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# Diversity of herbs and spices plants and their importance in traditional medicine in the South Aceh District, Indonesia

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**Abstract.** *Adnan, Navia ZI, Silvia M, Antika M, Suwardi AB, Baihaqi, Yakob M. 2022. Diversity of herbs and spices plants and their importance in traditional medicine in the South Aceh District, Indonesia. Biodiversitas 23: 3836-3843.* Kluet people are one of the ethnic communities living in Southern Aceh, Indonesia. Various herbs and spices plants are used by the Kluet people as a traditional medicine in treating diseases and disorders. The study aimed to investigate the diversity of herbs and spices plants and their importance in the traditional medical system. It was based on field surveys, plant collection, and semi-structured interviews with the local people. Interviews were performed with 355 informants selected by using the random sampling technique. A total of 30 medicinal plant species, consisting of 18 families, have been documented. *Curcuma longa, Kaempferia galanga, Zingiber officinale, Citrus x aurantiifolia, Alpinia galanga, Averrhoa bilimbi, Elettaria cardamomum, Allium sativum, Cocos nucifera*, and *Syzygium aromaticum* are the most popular medicinal plants known by Kluet people. More than 40% of traditional knowledge related to the use of herbs and spices as traditional medicine was obtained from their families/friends/neighbors. Traditional knowledge is thought to decline among generations. It is supposedly due to lifestyle changes as a result of modernization. The documentation and promotion of traditional medicine systems through formal and non-formal education may contribute to the conservation of biodiversity and traditional knowledge.

**Keywords:** Biodiversity, medicine, South Aceh, traditional uses

## INTRODUCTION

Indonesia is a tropical country known for its plant diversity, with over 20,000 species recorded, accounting for approximately 25% of the world's flowering plant species (Kusmana and Hikmat 2015). It is estimated that 60-70% of the population in developing countries who live in agricultural and forest areas used various plants as part of their daily needs (Raut et al. 2021). These plants play an important role in food (Listiani and Abrori 2018; Elfrida et al. 2020; Suwardi et al. 2020; Navia et al. 2021), medicine (Ani et al. 2021; Elfrida et al. 2021; Navia et al. 2021), fuelwood, construction material, fodder (Navia et al. 2020; Wakhidah et al. 2020) and even cultural purposes (Sutrisno et al. 2020; Wakhidah et al. 2020). The plants can be used as a substitute for their daily staple foods as well as a valuable food supplement during times of food scarcity in order to achieve a nutritionally balanced diet (Narzary et al. 2013). Furthermore, various plant species have long been a valuable source of natural products used by various tribes around the world to maintain their health. Despite the fact that over 7,000 plant species are cultivated or harvested from the wild vegetation around the world, many of them are still neglected and underutilized due to a lack of understanding about their utility and necessity in human health so further study is needed to reveal the potentials (Ghane et al. 2010; Ilonga et al. 2018).

Herbs and spices are plant resources that have long been used in food production by communities all over the world, and they also have health benefits (Sharma et al. 2017). Herbal medicine, also known as phytomedicine, is the use of therapeutic plants, plant parts, or plant-derived compounds to treat infections, diseases, or to improve overall health. Many herbal plants with hypoglycemic properties have been discovered all over the world. Spice, on the other hand, refers to a plant of indigenous or exotic origin that is aromatic or has a hot, delicious taste and is used to enhance the flavor of foods as well as to add stimulant ingredients to them (Abebe et al. 2018). Herbs and spice plants have a long culinary history, as well as the potential to reduce and treat chronic health problems due to their antioxidant, antibiotic, antiviral, anticoagulant, anti-carcinogenic, and anti-inflammatory properties (Asowata-Ayodele et al. 2016; Garcia-Casal et al. 2016). These plants are commonly used to treat chronic conditions such as cancer, diabetes, and heart disease (Sharma et al. 2017).

Aceh is one of the provinces in Indonesia and is well known for its plants and cultural diversity (Sutrisno et al.

