, Central Java, Indonesia

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Abstract. *Fadhilah RN, Koesdaryanto NS, Pribady TR, Restanta RAP, Nugroho GD, Yasa A, Sujarta P, Setyawan AD. 2023. Ethnomedicinal knowledge of traditional healers on medicinal plants in Sukoharjo District, Central Java, Indonesia. Biodiversitas 24: 4223-4234.* Indonesia is blessed with the world's largest biological diversity, reflected in the tens of thousands of species of plants that occur in Indonesia. This privilege benefits the community by using it in everyday life, including in the health sector. Medicinal plants have various benefits, such as relieving cough, fever, wounds, and other body system problems. Sukoharjo District, Central Java, Indonesia, is known as a center of traditional herbal medicine (*jamu*), and the people in this district have used medicinal plants in the traditional medicine practiced by various healers or shamans. However, this local wisdom has not been documented scientifically. This study aims to collect data on ethnomedicinal knowledge of traditional healers in Sukoharjo and relevant information regarding medicinal plants used by them, including the taste of the plant. The method used in this research was a combination of direct observation, field notes, and in-depth interviews with several traditional healers. The study documented that 75 species of medicinal plants belonged to 41 families dominated by the Zingiberaceae family. Most of the plant parts of the medicinal plants used are the leaf, mostly consumed by boiling, resulting in a bitter taste drink. Common diseases to cure with traditional medicinal plants include coughs, fever, flatulence, diarrhea, diabetes, menstrual pain, flu, toothache, and ulcers. The findings of this study highlight that even though modern medicine is available, people still trust traditional healers and utilize medicinal plants, which are important for preserving ethnomedicinal knowledge in a region.

Keywords: Ethnomedicine, herbs, local genius, physicians, species

INTRODUCTION

Indonesia ranks second as a mega-biodiversity country after Brazil (Rintelen et al. 2017). Despite the land area of Indonesia only covering 3% of Earth's land surface, most of the world's biodiversity is found in Indonesia. Unfortunately, most of this biological wealth has not been used optimally by the nation. For example, of the 30,000 species of plants in Indonesia, less than 1,000 have been used as traditional medicine. Traditional medicine is indigenous knowledge and practices used for preventing and treating physical and mental illnesses, and it is the oldest form of healthcare in the world (Ventevogel et al. 2013; Yuan et al. 2016). Traditional medicine practices largely depend on the high utilization of plants for treatment (Ngarivhume et al. 2015). The use of plants as medicine has long been applied daily. According to the World Health Organization (WHO), as many as 60-80% of the world's population still uses plants in medical care (Silalahi et al. 2015).

Indonesia recognizes two medicinal systems, namely modern or medical medicine and traditional medicine (Jadid et al. 2020). Modern medicine often uses chemical drugs and is carried out by health professionals, while traditional medicine is carried out based on traditional recipes of ancestors, beliefs, or local customs. However, nowadays, traditional medicine is sometimes referred to as complementary medicine with treatments using herbs or herbal therapy, acupuncture, and cupping (Abbo et al. 2019). In other words, complementary medicine is a form of healing sourced to various health systems, modalities, and practices supported by theories and beliefs. In the context of medicinal plants, the Indonesian government has divided them into three categories, namely herbal medicine, standardized herbal medicine, and phytopharmaceuticals (Mahomoodally 2013). This categorization is aimed to indicate the efficacy and utilization of medicinal plants.

Differ from modern medicine, which uses empirical and scientific methods in its dissemination and uses, the knowledge and practices of traditional medicine, including the use of plants for medication, are generally passed down for generations by ancestors using traditional practices,

such as by oral, self-taught and hereditary (Kunwar et al. 2013; Az-Zahra et al. 2021). This situation poses a risk that traditional medicine might not be developed optimally and disappear since no documented record exists (van Andel and Carvalheiro 2013). This is unfortunate since traditional medicine provides a great amount of information about the uses of plant species and plant parts for medicinal purposes (Supiandi et al. 2019), and in many cases, medicinal herbs have been proven to help prevent and treat diseases that occur in the community (Yabesh et al. 2014). Therefore, the indigenous knowledge and skills developed in alternative medicine possessed by some individuals and the advantages of biodiversity and ethnic wealth in Indonesia are the opportunities that must be explored and developed.

People with jobs practicing traditional medicine, for example, healers and shamans, are important sources of knowledge. In many cases, some traditional healers have developed their knowledge and practices in medication based on their beliefs which might be unique to a region or community group. This means that the knowledge and practices of traditional healers in one region might differ. Therefore, preserving their knowledge is important to safeguard traditional medicine practiced in a region. Also, since the raw materials for traditional medicine are mostly obtained by harvesting medicinal plants directly from nature, the preservation and improved management of medicinal plants need to be promoted for their sustainable utilization (Oyebode et al. 2016)

Sukoharjo is one of the districts in Central Java, Indonesia, where traditional medicine is largely still being practiced. This region has the nickname of *Kota Jamu* (city of traditional herbal medicine) because it is known as a producer and business activity of traditional herbal medicine. People in Sukoharjo have a good knowledge of traditional medicine for curing diseases and health treatment. The area has a high diversity of medicinal plants, so all groups, from children to older people, regularly consume herbal medicine. They assume that the benefits of using medicinal plants as ingredients for traditional medicine include the lower price, widely available and no side effects like modern drugs that contain chemical components which might cause organ damage if consumed continuously (Sumayyah and Salsabila 2017; Rivaldi et al. 2020). Thus, this study aims to collect ethnomedicinal knowledge and practices of traditional healers in the Sukoharjo District. Several targeted information to collect included the diversity of medicinal plants, the plant organs used, the processing methods, the tastes of processed herbal medicine and the ailments being cured by the plants.

MATERIALS AND METHODS

Study area

This research was conducted in Sukoharjo District, Central Java Province, Indonesia. Geographically, Sukoharjo is located between 7º32'17" to 7º49'32" S and 110º42'06.76" to 110º57'33.7" E with an area of 46,666 ha (Figure 1). Sukoharjo District comprises 12 sub-districts. Topographically, the northern part is a lowland area, while the southern and eastern parts are hilly areas. According to its geographical location, Sukoharjo District is affected by monsoon winds with two seasons, namely dry and rainy, with an average annual rainfall of 2,790 mm and air temperatures ranging from 23ºC to 34ºC (Statistics Central Agency 2022).

