BIODIVERSITAS
Volume 22, Number 1, January 2021
Pages: 386-392

ISSN: 1412-033X
E-ISSN: 2085-4722
DOI: 10.13057/biodiv/d220147

Ethnobotanical study of medicinal plants used for maintaining stamina in Madura ethnic, East Java, Indonesia

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Manuscript received: 4 November 2020. Revision accepted: 27 December 2020.

Abstract. *Fathir A, Haikal M, Wahyudi D. 2021. Ethnobotanical study of medicinal plants used for maintaining stamina in Madura ethnic, East Java, Indonesia. Biodiversitas 22: 386-392.* The use of herbal medicine that expands rapidly across the world opens a lot of opportunities for drug exploration and discovery through ethnobotanical study. Therefore, countries with high level of biological and cultural diversity like Indonesia have great opportunities to achieve this goal, and even Indonesia has its own term for a group of herbal medicine, called *jamu*. This research aimed to conduct ethnobotanical study of jamu used by Madura ethnic in Pamekasan District, Madura Island, Indonesia by focusing on the specific use of it for maintaining stamina. Structured interviews with purposively selected respondents of 80 knowledgeable elder women were performed to gain insights about the medicinal herb used by them. Our study found 10 recipes of jamu used by Madura ethnic for maintaining stamina. These recipes contain 19 medicinal plants belonging to 16 genera and 11 families, with the family of Zingiberaceae contributed to the largest share of species used with eight species. Turmeric (*Curcuma longa*) was the species with the highest use-value by the respondents and the rhizomes were the most favorable plant organ used. In conclusion, the diversity of medicinal plants used by Madura ethnic could contribute to the development of new plant-based drugs, especially those for maintaining stamina.

Keywords: Ethnobotany, herbal medicine, stamina, turmeric, Zingiberaceae

INTRODUCTION

Medicinal herbs play a crucial role to serve as primary health care system especially in remotes areas in developing countries where herbal medicine is the only medication available (Vitalini et al. 2013; Hoang et al. 2019). More than 80% of the world's total population relies on herbal medicine (Alsarhan et al. 2012), and the users continue to expand rapidly (Ekor 2014). In recent years, the use of herbal medicine shows a decreasing trend in developing countries, but it has been starting to embrace widely in many developed countries, especially in Europe (Braun et al. 2011).

The use of medicinal herbs has been traditionally started since prehistoric times by applying them in conventional manner and then being transferred from generation to generation (Yuan et al. 2016). As human civilization develops, the interaction of humans and plants has become intense, resulting in the accumulation of knowledge and expertise of human in the use of medicinal herbs (Young et al. 2020). From scientific perspective, the interaction between human and plant throughout time is documented in ethnobotany studies (McClatchey et al. 2009; Suntar 2019).

Many ethnobotanical studies become pivotal references in the discovery of new pharmacological products (Yuan 2016) and contemporary drugs (Calzada and Bautista 2020). This condition highlights the importance of ethnobotany in every country globally, especially in a country with high plant biodiversity and cultural diversity like Indonesia. Indonesia ranks second in terms of biodiversity and cultural diversity globally, implying that the country Indonesia has a significant opportunity to discover a new drug through ethnobotanical study. Currently, over 6,000 species among 40,000 identified plant species have been recognized to be a potential for herbal medicine (Elfahmi et al. 2014).

Many Indonesian people call herbal medicine as "*jamu*" (Fahmi et al. 2014; Rahardjanto et al. 2019). Jamu is a word in Javanese tribal that has a meaning of traditional herbal produced from plant matters used for medicinal purposes, and the term has been adopted into Bahasa Indonesia with similar meaning. *Jamu* plays an essential role in healthcare for more than 80% of Indonesian people including for Madura Tribe (Mangestuti et al. 2007; Holil 2015; Abdi et al. 2017). Local people of Madura ethnic consume jamu for both before doing daily activities and when fell a bit under the weather. There are two types of jamu in Madura ethnic, i.e. commercialized jamu produced by small-sized home industries preserved in fresh and liquid form, and non-commercialized jamu made and produced by every family based on prescription inherited from generation to generation and for their own consumption (Roosita et al. 2008, Limyati and Juniar 1998). The majority of non-commercialized jamu made by Madura ethnic is jamu for maintaining stamina and health.

