Education System and Traditional Knowledge of Medicinal Plants for Healthcare in Tengger Tribe, Argosari Village, East Java, Indonesia

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Abstract. Ethnomedicinal plants knowledge of the Tengger tribe is abundant, but efforts are needed to preserve it. Younger generation contributes greatly to the preservation of this traditional knowledge. Here we advance our fndings on traditional knowledge of medicinal plant from Tengger tribe, Argosari village and reveal the education system of their young generation, not only for conservation purposes, but also for further ethnopharmacological research. Data on traditional knowledge and education system of their young were collected from 2011 to 2020 in the Tengger tribe of Argosari. Information was obtained through semi-structured interviews and in-dept observation with informants who were selected using snowball sampling. This ethnomedicinal field study uses descriptive analysis and quantitative ethnomedicinal indices (SUV and ICF). We found 68 plant species from 38 families using various plant parts, preparation methods, and administration modes. The highest SUV was found in *Foeniculum vulgare* Mill. (0.87) and the highest ICF was observed in gastro-intestinal disorders category. The education system applied to the younger generation is through informal education delivered orally by the family (83.33%).

Keywords: Argosari village · Education system · Medicinal plants · Traditional knowledge · Tengger tribe

1 Introduction

Since antiquated civilizations, medicinal plants have been utilized by people as essential healthcare [1, 2]. Roughly, 65–80% of the world's populace in developing nations essentially utilize medicinal plants for their healthcare [3]. The practice of medicinal plants is growing rapidly due to low prices, limited accessibility of modern medicine, and the influence of cultural or social beliefs [4–6]. However, this traditional knowledge of medicinal plants is vulnerable to being degraded by the modern-western paradigm

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[7–9]. Therefore, efforts to preserve and document traditional knowledge and practices of medicinal plants in indigenous communities are urgently needed [10], especially in tropical countries [11–16].

Traditional knowledge of medicinal plants is an intangible cultural heritage that must be preserved [17]. The younger generation contributes greatly to the preservation of this traditional knowledge [18]. The younger generation's interest in traditional medicine concepts and practices is very low when compared to modern medicine [19]. The tendency of the decline of traditional knowledge in the younger generation to occur in various parts of the world, for example Africa [20], North America [21], South America [22], and Indonesia [23]. One of the biggest factors for the low level of traditional knowledge of the younger generation is the inadequate education system, thus failing to maintain the traditional knowledge inherited from their ancestors [24].

Indonesia has abundant medicinal plant resources, besides that it has more than 300 indigenous ethnic groups. The Tengger tribe is one of the indigenous communities in Java and lives in remote villages around Bromo Tengger Semeru National Park which have long been rich in medicinal plants [25]. This community creates a unique traditional knowledge of medicinal plants with its own cultural and religious theories. Due to the obstruction of the inheritance of traditional knowledge in the Tengger tribe, this knowledge only spreads within the same traditional elders, families, or regions. Therefore, ethnomedicinal field studies to document traditional knowledge and analyze education system on their young of Tengger tribe are necessary.

Over the last decade, documentation and ethnomedicinal field study of medicinal plants used by the Tengger tribe has been carried out. Recently Bhagawan and Kusumawati [26] documenting 30 species of medicinal plants for healthcare in only one village, namely Ranupani. Another ethnomedicinal field study was carried out in Ngadas Kidul village by Shalas et al. [27] and Jadid et al. [28] in Ngadisari village, which inventoried only a few species of medicinal plants. However, there is a lot of undocumented information from the Tengger community in other core villages, one of which is Argosari village. This village is far from the center of the cultural and religious rituals of the Tengger tribe, namely Mount Bromo. There is only one ethnomedicinal field study conducted by Bhagawan et al. [29], which only documented medicinal plants for sexual problems. Therefore, this study aims to document traditional knowledge and explore the education system of the young generation of the Tengger tribe in Argosari village, East Java, Indonesia.

2 Material and Methods

2.1 Study Area

This research took place at the Bromo Tengger Semeru National Park, East Java, Indonesia has high medicinal plant biodiversity and inhabited by the local Tenggerese community [30]. One core-village of Tengger, namely Argosari, was designated as the research location (Fig. 1). Argosari is about 135 km from Surabaya, the capital city of East Java. This village is located at 77.52° −89′23″ South 112.5° −113′22″ East, with a population of 3,397 people. Argosari has an area of 56.05 km2 and an altitude of 2,300 m above sea level (masl). This area is one of the highlands in Java.