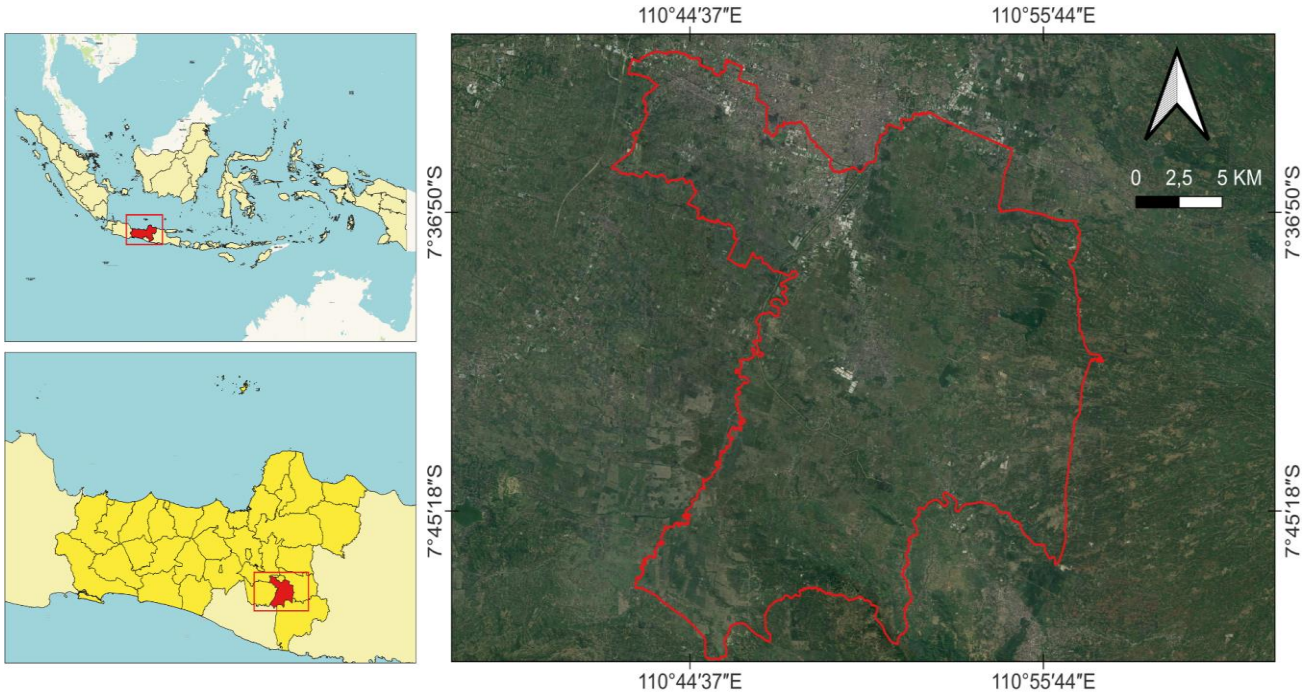

Figure 1. Map of Sukoharjo District, Central Java, Indonesia

The total population of Sukoharjo District in 2020 was 911,966 people (Statistics Central Agency 2022). Most of the population is Moslem, followed by Christianity. Sukoharjo has the second smallest district in Central Java, and most of the population works in industry, trade, and agricultural sectors, spreading throughout the sub-district. Sukoharjo District has been producing traditional herbal medicine (locally called *jamu*) for a long time; even now, *jamu* is still maintained. For example, an area in Sukoharjo, i.e., Nguter Sub-district, with almost the entire population having activities related to *jamu.* Although the modern healthcare system is easily accessible, some people in Sukoharjo still believe in traditional medicine. Therefore, traditional healers can still be found in this region.

Data collection procedure

An ethnobotanical survey was conducted in Sukoharjo District in December 2022. Ethnobotanical data was collected by combining methods, including interviews, observations, and field notes on traditional healers from various regions in the Sukoharjo District. Before data collection, snowball sampling was used to find data on traditional healers in the Sukoharjo District through the website of the Sukoharjo District Health Office, Central Java Province, Indonesia (Maneenoon et al. 2015). Based on various criteria, four experienced traditional healers still actively treating patients and respected figures in their community were selected as key informants.

They consist of women and men aged over 30 years. Their experience ranges from 15 to 20 years in traditional medicine. The four traditional healers are Moslems. In terms of education level, these traditional healers have attended high school and college, and most work as herbal therapists. Their knowledge of traditional medicine was obtained from training and inheritance from their ancestors, especially on how to use medicinal plants. In addition, two traditional healers treat illnesses with special prayers if, according to them, the disease is caused by supernatural powers. Interviews were conducted to find out the plant species, the taste of medicinal plants, diseases that can be treated, parts of plants used as medicine, and the processing forms. Before the interviews began, an explanation of the research objectives was carried out to the traditional healers. After that, the data obtained is registered as a table equipped with the family column and the scientific name obtained from the website https://powo.science.kew.org/.

Data analysis

Plant data were classified by family group, scientific name, the taste of medicinal plants (divided into 5 (i.e., sweet, sour, bitter, salty, and umami)), treatable diseases, plant parts used as medicine, and the processing methods. The data was then analyzed descriptively.

RESULTS AND DISCUSSION

Diagnostic methods of the traditional healer

Every human being certainly has different skills, abilities, and knowledge. Likewise, each healer in traditional medicine practices has different skills and knowledge about the type of disease she or he treats and treatments with something in common. The types of diseases commonly carried out by traditional healers in their treatment are: (i) male sexual problems, (ii) sprains and fractures, (iii) child ear piercings, (iv) female circumcision, (v) abdominal swelling, (vi) heatiness, (vii) measles or smallpox, (viii) *Tasapo*/diseases due to spiritual disorders, (ix) bad blood, (x) childbirth (Karunamoorthi et al. 2013). Based on the results of interviews and observations, not all kinds of diseases can be treated or healed by one traditional healer because each healer has limited knowledge. Each traditional healer also has different techniques or treatment methods and has a unique way of knowing the type of disease experienced by their patients. Therefore, to diagnose the patient's disease, traditional healers have integrated procedures such as examination of the patient's medical history, physical examination, and pulse examination.

Furthermore, physical examination involves observing skin, eyes, tongue, and hair and asking about body parts with health problems or pain. This procedure is very important; if the traditional healer has sufficient skills, the disease will be diagnosed appropriately. Further, after confirming the disease, traditional healers will give recipes and traditional remedies.