The composition of jamu is complex, often not only limited to medicinal plant but also other ingredients are

also used. Besides the composition, the method of preparation of jamu also varies among sellers or families. While there is extensive knowledge about jamu by Javanese, where the term of jamu is originated, the information of the variety in the composition and preparation methods of jamu used by Madura ethnic are rarely explored. Therefore, this research aimed to conduct ethnobotanical study of jamu used by Madura ethnic in Pamekasan District, Madura Island, Indonesia by focusing on the specific use of it for maintaining stamina and health. We expected the results of this study can serve as baseline information in the exploration of new drugs for maintaining health and stamina.

MATERIALS AND METHODS

Study area

This study was conducted in Pamekasan District, which is located in the center of Madura Island, and the focus area was the Sub-districts of Pademawu, Proppo, Galis, Tlanakan, and Palengaan (Figure 1). Pamekasan is one of four districts in Madura Island that belongs to East Java Province, Indonesia, approximately 120 km east of Surabaya City, the capital of East Java. In the east, Pamekasan is bordered with Sumenep District, in the west with Sampang District, in the north with Java Sea and in the south with Madura Strait. Pamekasan District has thirteen sub-districts with a total population of 854,198 in 2018 (BPS 2019).

Like most parts of Indonesia, Pamekasan has two seasons, i.e. the dry season and rainy season. The dry season begins in June until October whereas the rainy season spans from November to May. Most inhabitants in Pamekasan are Madura ethnic and speaking in local Madurese language.

Ethnobotanical data collection

Ethnobotanical data were collected between June and July 2020 using purposive sampling method to selected knowledgeable elders. Structured interviews were conducted focusing only on women more than 30 years old and have personal experience in self-medication using herbal medicine in their family. A total of 80 women that made jamu for their families was identified in the initial phase of the study. However, only 50 respondents (10 respondents in every sub-district) were selected proportionally for data collection. Personal information of participants including age, education level, and occupation was recorded to identify the variation of the respondent's background.

Specimen collection and identification

The plant specimens were collected onsite during interview and photographed for identification. The identification of the specimen was carried out based on the interview with participant and crosschecked using Backer and Bakhuizen v.d. Brink (1968).

Data analysis

Descriptive analysis was employed to analyze the ethnobotanical data on the reported medicinal plant. Species Use Value (SUV) was used to know the importance of the species for Madura ethnic. SUV was determined based on the equation proposed by Hoffman and Gallaher (2007) and formulated as follows:

$$SUV = \frac{\sum UVis}{(n_i)}$$

Where; ΣU is use-value or particular species and n_i is total of a number of participants (Zenderland et al. 2019).