Fig. 1. Map of the study area showing sampling site of Argosari village, Lumajang district, East Java, Indonesia.

2.2 Informant's Selection and Data Collection

The ethnomedical field survey was carried out continuously during the period between 2011–2020. Written ethical approval was obtained from the Lumajang district government (No. 070/124/427.917.11/2010) and the Bromo Tengger Semeru National Park office (No. S.720/21/BT.1/2010). Meanwhile, verbal requests were obtained from the customary head and village head. Information was collected from 30 traditional practitioners who use plants for their daily medicinal needs. The selection of informants was carried out using the snowball sampling method, as the key informant was the customary head of Argosari village (Dukun Pandhita). Data were collected through semi-structured interviews and in-depth observations, following the classical indications in ethnomedicinal field studies proposed by Heinrich et al. [8]. The semi-structured interviews were immediately documented in field notebooks, voice, and image recorders.

2.3 Plant Taxonomic Identification

The taxonomic identification of plants was carried out by the first author using the reference to the book Flora of Java. In addition, the scientific name of the plant is also determined by referring to the websites www.theplantlist.org and www.plantamor.com. Meanwhile, plants that could not be identified were photographed and herbariumed for scientific name identification by taxonomists at Materia Medika (Batu) and the Indonesian National Research and Innovation Agency (Purwodadi Botanical Gardens).

Table 1. Demographic data about informants of the study area

Variable	Category of Informants	Number of Informants	Percentage
Age	Adolescent (13–19 years)	1	3.33%
	Adult (20–40 years)	2	6.67%
	Elderly (>41 years)	27	90.01%
Education system and traditional knowledge source	Family	25	83.33%
	Neighbors	1	3.33%
	Peers	1	3.33%
	Traditional healers	3	10.00%
Educational background	Uneducated	7	23.33%
	Didn't pass elementary school	11	36.67%
	Elementary school graduated	9	30.01%
	Junior high school graduated	1	3.33%
	Senior high school graduated	1	3.33%
	University graduated	1	3.33%
Gender	Female	6	20.00%
	Male	24	80.00%
Main profession	Customary head	1	3.33%
	Farmer	23	76.67%
	Traditional healer	3	10.00%
	Village head	1	3.33%
	Village staff	2	6.67%

2.4 Data Analysis

The ethnomedicinal data obtained include demographic characteristics of the informants, plants used for traditional medicine, the most common disease categories, and education system on traditional knowledge of medicinal plants. Demographic characteristics of the informants and the education system were analyzed descriptively and percentages. Data on medicinal plants and disease categories were analyzed using quantitative ethnomedicinal indices based on Hoffman and Gallaher [31], including:

$$\mathrm{SUV} = \frac{\left(\sum \mathrm{UV}\right)}{\mathrm{n}} \tag{1}$$

Species Use Value (SUV) is used to determine plant species that are important for the treatment of specific diseases in local communities. Where ΣUV is the number of

reports of each medicinal plant species used by the informants and n is the number of informants interviewed for the medicinal plant species, and is calculated as follows Eq. (1).

$$\text{ICF} = \frac{(\text{nur} - \text{nt})}{(\text{nur} - 1)} \tag{2}$$

The informant consensus factor (ICF), estimates the level of agreement between interviewees about which plants to use for each desease category, and was calculated as follows Eq. (2). Where, nur is the number of citations of the medicinal plant in each category and nt is the number of citations of the uses given to the plant in each category (Table 2).

3 Results and Discussion

3.1 Informant's Demographic Characteristics

Table 1 shows the informant's demographic characteristics. Most of the informants (80.00%) were male, and this finding may not be separated from the fact that men are more concerned about the use of plants for health care needs. The table also reveals that

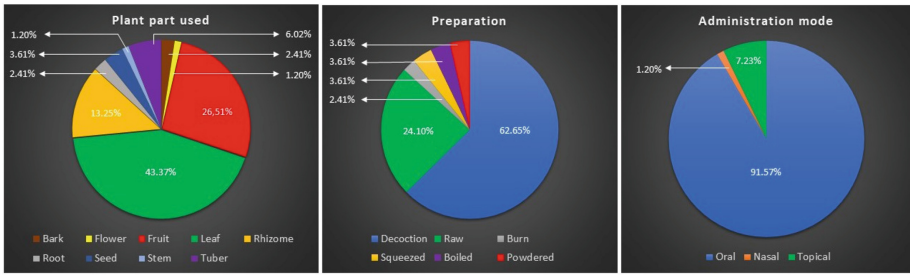

Fig. 2. Plant part used, preparation method, and administration mode of medicinal plants