Diversity of medicinal plants

The research revealed that 75 species belonged to 41 families of medicinal plants used by traditional healers in Sukoharjo (Table 1). The most widely used group of medicinal plants is the Eudicots group (78%), while Monocots and ferns contribute 20% and 2%, respectively (Figure 2). Eudicots are most widely used as a medicinal plant because this group has the largest number of species compared to other plant groups. The Eudicots are dominated by the families of Euphorbiaceae, Acanthaceae, Fabaceae, and Myrtaceae, each consisting of four species. The Euphorbiaceae family is widely used as a medicinal plant because it is easy to grow in various environmental conditions and can be found in various habitats (Sari et al. 2015). This family is mainly distributed in the tropics, with most species occurring in Indo-Malayan and tropical America (Thaib et al. 2021). Euphorbiaceae have year-round flowering and fertilization periods and has a wide distribution pattern in Indonesia. For example, a species from the family Euphorbiaceae is the *patikan kebo* (*Euphorbia hirta* L.).

Table 1. List of medicinal plants and their major uses cited by four traditional healers in Sukoharjo District, Central Java, Indonesia

Family	Scientific name	Local name	Taste	Ailments treated / uses	Part used	Form of administration
Eudicots						
Acanthaceae	*Graptophyllum pictum* (L.) Griff.	*Daun ungu*	Bitter	Constipation, hemorrhoids	Leaf	Decoction
	Clinacanthus nutans (Burm.fil.) Lindau	*Belalai gajah*	Bitter	Diabetes, cancer	Leaf	Decoction
	Andrographis paniculata (Burm.fil.) Nees	*Sambiloto*	Bitter	Diabetes, immunity	Leaf	Decoction
	Strobilanthes crispa (L.) Blume	*Keji beling*	Bitter	Urolithiasis, hemorrhoids	Leaf	Decoction
Annonaceae	*Annona squamosa* L.	*Srikaya*	Bitter	Insomnia, dysentery	Root	Dried
	Cananga odorata (Lam.) Hook.f. & Thomson	*Kenanga*	Sour	Asthma, bronchitis	Flower	Decoction
	Annona muricata L.	*Sirsak*	Bitter	Diarrhea	Leaf	Decoction
Apiaceae	*Centella asiatica* (L.) Urb.	*Pegagan*	Bitter	Ulcer, diabetes	Leaf	Decoction
	Pimpinella pruatjan Molk.	*Purwaceng*	Bitter	Cough	Root	Decoction
	Anethum graveolens L.	*Adas*	Sweet	Cough, maag	Whole plant	Decoction
Apocynaceae	*Catharanthus roseus* (L.) G.Don	*Tapak dara*	Bitter	Hypertension, malaria	Leaf	Decoction
Araliaceae	*Polyscias scutellaria* (Burm. f.) Fosberg	*Daun mangkokan*	Sour	Hair loss, swollen	Leaf	Pounded
Asteraceae	*Gynura divaricata* (L.) DC.	*Daun dewa*	Bitter	Cough	Leaf	Decoction
	Chrysanthemum sp.	*Krisan*	Sweet	Headache	Flower	Decoction
Balsaminaceae	*Impatiens balsamina* L.	*Pacar air*	Sweet	Menstrual laxative	Root	Decoction
Basellaceae	*Anredera cordifolia* (Ten.) Steenis	*Binahong*	Bitter	Itchy, nosebleed	Leaf	Crushed
Campanulaceae	*Hippobroma longiflora* (L.) G. Don	*Kitolod*	Bitter	Itchy	Flower	Marinade
Cleomaceae	*Cleome gynandra* L.	*Maman pasir*	Bitter	Rheumatism, vaginal discharge	Leaf	Decoction
Caricaceae	*Carica papaya* L.	*Pepaya*	Bitter	Dengue fever	Leaf	Juice
Clusiaceae	*Garcinia mangostana* L.	*Manggis*	Bitter	Cancer	Fruit skin	Drying
Convolvulaceae	*Merremia mammosa* (Lour.) Hallier fil.	*Bidara*	Bitter	Sore throat, diabetes	Leaf	Decoction
Euphorbiaceae	*Euphorbia hirta* L.	*Patikan kebo*	Bitter	Asthma, flu	Leaf	Decoction
	Jatropha multifida L.	*Betadine/jarak tingkir*	Bitter	Wound	Leaf stem	Spread
	Euphorbia tirucali L.	*Patah tulang*	Bitter	Wound	Stem	Spread
Fabaceae	*Erythrina fusca* Lour	*Cangkring*	Bitter	Chickenpox, measles	Leaf	Decoction
	Caesalpinia sappan L.	*Secang*	Sweet	Diarrhea, pain	Stem bark	Decoction
	Erythrina crista-galli L.	*Dadap*	Bitter	Fever, insomnia	Leaf	Crushed
	Clitoria ternatea L.	*Bunga telang*	Sweet	Itchy	Flower	Marinade
	Parkia timoriana (DC.) Merr.	*Kedawung*	Bitter	Diarrhea, bloating	Seeds	Roasted
Lamiaceae	*Orthosiphon stamineus* Benth.	*Kumis kucing*	Sweet	Urolithiasis	Leaf	Decoction
	Ocimum basilicum var. *anisatum* Benth.	*Kemangi*	Bitter	Cough, flu	Leaf	Decoction
	Ocimum basilicum L	*Selasih*	Sweet	Cough, flu, headache	Seeds	Marinade
	Clerodendrum paniculatum L.	*Bunga pagoda*	Sweet	Hemorrhoids	Leaf	Decoction
Lauraceae	*Cinnamomum burmannii* (Nees & T.Nees) Blume	*Kayu manis*	Sweet	Diabetes	Stem	Decoction
	Litsea cubeba (Lour.) Pers.	*Krangean*	Bitter	Cough	Stem bark	Decoction
Magnoliaceae	*Michelia ×alba* DC.	*Cempaka putih/ kantil*	Sour	Stress	Flower	Decoction
Malvaceae	*Hibiscus rosa-sinensis* L.	*Bunga sepatu*	Sour	Cough, ulcer	Leaf	Decoction
	Hibiscus sabdariffa L.	*Rosella*	Sour	Cough	Flower	Decoction
Meliaceae	*Azadirachta indica* A. Juss.	*Mimba*	Bitter	Pimple	Leaf	Crushed
	Swietenia mahagoni (L.) Jacq.	*Mahoni*	Bitter	Hypertension, diabetes	Seeds	Decoction
Menispermaceae	*Tinospora tuberculata* Beumée ex K.Heyne	*Brotowali*	Bitter	Malaria, rheumatism	Stem	Decoction
Muntingiaceae	*Muntingia calabura* L.	*Seri/kersen*	Bitter	Gout, diabetes	Leaf	Decoction