2021; Ramaidani and Navia 2022; Suwardi et al. 2022). This area is home to 13 indigenous tribes, one of which is the Kluet tribe. According to oral historical sources, this tribe was formed by the assimilation of three Sumatran tribes, namely Aceh, Batak, and Minangkabau. This ethnic has a unique cultural system as a result of the combination of three ethnic cultures. Kluet people's inhabitants live along the Kluet river bank and the edge of Gunung Leuser National Park in four sub-districts known as Kluet Timur, Kluet Utara, Kluet Selatan, and Kluet Tengah (BPS 2010). The Kluet people have a long tradition of using herbs and spices plants in their traditional medicinal systems. This traditional knowledge is passed down orally from generation to generation and is poorly documented. Although traditional medicinal systems are still practiced, this knowledge will be lost over time as a result of the use of conventional medicine. Thus the need to document and preserve this knowledge is essential. Ethnobotanical information provides an opportunity to learn indigenous knowledge regarding various plant uses and traditional management systems (Mathewos 2015), including for medicinal purposes. This study aims to investigate the diversity of herbs and spices plants and their importance in the traditional medical system among the Kluet people of South Aceh, Indonesia.

## MATERIALS AND METHODS

### Study area

The district of South Aceh is located from 02°23′ to 03°44′ N; 96°57′ to 97°56′ E. The topography of the South Aceh district is highly varied, ranging from lowlands to hills. This area experiences a dry season from January to July and a rainy season from August to December. Rainfall ranges from 1,677 to 4,552 mm per year, which is distributed into 101 to 225 rainy days per year. The total population of South Aceh is 230,254 comprising three indigenous peoples, namely Aceh (60%), Aneuk Jamee (30%), and Kluet (10%) (BPS Kabupaten Aceh Selatan 2021). This study focused on the Kluet People, which are distributed in four sub-districts, namely Kluet Utara, Kluet Timur, Kluet Selatan, and Kluet Tengah. The study was carried out in 12 villages, namely Kampung Ruak, Krueng Kluet, Pulo Kambing, Kedai Runding, Kedai Kandang, Ujung Padang, Malaka, Koto, Lawe Melang, Durian Kawan, Alai, and Lawe Sawah (Figure 1).

### Sample size and informant selection

Twelve study villages, i.e., Kampung Ruak, Krueng Kluet, Pulo Kambing, Kedai Runding, Kedai Kandang, Ujung Padang, Malaka, Koto, Lawe Melang, Durian Kawan, Alai, and Lawe Sawah (Fig. 1), were selected from a total of 60 villages in four sub-districts based on recommendations of local authorities and presence of Kluet people. To ensure a representative sample for the 12 villages, the sample size was determined using Cochran's sample size formula as presented by Bartlett et al. (2001).

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

Where: n is the study sample size, N is the total number of households in all 12 selected villages, e is the maximum variability or margin of error of 5% (0.05), whereas 1 is the probability of the event occurring. As a result, the total sample is as follows:

$$n = 3{,}174/1 + 3{,}174(0.05)^2,\ n = 355$$

The sample size for each village was determined based on the proportion of households (HH) in the respective villages. For example, the total number of households in Kampung Ruak was 375, yielding a number of 42 (n = 375 x 355/3,174 = 42). The same calculation was performed for the other villages and is shown in Table 1.