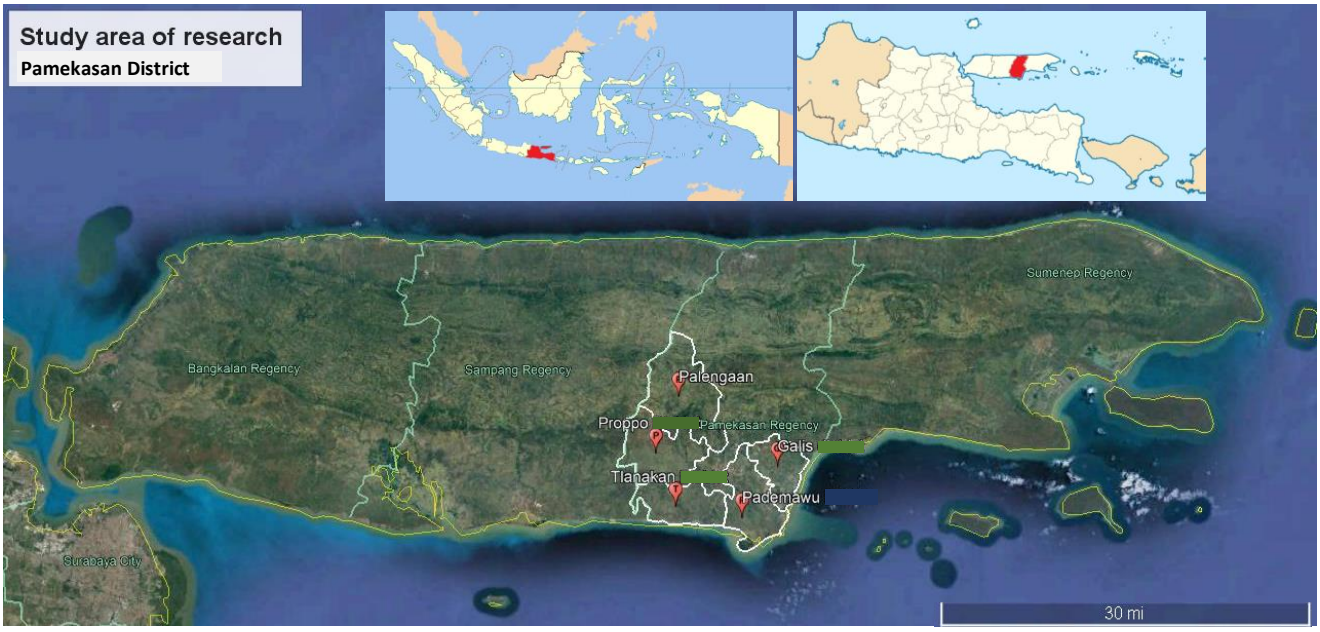

Figure 1. Map showing the study area in Pamekasan District, Madura Island, East Java Province, Indonesia

RESULTS AND DISCUSSION

We found ten (10) recipes of jamu or herbal medicines used by Madura ethnic for maintaining stamina. These recipes consisted of 19 species of medicinal plants belonging to 16 genera and 11 families. Total of 8 species was the member of the family Zingiberaceae, two species were Rubiaceae and the remaining were Alliaceae, Apiaceae, Poaceae, Fabaceae, Phyllanthaceae, Caricaceae, Meliaceae and Asteraceae (Table 1).

The dominance of Zingiberaceae in herbal medicine has been reported in previous studies. Jadid et al. (2020) revealed that Zingiberaceae is the dominant family of plants used by the Tengger tribe for internal diseases as well as diseases related to respiratory problems. In many parts of Southeast Asia, plants from the family of Zingiberaceae are also widely known as medicinal herbs (Kumar et al. 2013), for example, to cure dermatological disorder and gastrointestinal problems (Daimei and Kumar 2014). The possible reason why Zingiberaceae becomes the primary ingredient for herbal is the high diversity and abundance in tropical countries (Widyowati et al. 2018). Besides, the high bioactive phytochemical contents in Zingiberaceae (Kumar et al. 2013) maybe also the reason for the highly use of this family. Apart from being a medicine, Zingiberaceae is also widely used for spices, dyes, and perfume (Zhou et al. 2018).

One of the medicinal plants from Zingiberaceae, namely ginger (*Zingiber officinale*), has been launched as *Fitofarmaka* (phytomedicine) in Indonesia (Elfahmi et al. 2014), and is recognized as a standardized herbal medicine in Indonesia. Phenolic gingerol and paradol is the primary content in ginger that has been proved as anti-carcinogenic. In vivo study has been performed and confirmed that ethanolic extracted from ginger could treat human colon cancer and breast cancer (Prasad and Tyagi 2015). Furthermore, ginger extracts demonstrated effective antioxidant properties and their consumption may reduce or delay the progression of diseases that oxidative stress (Tohma et al. 2017).