Myrtaceae	*Psidium guajava* L.	*Jambu biji*	Bitter	Diarrhea	leaf	Pounded
	Melaleuca cajuputi Powell	*Kayu putih*	Bitter	Flu, cough	Leaf	Decoction
	Syzygium polyanthum (Wight) Walp.	*Salam*	Sweet	Diarrhoea, maag	Leaf	Decoction
	Syzygium aromaticum (L.) Merr. & Perry	*Cengkeh*	Sweet	Toothache, maag	Flower	Decoction
Oleaceae	*Jasminum sambac* (L.) Aiton	*Melati*	Bitter	Stress	Flower	Pounded
Phyllanthaceae	*Phyllanthus niruri* L.	*Meniran*	Bitter	Urolithiasis	Leaf	Decoction
Piperaceae	*Piper betle* L.	*Sirih*	Bitter	Diarrhea	Leaf	Marinade
	Piper retrofractum Vahl	*Cabe jawa*	Bitter	Fever, bloating	Fruit	Decoction
Rubiaceae	*Oldenlandia corymbosa* L.	*Rumput mutiara*	Sweet	Breast cancer	Leaf	Decoction
	Morinda citrifolia L.	*Mengkudu*	bitter	Cough	Fruit	Juice
Rutaceae	*Murraya paniculata* (L.) Jacq.	*Kemuning*	Bitter	Menstrual, rheumatism	Whole plant	Decoction
	Citrus ×limon (L.) Burm.fil.	*Jeruk lemon*	Sour	Cough	Fruit	Squeezed
	Citrus ×aurantiifolia (Christm.) Swingle	*Jeruk nipis*	Sour	Cough, malaria	Fruit	Squeezed
Schisandraceae	*Illicium verum* Hook.fil.	*Pekak*	Sweet	Insomnia, bloating	Flower	Decoction
Solanaceae	*Physalis angulata* L.	*Ceplukan*	Bitter	Blood stability	Leaf	Decoction
Thymelaeaceae	*Phaleria macrocarpa* (Scheff) Boerl.	*Mahkota dewa*	Bitter	Dysentery, eczema	Stem bark	Dried
Monocots						
Acoraceae	*Acorus calamus* var. *americanus* Raf.	*Dlingo*	Bitter	Stomach ache	Leaf	Decoction
Araceae	*Typhonium flagelliforme* (G.Lodd.) Blume	*Keladi tikus*	Bitter	Cough, cancer	Leaf	Pounded
Asphodelaceae	*Aloe vera* (L.) Burm.f.	*Lidah buaya*	Bitter	Cough, stomach acid	Leaf	Juice
Commelinaceae	*Tradescantia spathacea* Sw.	*Adam hawa*	Bitter	Wound	Leaf	Burned
Asparagaceae	*Pleomele angustifolia* (Medik.) N.E.Br.	*Suji*	Sweet	Toothache	Leaf	Decoction
Pandanaceae	*Pandanus amaryllifolius* Roxb. ex Lindl.	*Pandan*	Sweet	Rheumatism	Leaf	Pounded
Poaceae	*Chrysopogon zizanioides* (L.) Roberty	*Akar wangi*	Sweet	Urolithiasis	Root	Decoction
	Cymbopogon nardus (L.) Rendle	*Serai*	Sweet	Cough	Stem	Decoction
	Imperata cylindrica (L.) P. Beauv.	*Alang - alang*	Sweet	Deep heat, Diarrhea	Root	Decoction
Zingiberaceae	*Curcuma zedoaria* (Christm.) Roscoe	*Kunyit putih*	Bitter	Bloating, Maag	Rhizome	Decoction
	Kaempferia galanga L.	*Kencur*	Sweet	Cough, bloating	Rhizome	Decoction
	Zingiber officinale Roscoe	*Jahe*	Sweet	Cough, asthma	Rhizome	Decoction
	Zingiber officinale var. *rubrum* Theilade	*Jahe merah*	Sweet	Cough, immunity	Rhizome	Decoction
	Zingiber zerumbet (L.) Roscoe ex Sm.	*Lempuyang*	Bitter	Sore throat, Stomach acid	Rhizome	Decoction
	Curcuma xanthorrhiza D.Dietr.	*Temulawak*	Bitter	Immunity, indigestion	Rhizome	Decoction
	Elettaria cardamomum (L.) Maton	*Kapulaga*	Sweet	Flu, cough	Seeds	Decoction
Ferns						
Selaginellaceae	*Selaginella* sp.	*Cakar ayam*	Sweet	Cough	Whole plant	Decoction

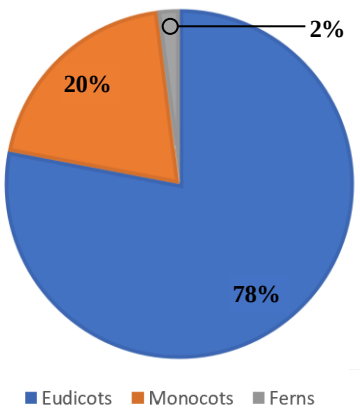

Figure 2. The clade of medicinal plants used by traditional healers in Sukoharjo District, Central Java Province, Indonesia

The most dominant family of Monocots is Zingiberaceae, with seven species. Our result aligns with research by Irawati et al. (2018), which states that the Zingiberaceae family is most widely used as a medicinal plant because it is easy to grow, so it is widely planted in the yard of the house and used in daily activities. The Zingiberaceae family is characterized by a distinctive aroma on its rhizomes (Syamsuri and Alang 2021). An example of a species from the Family Zingiberaceae is *jahe* (*Zingiber officinale* Roscoe). This family with 36 usages is represented by one to three species. Zingiberaceae plants have been cultivated until now, even though the wild species are also often found in the forests. The richness of Zingiberaceae plant species needs to be explored since various communities highly use it.

Various methods of processing medicinal plants include boiling, making herbal medicine, drinking boiled water, and making juice. Other ways, such as smearing the decoction of medicinal plants on the affected part of the body, such as the stomach, forehead, or other body parts, and some are eaten immediately, such as *kencur* (*Kaempferia galanga* L.) rhizome.