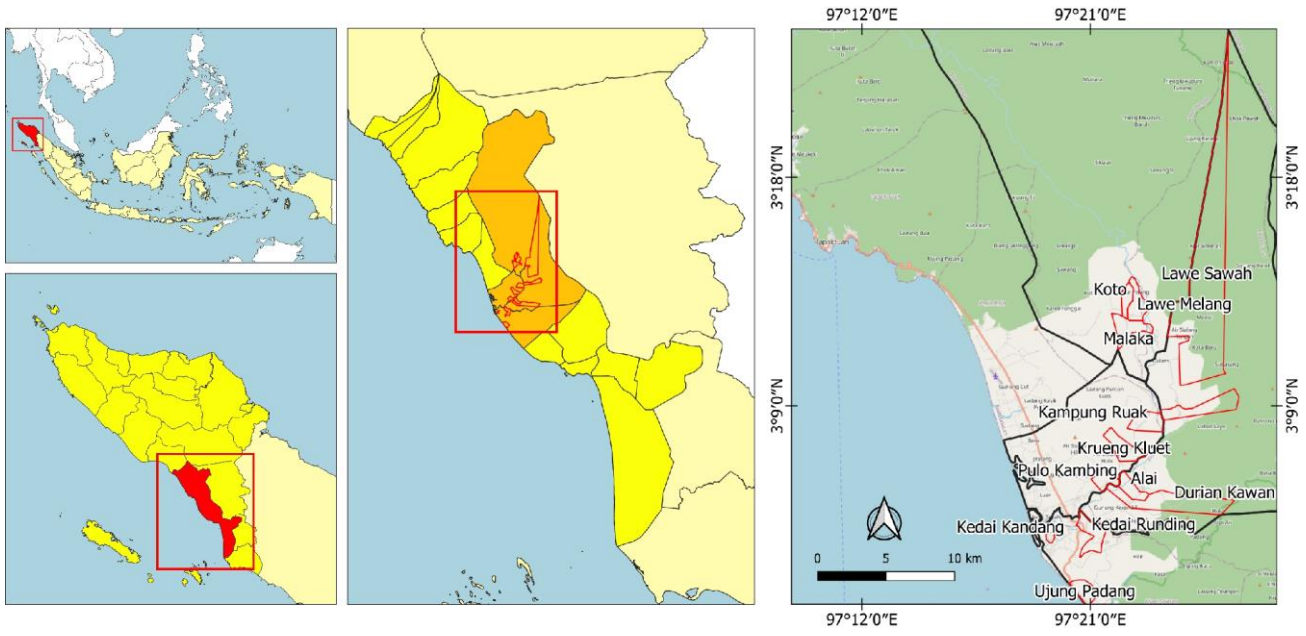


**Figure 1.** Map of South Aceh District, Aceh Province, Indonesia, showing the study area

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

| Name of village | Area in $km^2$ | No. of households | No. of respondents |
|---|---|---|---|
| Kampung Ruak | 2,058 | 375 | 42 |
| Krueng Kluet | 453 | 239 | 27 |
| Pulo Kambing | 333 | 235 | 26 |
| Kedai Runding | 9.62 | 626 | 70 |
| Kedai Kandang | 0.25 | 122 | 14 |
| Ujung Padang | 2.0 | 101 | 11 |
| Malaka | 20.54 | 169 | 19 |
| Koto | 23.1 | 401 | 45 |
| Lawe Melang | 22.78 | 104 | 12 |
| Durian Kawan | 9.5 | 364 | 41 |
| Alai | 7.0 | 160 | 18 |
| Lawe Sawah | 20.43 | 278 | 31 |
| Total | 2,959.22 | 3,174 | 355 |

**Ethnobotanical data collection**

Fieldwork included data documentation and plant collection. Before the interviews, all informants provided formal written consent, including permission for publication. A total of 355 women were divided into six age groups, i.e., (1) 15-25, (2) 26-35, (3) 36-45, (4) 46-55, (5) 56-65, and (6) > 65 years old. Interviews and transect walks were the most common types of field surveys. Informants were asked to complete a semi-structured questionnaire about their traditional knowledge, plant use, disease treatment, used plant-part, and mode of preparation and administration. The majority of the interviews were conducted in Kluet's native language with the assistance of native translators, and the data was then translated into English.

**Species documentation and identification**

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

**Data analysis**

*Relative Frequency Citation (RFC)*

The ethnomedicinal data was assessed using a relative frequency citation (RFC) index (Vitalini et al. 2013):

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

RFC indicates the local importance of each species and is calculated by dividing the frequency of citation (FC) by the total number of informants participating in the study (N), without taking use categories into account.

*Use Value (UV)*

The use-value (UV) reflects the relative importance of each plant species used by the informants in the study range. The use-value was calculated using the following proposed formula (Tardio and Pardo-de-Santayana 2008):

$$UV = \sum U/n$$

Where: U is the number of use reports quoted by each informant for a given plant species; n refers to the total number of informants interviewed for a given plant.

## RESULTS AND DISCUSSION

**Socio-demographic of the respondents**

A total of 355 informants were interviewed during this study. All of them are women between the ages of 36 and 45 years. The majority of informants had an elementary level of education (35.77%), while the percentages of other levels (Junior, Senior, University, and no education) were 25.92%, 21.41%, 11.83%, and 5.07%, respectively (Table 2).

**Diversity and use of herbs and spices plants**

The study was carried out in 12 selected villages to document the traditional knowledge of the Kluet people on herbs and spices plants. A total of 30 herbs and spices plant species belonging to 18 families were listed in Table 2, with traditional uses against various diseases. The most encountered plant families were Zingiberaceae (5 reported species), Apiaceae (3), Rutaceae (3 each), Amaryllidaceae (2), Lamiaceae (2), Rutaceae (2), Myrtaceae (2), Solanaceae (2), while the rest of the families were represented with 1 species (Table 3).