Curcuma is the genus from Zingiberaceae that shared the largest contribution as medicinal plants used as jamu for maintaining stamina by Madura ethnic. Curcumin is the main phenolic constituent of the genus, especially in turmeric rhizome. Curcumin is widely known as modulators of various signaling molecules, including inflammatory molecules, transcription factors, protein reductase, etc. (Gupta et al. 2012). Related to maintaining stamina, drink supplemented with curcumin has proved to increase grip strength and endurance performance and significantly decreased lactate and ammonia after physical challenge (Huang et al. 2015).

Various plant organs within one plant species may have a different effect on human body, as such different plant organ is used differently by Madura ethnic for particular purpose related to maintaining stamina. Some recipes use rhizome and leaf only, but other recipes might use the whole plant. A total of 60% of the composition of jamu for maintaining stamina consists of rhizome, followed by leaf (29%), whole plant (3%), tuber (3%), fruit (3%), and seed (2%) (Figure 2).

Rhizome becomes the most used organ because many studies reported that it has a higher content of total flavonoid and phenolic (Ghasemzadeh et al. 2016). This finding is also similar to the study by Jima and Megersa (2018) in which rhizome and root are the most widely used organs of medicinal plants used to treat human diseases. The finding was also reported by Yineger and Yewhalaw (2007) in which a total of 42% rhizome was used as a healer in Ethiopia.

Table 1. Medicinal plants used by Madura ethnic, East Java, Indonesia for maintaining stamina and health

Local name	Common name	Scientific name	Family	Uses in recipe
Temu hitam	Black turmeric	*Curcuma aeruginosa* Roxb.	Zingiberaceae	2
Temulawak	Javanese turmeric	*Curcuma zanthorrhiza* Roxb.	Zingiberaceae	4
Kunyit putih	White turmeric	*Curcuma zedoaria* (Christm.) Roscoe	Zingiberaceae	2
Kunyit kuning	Turmeric	*Curcuma longa* L.	Zingiberaceae	7
Lengkuas	Siamese ginger/ galangal	*Alpinia galanga* (Blume) K.Schum.	Zingiberaceae	2
Kencur	Aromatic ginger	*Kaempferia galanga* L.	Zingiberaceae	1
Jahe	Ginger	*Zingiber officinale* Roscoe	Zingiberaceae	4
Temu kunci	Finger root	*Boesenbergia rotunda* (L.) Mansf.	Zingiberaceae	2
Kesembukan	Chinese flower	*Paederia foetida* L.	Rubiaceae	2
Mengkudu	Great morinda	*Morinda citrifolia* L.	Rubiaceae	1
Bawang putih	Garlic	*Allium sativum* L.	Alliaceae	1
Jeringau	Sweet flag	*Acorus calamus* L.	Acoraceae	1
Serai wangi	Citronella grass	*Cymbopogon nardus* (L.) Rendle	Poaceae	2
Asam jawa	Tamarind	*Tamarindus indica* L.	Fabaceae	3
Meniran	Leafflower	*Phyllanthus urinaria* L.	Phyllanthaceae	1
Pepaya	Papaya	*Carica papaya* L.	Caricaceae	2
Mimba	Nimtree/Indian lilac	*Azadirachta indica* A. Juss.	Meliaceae	2
Beluntas	Indian fleabane	*Pluchea indica* L.	Asteraceae	2
Ketumbar	Coriander	*Coriandrum sativum* L.	Apiaceae	1