Table 2. Disease categories, ICF, and health-related problems treated by medicinal plants in Argosari villagers

Desease Categories	ICF	Specified disease name
Dermatological diseases	0.85	Dry skin, Hair problems, Skin burn, Wound infection
Gastro-intestinal disorders	0.97	Diarrhea, Flatulence, Intestinal worms
Internal medical diseases	0.90	Dengue fever, Diabetes, Fever, High cholesterol, Hypertension, Insomnia, Kidney stones, Obesity, Low immune system, Nose bleeding
Reproductive health problems	0.87	Erectile dysfunction, Leucorrhea, Low breast milk production, Menstrual pain, Postpartum care, Syphilis
Respiratory problems	0.93	Asthma, Cough, Mouth ulcer
Skeleto-muscular disorders	0.96	Headache, Osteoporosis, Rheumatoid arthritis

most of the informants (37.33) are 40 to 89 years old, which indicates that the elderly are the main custodians of traditional knowledge. However, this is a serious threat to local wisdom because it can eventually disappear with the death of the older generation. Most of the respondents (36.67%) didn't pass from elementary school and their main occupation is a farmer (76.67%). This result is in accordance with the findings reported by Jadid et al. [28] in other villages in the same area.

3.2 Traditional Knowledge and Disease Categories

A total of 68 plant species belonging to 38 families, with traditional uses as herbal medicines for various illness. The most common medicinal plant family was Zingiberaceae (7 species were reported). Our findings regarding the dominant use of the Zingiberaceae family in Argosari village are in line with findings in other highland areas of Java [16]. The reason for the high level of ethnomedicinal plants from the Zingiberaceae family in our area is due to their widespread existence with a number of traditional uses known to local informants. Additionally, the Zingiberaceae family is abundantly distributed across the study area.

The most widely used plant parts were leaves (41.32%), while fruits (26.51%), rhizomes (13.25%), tubers (6.02%), seeds (3.61%), root and bark (2.41%), flower and stem (1.20%) were also citation (Fig. 2). A similar study conducted in the highlands of Java also reported that ethnic populations mostly use leaves as traditional medicine for primary health care, including on the northern slopes of Mount Wilis [16], the southern slopes of Mount Merapi [32, 33], and Mount Gede Pangrango [34]. The frequency of plant parts used in different areas depends on the sharing of traditional knowledge and the availability of plants in the area [35]. According to Zahoor et al. [36], the reason why leaves are more widely used is because they are easier to collect than other plant parts and are easy to process for the preparation of plant-based medicines. In addition, leaves tend to contain more secondary metabolites than other parts of the plant [37].

Herbal preparations involve various preparation methods. The preparation methods documented were classified into 6 groups. The most prominent herbal formulation method was decoction (62.65%) followed by raw (24.10%), meanwhile boil, powder, and squeeze have the same proportion (3.61%) (Fig. 2). Decoction is the predominant method of herbal preparation, similar results are documented from the surrounding area [27, 28, 38, 39]. The frequent preparation of decoction may be due to its easy preparation and the higher concentration of phytochemical compounds. Therefore, herbal decoction is more popular among local people. Furthermore, the mode of administration is mostly oral. It is closely related to the diseases being treated.

A total of 29 illness belonging to six desease categories are cataloged in Table 3. Disease categories were grouped according to ICD-11 [40] with minor modifications and consideration of emerging diseases in the study area. These categories include: dermatological diseases, gastro-intestinal disorders, internal medical diseases, reproductive health problems, respiratory problems, and skeleto-muscular disorders. Our findings are similar to those of Jadid et al. [28] and Bhagawan and Kusumawati [26] who conducted ethnomedicine research in other villages, furthermore that it was similar to ethnomedicine research in other highlands of Java [16, 32].

3.3 SUV and ICF Analysis

The results showed that *Foeniculum vulgare* citation with the highest SUV (0.87). As shown in Table 3, other plant species that have a high SUV are *Prunus persica, Acorus calamus, Plantago major, Piper batle, Curcuma xanthorrhiza, Pimpinella pruatjn, Bidens pilosa, Alyxia* reinwardtii, and *Zingiber officinale.* Medical plants with superior SUVs reflect the importance of cultural values in a local community [41]. In

Table 3. Ten medicinal plants used by the people of Argosari with the highest SUV.