The number of species (30) found in the study area was comparable to the 31 species of medicinal plants reported in Aceh Tamiang district, Aceh, Indonesia (Navia et al. 2020), but lower than the 46 species of medicinal plants reported in Sekerak, Aceh Tamiang district (Navia et al. 2021), 73 species in Central Russikada, Northeastern Algeria (Souilah et al. 2021), 96 species in Kota Bahagia, Aceh Selatan district (Suwardi et al. 2021), and 107 species in Jambur Labu, Aceh Timur district (Elfrida et al. 2021).

The highest value of RFC ranked the *Curcuma longa* (0.98), followed by *Kaempferia galanga* (0.97), *Zingiber officinale* (0.96), *Citrus x aurantiifolia* (0.94), *Alpinia galanga* (0.92), *Averrhoa bilimbi* (0.90), *Elettaria cardamomum* (0.89), *Allium sativum* (0.88), *Cocos nucifera* (0.87), and *Syzygium aromaticum* (0.86) (Figure 2).

**Table 2.** Socio-demographics of respondents

| Variable | | Total | Percentage |
|---|---|---|---|
| Gender | Women | 355 | 100 |
| Age | 15-25 | 46 | 12.96 |
| | 26-35 | 68 | 19.15 |
| | 36-45 | 78 | 21.97 |
| | 46-55 | 67 | 18.87 |
| | 56-65 | 68 | 19.15 |
| | >65 | 28 | 7.89 |
| Education | No Education | 18 | 5.07 |
| | Elementary School | 127 | 35.77 |
| | Junior High School | 92 | 25.92 |
| | Senior High School | 76 | 21.41 |
| | University | 42 | 11.83 |