Based on the study's results, the medicinal plants used by the four traditional healers are purchased at the market or from farmers. The interviewed healers state that medicinal plants require a long planting time, so they cannot cultivate them independently since they practice medication almost daily. However some traditional healers have grown medicinal plants, but some wild animals damage their plants.

Of the various parts of medicinal plants used by traditional healers in the Sukoharjo District, the leaf is mostly used organ to make treatment recipes with 35 species, followed by the underground part (roots and rhizomes) with 11 species and flowers with nine species (Figure 3). This result is in line with a study by Maver et al. (2015), which found that the dominant plant parts used are the leaves and followed by the roots. Similarly, Mulyani et al. (2020) found that the leaves are the most widely used plant part for treatment. Using the leaf part is considered a method for preserving and conserving medicinal plants since this method does not disturb the plant (Jafar and Djollong 2018). However, our result differs from research by Shedoeva et al. (2019), which found that the whole plant and stem parts are the most widely used. Leaves are used in medicine because they are the easiest to obtain, so they are often consumed by the community, especially in the tropics (Saranani et al. 2021). The leaves have effective chemical ingredients in curing various diseases (Irawati et al. 2018). The leaves contain many secondary metabolites such as essential oils, flavonoids, alkaloids, steroids, and triterpenoids to be natural medicines (Albayudi and Saleh 2020). The leaves also have soft fibers that can be processed by various methods (Saranani et al. 2021).

Group of ailments cured by medicinal plant

This study documented seventy-five medicinal plants, which were then divided into ten groups of diseases (Table 2, Figure 4). The largest number of species of medicinal plants (32 species) is used to treat gastrointestinal problems such as constipation, hemorrhoids, maag, ulcer, diarrhea, bloating, sore throat, dysentery, stomach ache, toothache, deep heat, stomach acid and indigestion. Other gastrointestinal diseases could also be treated, for example, *Daun Ungu (Graptophyllum pictum* (L.) Griff.) for constipation and hemorrhoids, *Bunga Sepatu (Hibiscus rosa-sinensis* L.) for thrush, *Kunyit Putih (Curcuma zedoaria* (Christm.) Roscoe for ulcers and bloating. The second largest number of species is used to cure diseases related to the respiratory systems, such as cough, asthma, flu, and bronchitis, treated by 29 species. Several examples are *Jeruk Nipis (Citrus ×aurantiifolia* (Christm.) Swingle) for coughing, *Patikan Kebo (E. hirta)* for asthma, *Kapulaga (Elettaria cardamomum (*L.) Maton*)* for flu and cough, and *Kenanga* flower *(Cananga odorata* (Lam.) Hook.f. & Thomson) for bronchitis. The third largest group is for curing diseases related to skin problems. The skin diseases include itchy, painful, wound, pimple, swollen, chickenpox, measles, and eczema. Several examples of plants used are *mimba (Azadirachta indica* A. Juss.) for pimples, *binahong (Anredera cordifolia* (Ten.) Steenis) for itchy, *cangkring* (*Erythrina fusca* Lour) for chickenpox and measles, as well as the *mahkota dewa (Phaleria macrocarpa* (Scheff) Boerl.) for eczema. The disease groups of the excretory system include urolithiasis and diabetes. Several examples of medicinal to cure such diseases are *keji beling* (*Strobilanthes crispa* (L.) Blume) and *meniran* (*Phyllanthus niruri* L.) for urolithiasis, *mahoni* (*Swietenia mahagoni* (L.) Jacq.*)* and *kayu manis* (*Cinnamomum burmannii* (Nees & T.Nees) Blume) for diabetes. Other disease groups include female problems (3 species), circulatory system (3 species), cancer (4 species), fever (6 species), musculoskeletal system (5 species), and miscellaneous (12 species).

In addition to those disease grouping, there are other important things in recommending complementary treatment for patients (Shedoeva et al. 2019). These are the severity of the disease suffered, the ailment of the disease with conventional treatment, the Ivation rate of complementary medicine, the toxicity of complementary medicine, availability, quality evidence of complementary medicine, knowledge, and willingness of the patient to accept the benefits and risks of complementary treatment, maturity of the patient's intention to choose complementary treatment, and adherence to the use of prescribed drugs. These important things support people's perception of traditional medicine and disease cure.

Some common medicinal plants have been used for a long time in people's traditional medicine, such as *kunyit putih* (*C. zedoaria*), which is commonly used in digestive system diseases such as flatulence and ulcers. People in China and Japan have traditionally used the *kunyit putih* plant to treat flatulence, cough, menstrual disorders, fever, dyspepsia, vomiting, and hypothermia (Putri 2014). Meanwhile, in Indonesia, *kunyit putih* is very popular in treating stomach ulcers, asthma, and even cancer (Zamriyetti et al. 2021). *kunyit putih* (*C. zedoaria*) contains anti-inflammatory curcumin (Meltyza et al. 2015; Syamsuri and Alang 2021). Other species that have similar effects include *kencur (K. galanga*)*, lidah buaya (Aloe vera* (L.) Burm.f.*), alang-alang (Imperata cylindrica (*L.) P. Beauv.*), bunga sepatu (H. rosa-sinensis), lempuyang (Zingiber zerumbet* (L.) Roscoe ex Sm.*), daun ungu (G. pictum), jambu biji (Psidium guajava* L.*), srikaya (Annona squamosa* L.*),* and many more. *jambu biji (P. guajava)* contains flavonoid compounds such as quercetin, tannins, essential oils, and alkaloids useful as anti-diarrhea (Fratiwi 2015). *kencur* (*K. galanga*) has carminative activity that prevents gas formation in the digestive tract or helps remove gas from the stomach (Buana et al. 2020). In addition, *kencur* also contains alkaloids, tannins, saponins, and essential oils. Antibacterials are natural chemical compounds that inhibit bacterial growth at low levels (Erlina et al. 2018). In addition, Erlina et al. (2018) stated that *srikaya* (*A. squamosa*) can be used as an antibacterial