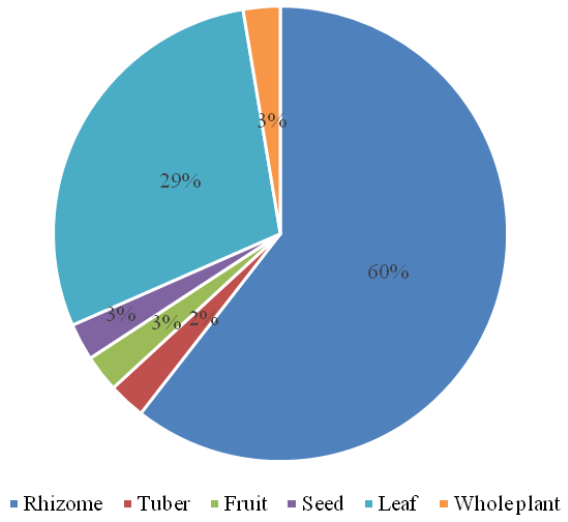

Figure 2. Percentage of plant organ used as jamu or herbal medicines for maintaining stamina by Madura ethnic, East Java, Indonesia

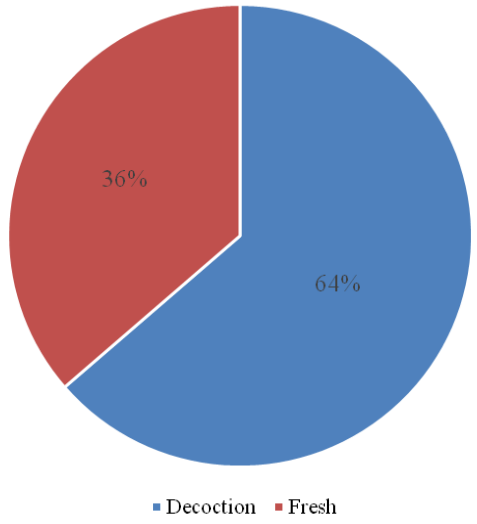

Figure 3. The preparation method of jamu or herbal medicines for maintaining stamina by Madura ethnic, East Java, Indonesia

Most of the rhizomes used as jamu by Madura Ethnic are from plants belongs to the family of Zingiberaceae. It is widely known that secondary metabolite of Zingiberaceae is higher in rhizome than in its leaves and flower. Furthermore, it is a common method by Madura Tribe to estimate the optimal age of the plant used for medicinal uses by measuring the length of the rhizome. A study found that at the age of 3-9 months, plants produce more optimal rhizome and higher secondary metabolite contents plants at the age of 1-3 months (Gasemzadeh et al. 2016).

Leaves are also the common plant organ used as herbal medicine in Indonesia (Jadid et al. 2020) and also in other countries such as Vietnam (Nguyen et al. 2019), Ethiopia (Jima and Megersa 2018), and Greece (Tsioutsiou et al. 2019). The rationale for the high use of leaves for herbal medicine is because the easy handling and extraction of leaves in a certain amount do not disturb plant growth compared to when using stem, root, and whole plant (Zheng and Xing 2009). Moreover, leaves contain more diverse plant secondary metabolites (Zahoor et al. 2018) was also another reason.

Our study found that 64% of the recipes documented were prepared by decoction (pounded and filtered), while the rest (36%) were freshly consumed (Figure 3). For fresh preparation, plant organ is finely crushed and pounded. The resulting paste is squeezed out and the extract then added with additional material including egg and palm sugar (Table 2). The results of structured interviews showed that there was a variety of methods and skills when preparing jamu for maintaining stamina. Since jamu is an oral intake, boiled in the water was the majority of the preparation technique of jamu. The results also showed that most of the recipes were prepared by combining several plant species. The majority of the recipes used fresh plants, since fresh materials are considered more effective as the contents are not lost before use compared to the dried forms. Some ingredients were also added, such as egg, palm sugar, sugar, salt, and honey (Table 2).