**Table 3.** List of medicinal plants with medicinal values

| Family | Botanical name | Vernacular name | Plant part(s) used | Mode of preparation | Administration route | Disease | RFC | UV |
|---|---|---|---|---|---|---|---|---|
| Amaryllidaceae | *Allium cepa* L. | Bawang merah | Bulb | Infusion | Oral | Fever, wound, menstrual disorders, cough, flu, constipation, flatulence, hypertension | 0.670 | 1.52 |
| | *Allium sativum* L. | Bawang putih | Bulb | Infusion | Oral | Fever, diabetes, intestinal worms, flatulence, dysentery, hypertension | 0.921 | 1.82 |
| Apiaceae | *Coriandrum sativum* L. | Ketumbar | Seed | Decoction | Oral | Stomachache, diarrhea, flatulence, diabetes, intestinal worms | 0.332 | 1.13 |
| | *Cuminum cyminum* L. | Jinten | Seed | Decoction | Oral | Hypertension, diarrhea, obesity | 0.321 | 0.63 |
| | *Foeniculum vulgare* Mill. | Adas | Seed | Decoction | Oral | Ulcer, cough, flatulence, diabetes, hypertension, menstrual disorder, appetite | 0.344 | 1.22 |
| Arecaceae | *Cocos nucifera* L. | Kelapa | Fruit | Juice | Oral | Diarrhea, menstrual disorders, fever | 0.918 | 1.53 |
| Asteraceae | *Elephantopus scaber* L. | Tapak leman | Whole plants | Decoction | Oral | Flu, cough, flatulence | 0.335 | 0.64 |
| Clusiaceae | *Garcinia atroviridis* Griff. ex T.Anderson | Asam gelugur | Fruit | Juice | Oral | Obesity, cough, sore throat | 0.963 | 1.67 |
| Euphorbiaceae | *Aleurites moluccanus* (L.) Willd. | Kemiri | Seed | Decoction | Oral | Coughs, headache, diarrhea, fever, ulcer | 0.569 | 0.91 |
| Lamiaceae | *Ocimum* × *africanum* Lour. | Kemangi | Leaf | Decoction | Oral | Flu, fever | 0.586 | 0.62 |
| | | | | Paste | Topical | Acne, skin disease | | |
| | *Ocimum basilicum* L. | Basil | Leaf | Decoction | Oral | Cold, flu, appetite | 0.530 | 0.69 |
| | | | | Paste | Topical | Acne, skin disease | | |
| Lauraceae | *Cinnamomum verum* J.Presl | Kayu manis | Bark | Decoction | Oral | Flu, hypertension, diarrhea, stomachache, appetite | 0.332 | 0.68 |
| Myristicaceae | *Myristica fragrans* Houtt. | Pala | Fruit | Juice | Oral | Malaria, flatulence | 0.839 | 0.92 |
| Myrtaceae | *Syzygium aromaticum* (L.) Merr. & L.M.Perry | Cengkeh | Fruit | Decoction | Oral | Ulcer, sore throat | 0.913 | 0.93 |
| | | | | Paste | Topical | Acne, toothache | | |
| | *Syzygium polyanthum* (Wight) Walp. | Daun salam | Leaf | Decoction | Oral | Hypertension, ulcer, diarrhea, stomachache | 0.637 | 0.90 |
| | | | | Paste | Topical | Skin disease | | |
| Oxalidaceae | *Averrhoa bilimbi* L. | Belimbing wuluh | Leaf | Paste | Topical | Itches, boils, acne | 0.975 | 1.98 |
| | | | Fruit | Juice | Oral | Cough, fever, obesity, sore throat, hypertension | | |
| Pandanaceae | *Pandanus amaryllifolius* Roxb. ex Lindl. | Pandan | Leaf | Infusion | Oral | Diarrhea, hypertension, menstrual disorders | 0.310 | 0.35 |
| Piperaceae | *Piper nigrum* L. | Lada | Fruit | Decoction | Oral | Flu, cough, diarrhea | 0.344 | 0.42 |
| Poaceae | *Cymbopogon citratus* (DC.) Stapf | Serai | Stem | Decoction | Oral | Cough, hypertension | 0.307 | 0.35 |
| Rutaceae | *Bergera koenigii* L. | Daun kari | Leaf | Decoction | Oral | Diarrhea, flatulence | 0.321 | 0.54 |
| | *Citrus hystrix* DC. | Jeruk purut | Fruit | Juice | Oral | Cough, fever, sore throat | 0.642 | 1.50 |
| | *Citrus x aurantiifolia* (Christm.) Swingle | Jeruk nipis | Fruit | Juice | Oral | Cough, fever, sore throat | 0.980 | 1.93 |
| Schisandraceae | *Illicium verum* Hook.f. | Bunga lawang | Seed | Decoction | Oral | Intestinal worms, rheumatism, diarrhea, dysentery, flatulence | 0.344 | 0.59 |
| Solanaceae | *Capsicum annuum* L. | Cabai merah | Fruit | Infusion | Oral | Flu, hypotension, appetite | 0.287 | 0.39 |
| | *Capsicum frutescens* L. | Cabai rawit | Fruit | Infusion | Oral | Flu, hypertension, appetite | 0.304 | 0.41 |
| Zingiberaceae | *Alpinia galanga* (L.) Willd. | Lengkuas | Rhizome | Decoction | Oral | Stomachache, fever, appetite, flatulence | 0.935 | 1.77 |
| | *Curcuma longa* L. | Kunyit | Rhizome | Decoction | Oral | Menstrual disorders, cough, flatulence, flu, fever | 0.952 | 1.82 |
| | *Elettaria cardamomum* (L.) Maton | Kapulaga | Rhizome | Decoction | Oral | Flu, asthma, hypertension | 0.287 | 0.30 |
| | *Kaempferia galanga* L. | Kencur | Rhizome | Decoction | Oral | Diarrhea, cough, flatulence, appetite | 0.946 | 1.84 |
| | *Zingiber officinale* Roscoe | Jahe | Rhizome | Decoction | Oral | Flatulence, fever, flu, cough, sore throat | 0.992 | 1.92 |

The UV of medicinal plants ranged from 0.30 to 1.98 which shows the least relative importance of *Elettaria cardamomum* from the Zingiberaceae family to the highest importance for *Averrhoa bilimbi* from the Oxalidaceae family. The fruit of the *Averrhoa bilimbi* plant was extensively used as a cure for cough, fever, obesity, sore throat, and hypertension, while leaves were used for the ailment of itches, boils, and acne. *Averrhoa bilimbi* is an important species for the Kluet People, not only in traditional medicine but also as a spice in various cuisines. This plant is commonly found in their home gardens.

The parts of the plant primarily used were the fruit (32%), followed by leaf (20%), Rhizome and seed (16% each), bulb (7%), and bark, stem, and whole plant (3% each) (Figure 3). The most common preparation and administration methods were categorized into decoction (54%), juice (17%), infusion (14%), and paste (14%) (Figure 4).