because it contains three chemical substances: flavonoids, terpenoids, and alkaloids. *alang-alang* (*I. cylindrica*) is widely used as a remedy for heartburn because it has an antipyretic effect, namely reducing fever and contains antioxidants that can counteract free radicals (Komansilan and Rumondor 2022). *jeruk nipis* (*C. ×aurantiifolia*) are known to have antitussive effects to relieve and treat coughs with the right dose (Hafsah et al. 2022). The *patikan kebo* (*E. hirta*) contains flavonoid compounds that act as anti-asthmatic effects (Damayanti et al. 2017). *manggis* (*Garcinia mangostana* L.) contains a lot of α-mangostin, xanthone, and anthocyanin compounds in the fruit skin which act as antioxidants (Puspitasari et al. 2016). The antioxidant effect plays a role in reducing and capturing free radicals. *rumput mutiara* (*Oldenlandia corymbosa* L.) is known to have an anti-cancer effect because it contains compounds of ursolic acid and oleanolic acid which can reduce the proliferation of breast cancer cells and liver cancer (Soemardji et al. 2015). *kayu manis* (*C. burmannii*) are known to have antidiabetic effects due to bioactive compounds that effectively lower blood sugar levels, inhibit α-Glucosidase enzyme activity and control glucose metabolism in non-diabetic people (Emilda 2018).

Generally, some diseases can be cured independently, including cough, flu, colds, dizziness, indigestion, and dental disorders. For example, cough is usually treated with a decoction of betel leaves or lime with soy sauce, for diarrhea using aloe leaves or guava, and for fever in a child using onions bandaged all over the body. Public awareness of health is quite high, and it is proven that while sick, they seek to treat it so that the pain is only a short time. Besides that, the community suffers only minor diseases, with complaints of pain being self-limiting (Theresiana et al. 2018). Some examples of medicinal plants for personal medicine in Sukoharjo District include *alang-alang (I. cylindrica)* for heatiness and diarrhea, *kencur (K. galanga*) for cough and bloating, *lempuyang (Z. zerumbet*) for sour throat and stomach acid, *jahe merah* (*Z. officinale* var. *rubrum* Theilade) for cough and immunity, and *Jahe* (*Z. officinale*) for cough and asthma. These plants are easy to find in traditional markets and are commonly used as raw materials for *jamu*.

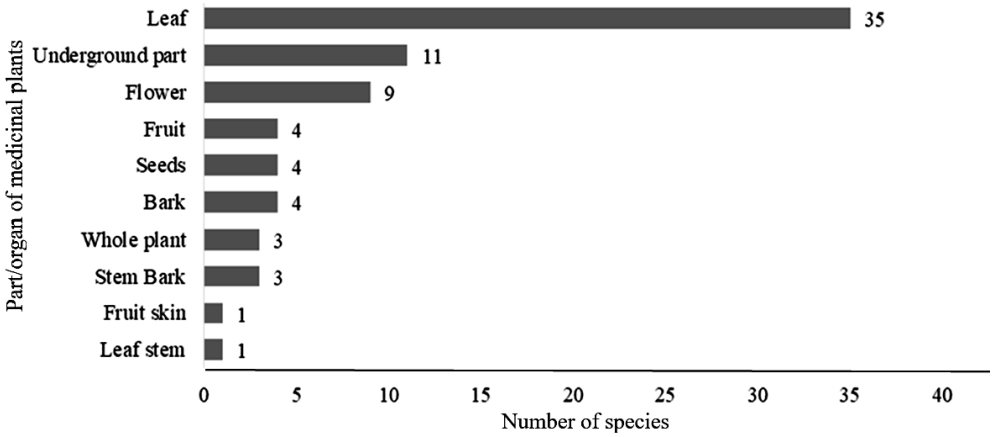

Figure 3. Part/organ of medicinal plants used by traditional healers in Sukoharjo District, Central Java Province, Indonesia

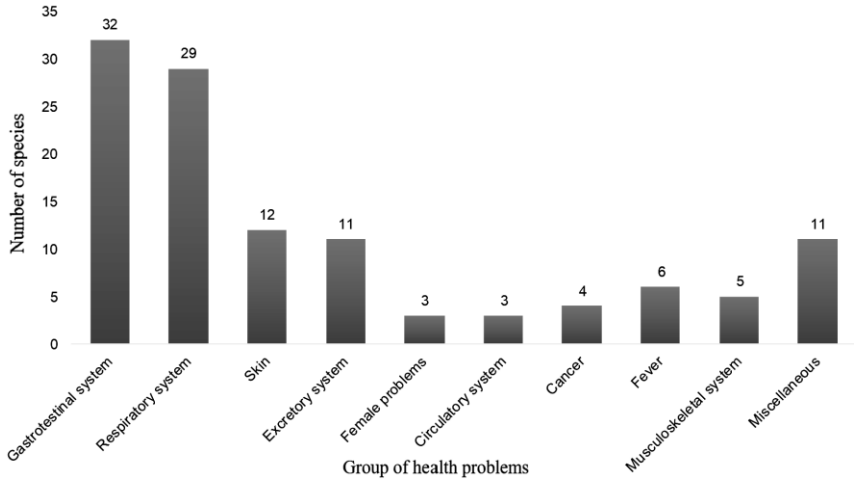

Figure 4. Number of species of medicinal plants used to treat a group of health problems by traditional healers in Sukoharjo District, Central Java Province, Indonesia

The *alang-alang* (*I. cylindrica*) is a medicinal plant native to Southwest Asia and tropical and subtropical zones. This plant shows various therapeutic potentials, including antibacterial and liver protection (Shin et al. 2021). In a study by Shin et al. (2021), four compounds were successfully isolated and identified, including new chromone, isoeugenol, ferulic acid, and caffeic acid. Another study also showed the antibacterial activity of *alang-alang* extract, which can inhibit the metabolite quorum-sensing *Chromobacterium violaceum* (Zhou et al. 2013). Furthermore, another study by Yusro et al. (2014) showed that the content of antioxidants, anti-inflammatories, and antimicrobials can play a role in relieving fever.

Kencur (*K. galanga*) is one of Indonesia's five most important medicinal plants. *Kencur* is a medicinal plant with a fairly high economic value, and from the past until now, it has been widely cultivated as a medicinal plant. The rhizome can be used as raw materials for traditional medicine, food, and beverage, including the famous *jamu beras kencur*. Empirically, the rhizome is often used as a folk remedy, one of which is to treat inflammations. The extract shows antinociceptive activity and also produces anti-inflammatory. In a study by Elfahmi et al. (2014), *kencur* mixed with honey can cure sore throat, cough and inflammation in children within a few days.