Decoctions are done by boiling herbs into water for a period of time. Decoctions are usually conducted when preparing medicinal herbal that use hard plant materials, such as bark and root (Ghiware et al. 2010). Medicinal herbs prepared using decoction has usually longer stored time than those that freshly consumed. It is likely the concentration of active compounds in the jamu prepared using decoction method is different with herb consumed solely to accord with the finding by Kumadoh and Ovori-Kwakye (2017), indicating the effect of decoction on active components. However, further research is needed to verify this statement.

Concerning the dosage, the respondents of this study used various unit of measurement, for example, finger length, the length of rhizome, spoon and cup of water. However, some respondents only mentioned the ingredients without explicitly mention the dosage. The lack of standardized dosage is one of the drawbacks of traditional medicinal plants (Jima and Mergesa 2018). Unstandardized measurement was also reported by Yirga (2010) who said that local people of Alamata, Southern Tigray, Northern Ethiopia used finger length, the number of leaves, seed and fruit even length of root for making the traditional healer. Although this measuring was not standard, the extent of the knowledge of conventional medicine practice based on medicinal plants should be documented through botanical surveys.

This study revealed that Species Use Value (SUV) of medicinal plants used by Madura ethnic for maintaining stamina varied from 0.0909 to 0.6364 (Figure 4). The highest SUV was obtained by *Curcuma longa* (turmeric), followed by *C. zanthorrhiza* (Javanese turmeric) and *Zingiber officinale* (ginger) (Figure 4). Previous study also revealed that turmeric was frequently used as medicinal plant, especially for maintaining stamina (Suhet et al. 2020). Laboratory research on turmeric revealed that

curcumin in turmeric increases performance when doing exercises and decreases physical fatigue (Huang et al. 2015). Besides maintaining stamina, turmeric is also used for other medicinal purposes, including measles, herpes, mumps, contraception, nose bleed, dental and oral care, ear disease, and mental disorder (Subositi and Wahyono 2019).

Table 2. The composition of ingredients and preparation method of jamu for maintaining stamina by Madura ethnic, East Java, Indonesia

Recipe	Ingredient	Preparation
1	A piece of sweet flag rhizome 2 pieces of garlic	Peel the garlic skin; Wash the sweet flag rhizome and garlic; Crush the sweet flag rhizome and garlic finely and add with the water up to 450 ml; Filter the extract into the glass and the extract is ready to drink; Drink twice in a week
2	A piece of black turmeric A piece of Javanese turmeric A piece of white turmeric A piece of turmeric	Wash all material, Crush all material finely; Add the water up to 800 ml; Squeeze out the extract; The flow-through then boil; Pour in a glass and drink while warm; Drink one in a day
3	A fruit of great morinda (cut into pieces) A piece of galangal (cut into pieces) 1 piece of aromatic ginger 1 piece of ginger 2 spoons of coriander 2 spoons of honey	Boil 800 ml of water; Put all ingredients except honey into the boiled water; Boil until the ingredients start to smell good and the water has shrunk; The decoction is then filtered[Add honey; Drink while warm; Drink twice a day
4	5 pieces of Fingerroot 3 pieces of galangal 3 pieces of turmeric as long as a finger length 4 piece of Javanese turmeric 2 pieces of ginger 2 pieces of the stem of citronella grass	Peel all of the skin of all ingredients; Wash all ingredients; Cut into a small piece of all ingredients (thickness 0.2-0.4 cm); Left the ingredients dry about 1-2 days; Boil all ingredients into 750 ml water and add palm sugar. Lift the decoction if the watercolor has changed; Filter the decoction and the jamu is ready to drink; Drink twice a day
5	A piece of turmeric Tamarind Young leaves of tamarind Palm sugar	Wash all ingredients; Cut into a piece of turmeric; Crush all ingredients; Put the ingredients into boiled 500 ml of water; Filter the extract and the jamu is ready to drink; Drink 3 times a day
6	Javanese turmeric Black turmeric Leafflower Leaf of papaya Leaf of nimtree Indian fleabane Turmeric Leaf of Chinese flower Tamarind Salt	Wash all ingredients with water; Crush all ingredients; Add 250 ml of water; Stir until homogeneous; Filter the ingredients and add salt; Pour the herbs into a glass then drink; Drink once a day
7	Javanese turmeric Black turmeric Palm sugar	Wash all ingredients; Cut all ingredients; Put the ingredients into 750 ml of water; Add palm sugar; Boil the water while stirring until homogeneous; Filter the mixture; Put into a glass of water; Drink once a day
8	Javanese turmeric Black turmeric Leaves of Chinese flower Leave of Indian fleabane Leaf of papaya Tamarind	Wash all ingredients; Crush all ingredients; Filter the mixture; Add salt and tamarind; Drink one a day
9	Turmeric Egg of native chicken Sugar	Grate turmeric then squeeze and take the juice (turmeric juice); Add chicken egg yolk and sugar; Stir until homogenous; Drink once a day
10	Turmeric Citronella grass Fingerroot Ginger	Wash all ingredients; Crush all ingredients until smooth; Add 800 ml of water and filter the mixture; Boil the flow-through; Put the extract into a glass and the jamu is ready to drink; Drink once a day