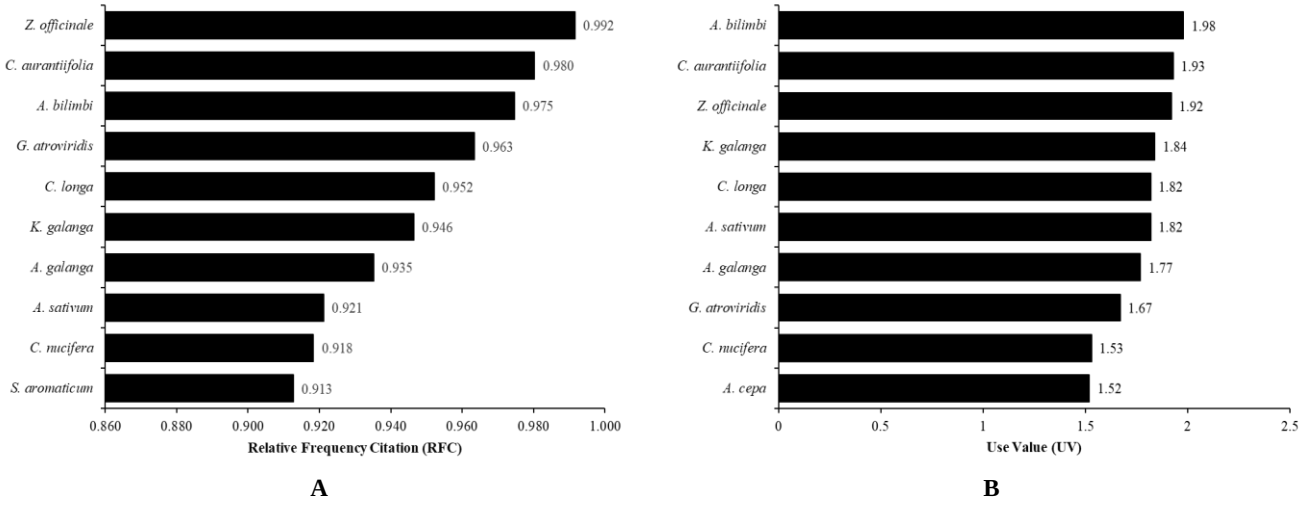


**Figure 2.** Plant species with the highest Relative Frequency Citation (RFC) (A) and Use Value (B)

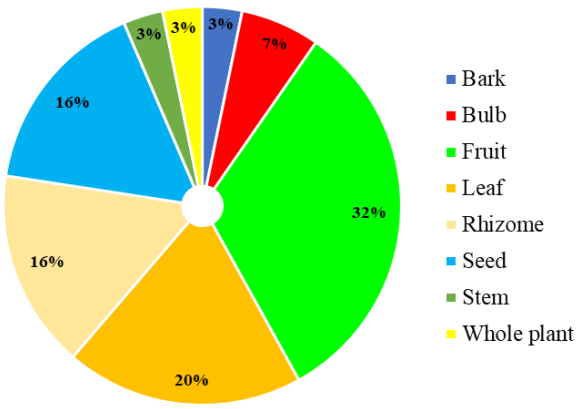


**Figure 3.** Plant part used in medicinal plants

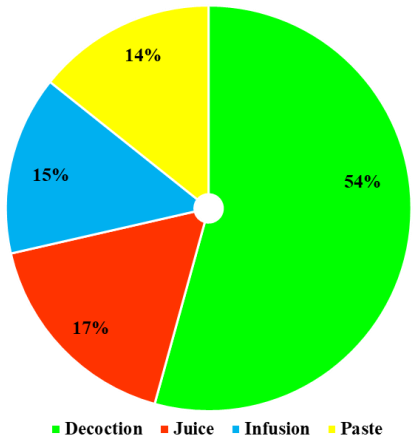


**Figure 4.** Preparation methods of medicinal plants

Fruits and leaves are the most commonly used plant part as an ethnomedicinal practice of the Kluet people. Fruits and leaves are high in flavonoids, alkaloids, saponins, and phenolic compounds, which may be responsible for the pharmacological effects observed by the Kluet people (Najda et al. 2014; Tantengco et al. 2018). The traditional use of various aerial plant parts as medicine, particularly fruit and leaves, can protect plants and ensure the sustainability of plant use. The preparation methods are commonly produced in the form of decoction, followed by juices, infusions, and paste, with unstandardized dosages. As a result, it is critical to establish the safety, effectiveness, and preservation of these highly valuable plants, as well as critically examine the claimed therapeutic values of the reported plant species.

The most treated diseases of the Kluet people using several medicinal plants are grouped into 28 pathological disorders. The highest number of plant species were used

against cough (13 species) followed by diarrhea (12 species), fever (11 species), hypertension (11 species), and flu (10 species), while the rest of the disease was represented with a variable number of fewer than 10 species (Figure 5).