Lempuyang (*Z. zerumbet*) in Sukoharjo is used to cure fever medicine. *Lempuyang* contains zerumbone, pinene, humulene, linalool, caryophyllene, limonene (Adnan et al. 2014). In addition, *lempuyang* is used to lower heat because it contains antipyretic activity. In studies by Tian et al. (2020) that microbial and antioxidant tests were carried out with several microbial strains *Staphylococcus aureus* (ATCC 6538P), *Enterococcus faecalis* (ATCC 29212), *Pseudomonas aeruginosa* (CMCC (B) 10104), *Bacillus subtilis* (CMCC (B) 63501), *Escherichia coli* (ATCC 25922), *Proteus vulgaris* (CMCC (B) 49027), and *Candida albicans* (CMCC (F) 98001). The results showed that the effects of antioxidants could effectively inhibit the production of free radicals and function to prevent and treat atherosclerosis in vivo.

Jahe (Z. officinale) is a medicinal plant in Zingiberaceae used as a raw material for Indonesia's herbal and medicinal industry. Ginger is one of the most important components in medicine; even in almost all types of traditional medicine, there is ginger content. For example, in traditional medicine, ginger is used as one of the components of a concoction. According to previous research, ginger in the traditional medicine industry is used the most in Central Java. For example, in Sukoharjo District, ginger is believed to be a drug that can cure colds because of its contents, namely galanolactone, gingesulfonic acid, galactosyl glycerol, ginger glycolipids, diarylheptanoids, and phytosterols, which have been proven to have free radical scavengers, antioxidants.

The benefits and uses of red ginger include relieving seizures, preventing the hardening of blood vessels, preventing inflammation, preventing microbes and parasites, preventing rheumatism, and stimulating the production of gastric sap and bile sap. In Sukoharjo District, red ginger is widely used by healers in traditional medicine because it is believed to have ingredients that treat colds and fevers. The ingredients contained in red ginger are terpenes and phenolics (panadol, gingerol, and shogaol). In addition, red ginger is used as a treatment to relieve bloating and menstrual pain because the ethanol extract of its rhizome has anti-inflammatory activity to cure and prevent acute and chronic inflammation.

Taste of medicinal plant

The taste of medicinal plants can be used as an indicator for treatment in traditional medicine for a particular disease to cure (Maneenoon et al. 2015). Understanding the tastes of medicinal plants is important to observe and know how to make more efficient and effective recipes for traditional medicine. Several flavors of medicinal plants include sweet, sour, salty, bitter, and umami (Gilca and Barbulescu 2015). The results of this study showed that the most dominant taste of medicinal plants used by traditional healers in Sukoharjo was bitter (70 species), followed by sweet (35 species) and sour (11 species). Plants with a bitter taste are the most used by almost every group of diseases (Table 2). In addition, the relationship between the taste of medicinal plants and pharmacological activity has been scientifically confirmed (Table 3).

Based on Table 2, bitter plants are widely used to cure respiratory diseases such as cough (eight species) and excretory systems such as diabetes (six species). Bitter taste is one of the important indicators in the selection of plants for medicinal use (Albuquerque et al. 2020). The bitter taste has a variety of chemical compounds, such as flavonoids, that can potentially treat several health problems (Medeiros et al. 2015). This follows research from Bahagia et al. (2018), which utilizes bitter plant extracts for diabetes drugs. Sweet plants are widely used in diseases related to the gastrointestinal system, especially ulcers. For example, clove flower decoction contains essential oils that cure ulcers (Tamnge and Yusnaini 2019). Based on research from Cahyayuliani et al. (2016), bay leaf decoction can inhibit diarrhea in male mice. Plants with a sour taste are associated with cough disease (four species), including lemon and lime. Lemons and limes contain compounds that relieve coughs and boost the immune system (Azizah and Kurniati 2020).

Table 2. Taste of medicinal plants and ailment cured as cited by four traditional healers in Sukoharjo District, Central Java Province, Indonesia

Group of ailment	Ailment	Taste					Total
		Sweet	Sour	Salty	Bitter	Umami	
Gastrotestinal system (32 species)	Constipation				1		1
	Hemorrhoids	1			2		3
	Maag	3			1		4
	Diarrhoea	3			4		7
	Sore throat				1		1
	Bloating	2			3		5
	Ulcer		1		1		2
	Toothache	2					2
	Dysentery				2		2
	Stomach ache				1		1
	Heatiness	1					1
	Stomach acid				2		2
	Indigestion				1		1
Respiratory system (29 species)	Cough	8	4		8		20
	Asthma	1	1		1		3
	Flu	2			3		5
	Bronchitis		1				1
Skin (12 species)	Itchy	1			2		3
	Pain	1					1
	Wound				3		3
	Chickenpox				1		1
	Measles				1		1
	Pimple				1		1
	Eczema				1		1
	Swollen		1				1
Excretory system (11 species)	Urolithiasis	2			2		4
	Diabetes	1			6		7
Female problems (3 species)	Menstrual				1		1
	Vaginal discharge				1		1
	Menstrual laxative	1					1
Circulatory system (3 species)	Hypertension				2		2
	Blood stability				1		1
Cancer (4 species)	Cancer				3		3
	Breast cancer	1					1
Fever (6 species)	Malaria		1		2		3
	Dengue fever				1		1
	Fever				2		2
Musculoskeletal system (5 species)	Rheumatism	1			3		4
	Gout				1		1
Miscellaneous (11 species)	Immunity	1			1		2
	Hair loss		1				1
	Nosebleed				1		1
	Stress		1		1		2
	Insomnia	1			2		3
	Headache	2					2
	Total	35	11	0	70	0	116

Table 3. The relationship between ailment and taste of some medicinal plant species