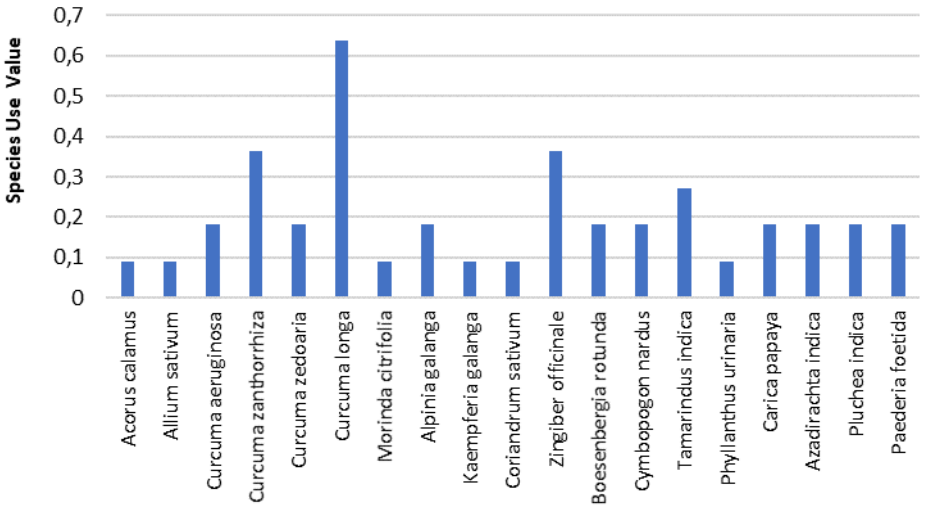

Figure 4. Species Use Value (SUV) of medicinal plants used in jamu for maintaining stamina by Madura ethnic, East Java, Indonesia

Other medicinal plants used in jamu for maintaining stamina by Madura ethnic were sweet flag (*Acorus calamus*) and garlic (*Allium sativum*) that also proved to increase fertility in women (Muchtaromah et al. 2020). Furthermore, garlic was also reported to have antibacterial, antiviral and antifungal activity (Arekemase et al. 2013).

In conclusion, there is a variety of recipes of jamu or herbal medicine used by Madura ethnic for maintaining stamina. Zingiberaceae was the family with the largest number of species used in such recipes as jamu. The majority of recipes used more than three plant species, indicating the importance of plant biodiversity as the primary source when developing a new herbal drug.

ACKNOWLEDGEMENTS

The author gratefully thanks the Ministry of education and Culture for funding this research through a grant with number 8/E1/KPT/2020 and contract number 083/SP2H/LT/DRPM/2020, 039/SP2H/LT-MONO/LL7/2020,0199/UIM/MONO/III/2020. The author also thanks to ethnobotany group in Universitas Islam Madura for help in collecting data.

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