During the fieldwork, 82.6% of informants mentioned that Kluet people had used more than one plant species to treat disease since ancient times, and most have one or more ethnomedicinal purposes. Traditional medicine is widely used to treat ailments such as coughs, stomachaches, diarrhea, fever, and other digestive problems (Suwardi et al. 2021). *Curcuma longa* is the most frequently mentioned medicinal plant. This plant is used by Kluet people to treat various diseases, including menstrual disorders, cough, flatulence, flu, and fever. *Curcuma longa* has anti-inflammatory, digestive, antibacterial, antimutagenic, antifungal, antiestrogenic, and anticarcinogenic properties (Labban 2014) that are useful in treating a variety of human diseases, as well as antioxidant compounds that protect against the effects of free radicals and boosts immunity (Qader et al. 2011). *Curcuma longa* has been widely cultivated in Asian countries for traditional food preparations and medicine (Awasthi and Dixit 2009; Labban 2014). *Averrhoa bilimbi* is another important medicinal species for the Kluet people, and it is used to treat a variety of ailments such as itches, boils, acne, cough, fever, obesity, sore throat, and hypertension. This species, in addition to being used as traditional medicine, is also widely used as a primary spice in the traditional cuisine of the South Aceh district (Syamsuardi et al. 2022).

**Information sources of people use herbs and spices for medicinal plants**

The Kluet people obtained information about using herbs and spices plants for traditional medicine from a variety of sources, including family/friends/neighbors, social media, surfing the web, television, books, and newspapers. Family/friends/neighbors provided the most information (40.5%), followed by surfing the web (20.8%), television (18.5%), social media (13.4%), book (6.3%), and newspapers (0.4%). Figure 6 depicts the distribution of information sources by age group and education level.

The majority of information about the use of herbs and spices plants as traditional medicine was obtained from family/friends/neighbors. The wealth of knowledge is rapidly dwindling as a result of the deaths of elderly people. As a result, the transmission of indigenous knowledge from generation to generation is being endangered and on the verge of extinction in our study area. The loss of traditional knowledge is influenced by the small proportion of elders who used to pass on their traditional knowledge to the younger generation, as the majority of them kept the knowledge secret (Yirga 2010; Okui et al. 2021). Furthermore, modernization is suspected of causing a decrease in the younger generation's interest in traditional medicine, resulting in a reduction in traditional knowledge among them. According to Sujarwo et al. (2014) and Navia et al. (2021), rapid technological advancements, particularly the internet, have resulted in the erosion of traditional knowledge among the younger generation. As a result, this traditional knowledge must be preserved, which can be accomplished by documenting it in written form and promoting traditional medicine systems through formal and non-formal education.