Disease	Taste of medicinal plants	Example	Pharmacological activity
Gastrotestinal system			
Constipation	Bitter	*Graptophyllum pictum* (L.) Griff.	Anti-inflammatory
Hemorrhoids	Bitter	*Graptophyllum pictum* (L.) Griff.	Anti-inflammatory
Maag	Bitter	*Curcuma zedoaria* (Christm.) Roscoe	Anti-inflammatory
Diarrhoea	Bitter	*Psidium guajava* L.	Anti-diarrheal
Sore throat	Bitter	*Zingiber zerumbet* (L.) Roscoe ex Sm.	Antimicrobial
Bloating	Sweet	*Kaempferia galanga* L.	Carminative
Ulcer	Sour	*Hibiscus rosa-sinensis* L.	Antiulcer
Toothache	Sweet	*Syzygium aromaticum* (L.) Merr. & Perry	Anti-inflammatory
Dysentery	Bitter	*Annona squamosa* L.	Antibacterial
Stomach ache	Bitter	*Acorus calamus* var. *americanus* Raf.	Antibacterial
Deep heat	Sweet	*Imperata cylindrica* (L.) P. Beauv.	Antipyretic
Stomach acid	Bitter	*Aloe vera* (L.) Burm.f.	Anti-inflammatory
Indigestion	Bitter	*Curcuma xanthorrhiza* D.Dietr.	Antimicrobial
Respiratory system			
Cough	Sour	*Citrus ×aurantiifolia* (Christm.) Swingle	Antitussive
Asthma	Bitter	*Euphorbia hirta* L.	Antiasthma
Flu	Sweet	*Elettaria cardamomum* (L.) Maton	Antioxidant
Bronchitis	Sour	*Cananga odorata* (Lam.) Hook.f. & Thomson	Antioxidant
Skin			
Itchy	Bitter	*Hippobroma longiflora* (L.) G. Don	Antioxidant
Pain	Sweet	*Caesalpinia sappan* L.	Anti-inflammatory
Wound	Bitter	*Jatropha multifida* L.	Anti-inflammatory
Chickenpox	Bitter	*Erythrina fusca* Lour	Anti-inflammatory
Measles	Bitter	*Erythrina fusca* Lour	Anti-inflammatory
Pimple	Bitter	*Azadirachta indica* A. Juss.	Antibacterial
Eczema	Bitter	*Phaleria macrocarpa* (Scheff) Boerl.	Anti-inflammatory
Swollen	Sour	*Polyscias scutellaria* (Burm. f.) Fosberg	Anti-inflammatory
Cancer			
Cancer	Bitter	*Garcinia mangostana* L	Antioxidant
Breast cancer	Sweet	*Oldenlandia corymbosa* L.	Anti-cancer
Fever			
Malaria	Bitter	*Tinospora tuberculata* Beumée ex K.Heyne	Anti-malaria
Dengue fever	Bitter	*Carica papaya* L.	Anti-inflammatory
Fever	Bitter	*Erythrina crista-galli* L.	Antipyretic
Excretory system			
Urolithiasis	Sweet	*Orthosiphon stamineus* Benth.	Anti-inflammatory
Diabetes	Sweet	*Cinnamomum burmannii* (Nees & T.Nees) Blume	Antidiabetic
Female problems			
Menstrual	Bitter	*Murraya paniculata* (L.) Jacq.	Anti-inflammatory
Vaginal discharge	Bitter	*Cleome gynandra* L.	Antibacterial
Menstrual laxative	Sweet	*Impatiens balsamina* L.	Anti-inflammatory
Miscellaneous			
Immunity	Bitter	*Andrographis paniculata* (Burm.fil.) Nees	Immunomodulator
Hair loss	Sour	*Polyscias scutellaria* (Burm. f.) Fosberg	Antibacterial
Nosebleed	Bitter	*Anredera cordifolia* (Ten.) Steenis	Antiseptic
Stress	Bitter	*Jasminum sambac* (L.) Aiton	Antioxydant
Insomnia	Bitter	*Erythrina crista-galli* L.	Sedative
Headache	Sweet	*Chrysanthemum* sp.	Antioxidant
Circulatory system			
Hypertension	Bitter	*Swietenia mahagoni* (L.) Jacq.	Antihypertensive
Blood stability	Bitter	*Physalis angulata* L.	Anticoagulant
Musculoskeletal system			
Rheumatism	Sweet	*Pandanus amaryllifolius* Roxb. ex Lindl.	Anti-inflammatory
Gout	Bitter	*Muntingia calabura* L.	Anti-inflammatory

Preservation of traditional knowledge of medicinal plants in Sukoharjo

This study aims to showcase the ethnomedicinal knowledge in certain regions, especially in Sukoharjo District, Central Java, which is still consistent in carrying out traditional medicinal plant medicine practices. The high level of activities related to ethnomedicine in Sukoharjo and the existence of producers and business actors in traditional herbal medicine make Sukoharjo a suitable research place to learn about this aspect. Many medicinal plants and traditional practices documented in this study have been strongly promoted in rural areas for self-healing. Traditional medicine is not only recognized by ordinary people; the government of the Sukoharjo District has also promoted its development and wide utilization of traditional medicine using medicinal plants.

The use of medicinal plants is carried out in two ways, namely directly and used by concocting. Direct use means that a certain type of plant is directly applied and consumed without mixing. For example, it is used for skin diseases and headaches, which is done by being tied up, rubbed/smeared, and washed. Plant parts commonly used directly are leaves, fruits, saps, sticks, buds, and fronds. Treatment using medicinal herbs traditionally has minimal side effects compared to modern drugs containing chemicals. In addition, plants used in traditional medicine are very easy to find in the surrounding environment because some people must have planted several species of medicinal plants, including ginger, turmeric, and many more. Since a long time ago, Indonesian people, especially in rural areas, have grown these plants to be used as spices for cooking, as it is known that Indonesian food spices come from various spices. Ginger, turmeric, and other species are the main spices in food. Therefore, people grow this plant species in their respective yards to be easy to find and practical use.

This research documented new information on the medicinal uses of several species of plants; for example, the *kemuning* (*Murraya paniculata* (L.) Jacq..) which is used to treat menstrual pain, toothache, and rheumatism, and the *kunyit putih* (*C. zedoaria*) to treat bloating diseases, inflammation of the joints, allergies, ulcers from a decoction of its rhizomes. *jarak tingkir* (*Jatropha multifida* L.) and *patah tulang* (*Euphorbia tirucali* L.) are often used to treat external wounds. Based on observations and interviews with traditional healers, each medicinal herb has its efficacy. Some are quickly curing the disease, while others are slow. Furthermore, each traditional healer has their way of processing medicinal plants, for example, when mixed with water and other ingredients, depending on the type of disease. This fact suggests that traditional knowledge in medicine is sometimes that abstract despite it has a very high position in society.

The study concluded that traditional healers in the Sukoharjo District use 75 species of 41 families of medicinal plants, most of which taste bitter. The most used organs of medicinal plants are leaves, flowers, and rhizomes. Furthermore, the common diseases cured by medicinal plants include cough, fever, flatulence, diarrhea, diabetes, menstrual pain, flu, toothache, and ulcer.

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