Species	SUV	Local name	Family	Diseases treated	Preparation, Administration	Part use
Foeniculum vulgare Mill.	0.87	Adas	Apiaceae	Fever, Flatulence, Headache, Leucorrhea, Postpartum care	Decoction, Oral	Leaf
Prunus persica (L.) Batsch	0.80	Jambu wer	Rosaceae	Diarrhea, Flatulence	Decoction, Oral	Fruit
Acorus calamus L.	0.67	Dringu	Acoraceae	Fever, Flatulence, Headache	Decoction, Oral	Leaf
Plantago major L.	0.67	Sri pandak	Plantaginaceae	Fever, Erectile dysfunction, Syphilis	Decoction, Oral	Leaf
Piper betle L.	0.67	Sirih	Piperaceae	Erectile dysfunction, Leucorrhea, Menstrual pain, Syphilis	Decoction, Oral	Leaf
Curcuma xanthorrhiza Roxb.	0.57	Temulawak	Zingiberaceae	Leucorrhea, Menstrual pain, Postpartum care	Decoction, Oral	Rhizome
Pimpinella pruatjan Molk.	0.57	Purwoceng	Apiaceae	Erectile dysfunction	Decoction, Oral	Root
Bidens pilosa L.	0.57	Sempretan		Erectile dysfunction, Fever, Syphilis	Decoction, Oral	Leaf
Alyxia reinwardtii Blume	0.57	Pulosari	Apocynaceae	Erectile dysfunction, Postpartum care	Squeezed, Topikal	Bark

(*continued*)

Table 3. (*continued*)

Species	SUV	Local name	Family	Diseases treated	Preparation, Administration	Part use
Zingiber officinale Rosc.	0.50	Jahe	Zingiberaceae	Leucorrhea, Menstrual pain, Postpartum care	Decoction, Oral	Rhizome

addition, these plants have the potential to be analyzed for their phytochemical content and pharmacological activity [42].

The highest ICF value appears in the category of gastro-intestinal disorders. The reason why the relatively higher number of medicinal plants used by the Argosari community to treat gastrointestinal complaints can be attributed to the high prevalence of this disorder in the study area. Disorders related to gastro-intestinal complaints are reported to be one of the diseases in the highlands of Java which is known for its high morbidity [16, 26, 28].

3.4 The Education System of Their Young Generation

The difference in the educational background of the Argosari community is inversely proportional to the level of traditional knowledge (Table 1). This proves that the educational background of the Tenggerese does not affect the level of local wisdom it has. This is because the education obtained by the community does not provide information about local knowledge of traditional medicinal plants. Our findings are similar to other ethnomedicinal studies in Indonesia [23, 43], where traditional knowledge is not affected by education level caused by socio-cultural changes.

This study revealed that most of the knowledge about medicinal plants was mastered by older members (>40 years). It finds the fact that traditional knowledge is concentrated, so it is relatively difficult to transfer it from the parents to the younger generation. This may be related to the waning interest of the younger generation in local wisdom. Different ethnomedicinal studies in Indonesia show that knowledge of medicinal plants and transfer of knowledge to the younger generation have been influenced by modernization and environmental changes [7, 23].

The traditional knowledge of the Tenggerese is obtained from the older generation and passed on to the younger generation through the informal education system. The majority of the informal education system is delivered to youth orally by their family members (83.33%). The involvement of traditional healers as a source of traditional knowledge is also relatively high, at 10.00%. However, the erosion of ethnomedicine knowledge among the youth of the Tengger tribe cannot be underestimated. In order to maintain ethnomedicine knowledge among young people, there needs to be a deliberate program of government and non-governmental organizations that incorporate local content into the formal education curriculum.

4 Conclusion

This study reports on traditional ethnomedical knowledge and education systems in younger generation of the Tengger tribe, Argosari village in East Java. Among the 68 plant species belonging to the 38 families reported, Zingiberaceae is the most widely used family in the area. The leaves are the favorite part of the local community. Gastrointestinal disorders are a category of diseases that are mostly treated using medicinal plants. The most popular medicinal plant is *Foeniculum vulgare* Mill. With an SUV of 0.87. The education system applied to the younger generation is through informal education delivered orally by the family. In this way, we have collected significant basic data regarding the traditional knowledge of medicinal plants for primary healthcare, henceforth ready for further phytochemical and pharmacological investigations leading to the discovery and development of natural drugs. Meanwhile, the findings of the education system for their younger generation about medicinal plants serve as a guide for the preservation of traditional knowledge.

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Competing Interests. The authors declare that they have no competing interests.

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