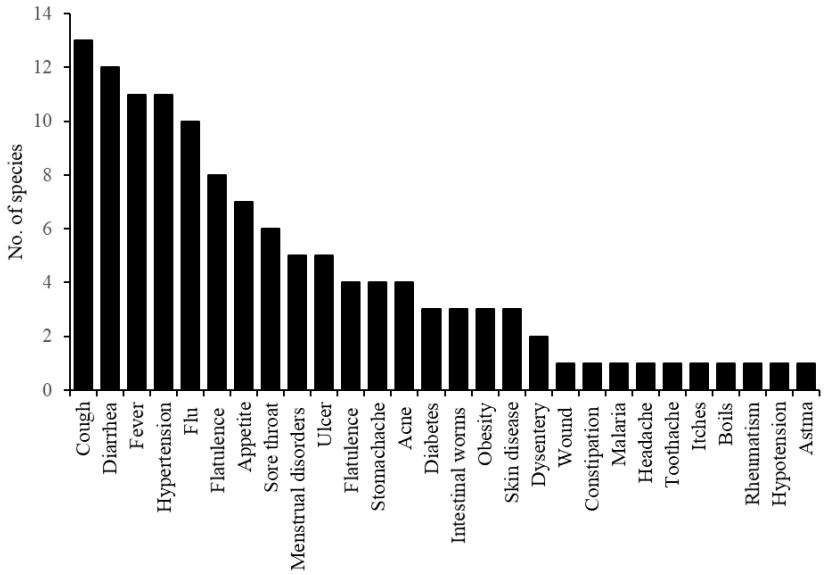


**Figure 5.** Number of plants used to treat various diseases

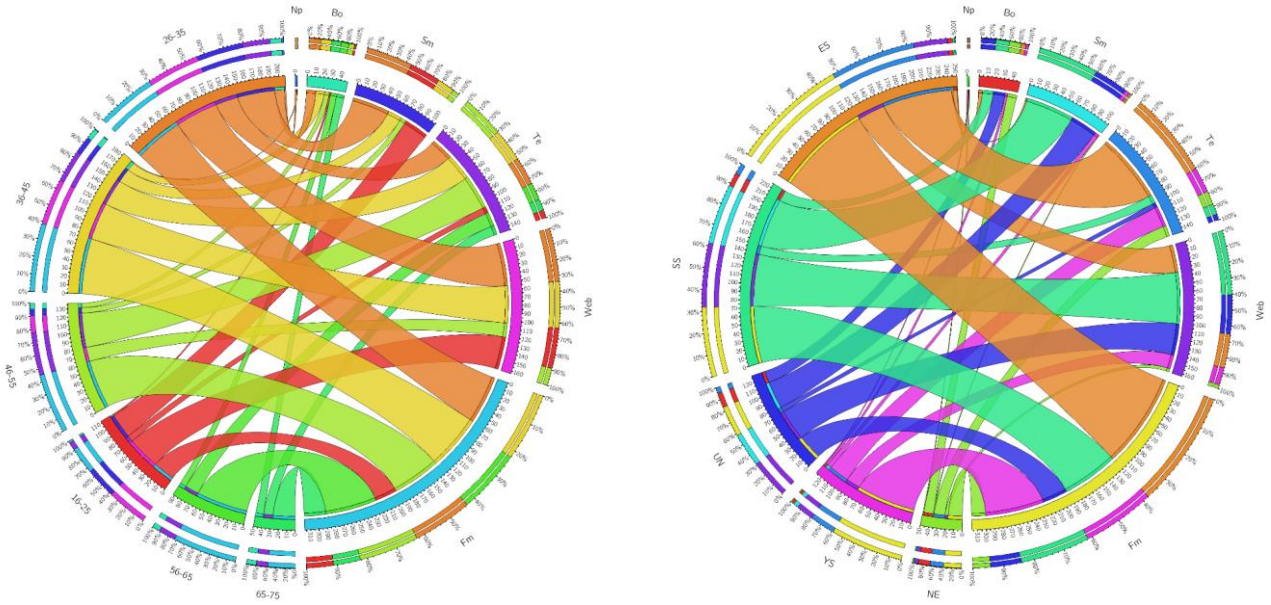


**Figure 6.** Distribution of six different information sources that people used to learn how to use medicinal plants for traditional medicine based on age group (A) and Educational level (B). Education level: No Education (NE), Elementary School (ES), Junior High School (YS), Senior High School (SS), University (UN); Source information: Newspaper (Np), Books (Bo), Television (Te), Social media (Sm), Surfing the web (Web), and Families/Friends/Neighbours (Fm)

Herbs and spices play an important role for people living in rural areas, including the Kluet people. Herbs and spices plants, in addition to being used in food processing, play an important role in traditional medicine. The loss of traditional knowledge in the use of herbs and spices in traditional medicine may endanger the future viability of these plants. Intensive cultivation allows for the application of new techniques to problems encountered in the production of medicinal plants (Raina et al. 2011). Cultivation under controlled growth conditions can boost active compound yields, which are almost always secondary metabolites, and ensure production stability (Chen et al. 2016). Good agricultural practices (GAP) for medicinal plants have been developed to regulate production, ensure quality, and facilitate standardization of herbal drugs (Chan et al. 2012) to ensure high quality, safe, and pollution-free herbal drugs (or crude drugs) by applying available knowledge to address various problems (Muchugi et al. 2008). Organic farming is gaining popularity due to its ability to create integrated, humane, environmentally, and economically sustainable medicinal plant production systems (Macilwain 2004). Organic farming is environmentally friendly because it relies on farm-derived renewable resources to maintain the biological processes of medicinal plants and the ecological balance of habitats (Chan et al. 2012). Organic fertilizer use continuously supplies soil nutrients and improves soil stability, which has a significant impact on medicinal plant growth and biosynthesis of essential substances. Organic medicinal plant farming is becoming more important in the long-term development and sustainability of medicinal plants (Macilwain 2004). Herbs and spices can be used sustainably to support food security, supply raw materials for medicines, and even as a source of household income through intensive cultivation activities. Moreover, efforts to document and promote herbs and spices plants must be systematic, both through formal and non-formal education sectors, in order to improve local knowledge and preserve traditional medical systems.

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