

# Ethnobotanical investigation of spice and condiment plants used by the Taming tribe in Aceh, Indonesia

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**Abstract.** Navia ZI, Audira D, Afifah N, Turnip K, Nuarini, Suwardi AB. 2020. Ethnobotanical investigation of spice and condiment plants used by the Taming tribe in Aceh, Indonesia. *Biodiversitas* 21: 4467-4473. Communities are inseparable from plants in meeting their daily food needs, especially plants as supplementary food. The aim of this study was to investigate of ethnobotany and economic value of spice and condiment plants used by Tamiang tribe in Aceh, Indonesia. A field survey was conducted in three sub-districts, namely Rantau, Seruwai, and Bendahara, Aceh Tamiang District involved 150 respondents (50 individuals from each sub-district) were randomly selected. A total of 31 spices and condiments plants consisting of 26 genera and 18 families was recorded in the study area. Fruits (36%) are the most commonly used parts of plants for spices and condiments, followed by leaves (16%), seeds (13%), rhizome and flower (10% respectively), bulb (6%), and stem and bark (3% respectively). These species were used for preserving traditional cuisines such as *bubur pedas*, *ikan cang rebong*, and *anyang*. *Capsicum annum* L has high economic value. The Tamiang tribe has always preserved traditional knowledge of the use of various spices and condiment plants for traditional cuisine.

**Keywords:** Aceh Tamiang, biodiversity, economics, Tamiang tribe, traditional cuisine

## INTRODUCTION

Spices and condiments plants are biological resources that have played an important role in human life for a long time, have been applied to the natural plant or vegetable products and mixtures of seeds in whole or ground form to enhance the flavor or aroma of food or drinks (Rathore and Shekhawat 2008; Gadegbeku et al. 2014). Approximately 400-500 species of spices are found in the world and 275 species are found in Southeast Asia (Hakim 2015). Sixty-nine of spice plants were used by local communities in Aceh Jaya district (Aqilah 2017), 34 species in Banyumas (Apriliyani et al. 2014), and 19 species by Kanayatn Tribe in Kalimantan (Manangka et al. 2017). Several important species, including *Amomum compactum* Sol. ex Maton, *Cinnamomum verum* J. Presl, *Syzygium aromaticum* (L.) Merr. & L.M.Perry, *Zingiber officinale* Roscoe, *Myristica fragrans* Houtt., and *Piper nigrum* L. are important spices plants in Indonesia. In addition, condiments are a mixture of herbs and spices blended in a liquid form (Manoj et al. 2004; Kumar and Singh 2014). Spices are therefore plants or plant products that are usually added during cooking or preparation, while condiments are plants or plant products that are added to a table of prepared food (Agize 2014; Gadegbeku et al. 2014). Spices and condiments are commonly aromatic and pungent (Achinewu et al. 1995) and are mainly used for improving the color, fragrance, and taste (Bharali et al. 2017).

The Tamiang tribe is a tribe living in the Aceh Tamiang region, Aceh Province, Indonesia were used various spices

and condiments plants as food, medicine, and traditional ceremonies. These species have been found either wild or cultivated in farmland or the home garden. In general, the Tamiang tribe uses different species of spices and condiments as ingredients in traditional dishes such as *bubur pedas*, *ikan cang rebong* and *anyang*. This food is distinctive and rich in spices, salty, and spicy and is usually served at traditional cuisine. Aqilah (2017) reported that Aceh province rich in traditional cuisine such as *gule plik*, *i bu pedah*, *kuah belangong*, *bu minyek*, *asam ue*, *pet udeng*, *gule boh panah*, *sie masak mirah*, *tumeh eungkot muloh*, *ayam tangkap*, *urap on peugaga*, *keumamah*. These foods are known to be rich in spices (Arif et al. 2013). In principle, the culinary richness and uniqueness of the traditional cuisine cannot be separated from the diversity of spices plants that grow in a different habitat. Various plants are known to be rich in nutrients and bioactive compounds that are important to human health (Navia and Chikmawati 2015; Elfrida et al. 2020; Suwardi et al. 2020a), including spices and condiment plants. However, modernization and changes in consumption patterns pose a serious threat to the future existence of spices and condiments plants (Hakim et al. 2015). In addition, the loss of species in different regions is also affected by the decline in the traditional knowledge of the local community on the use of various plant species (Maheshwari et al. 2018; Suwardi et al. 2019; Navia et al. 2019a) including spices and condiments.

Ethnobotanical knowledge has a vital role to play in the management of natural resources. This knowledge was



**Table 1.** The demographic structure of respondents

Parameter	Specification	Frequency	Percentage
Gender	Female	150	100%
Age	Youth (20–35)	30	20%
	Adult (36–64)	80	53%
	Elder (>65)	40	27%
Education	None	10	7%
	Elementary School	9	6%
	Junior High School	21	14%
	Senior High School	89	59%
	University	21	14%

### Data analysis

To compare the relative importance of each plant species, the frequency index was calculated. According to Mahwasane et al. (2013), the frequency index is a numerical expression of the percentage frequency of citation for a single plant species by informants. The following formula was used to calculate the frequency index (Madikizela et al. 2012):

$$FI = FC/N \times 100$$

Where: FC is the number of informants who mentioned the use of the plant species, and N is the total number of informants in each area. The frequency index was high when many informants mentioned a particular plant and low when there were few reports.

## RESULTS AND DISCUSSION

### Diversity of plants used as spice and condiments

The results show that the plants of the study area are rich in useful, which includes a total of 31 spices and condiments plants belonging to 26 genera and 18 families (Table 2).

*Allium cepa* L., *A. sativum* L., *Capsicum annum* L. are common spices and condiments plants have been found in the study area (FI = 100%). However, *Citrus amblycarpa* (Hassk.) Ochs is rarely found in the study area (FI = 18.67%). Zingiberaceae is the dominant family found in the study area with 5 species, followed by Rutaceae (4 species), Apiaceae (3 species), and Amaryllidaceae, Lamiaceae, Myrtaceae, and Solanaceae (2 species each). Zingiberaceae is widely used by the Tamiang tribe as a spice in cooking and consistent with the reported in Northeast India (Gudade et al. 2015; Chakraborty and Chaturvedi 2015; Salam and Jamir 2016) and in West Kalimantan, Indonesia (Robi et al. 2019).

The average number of species identified by each age group of the respondent ranged from  $8.5 \pm 1.21$  (20-30 years) to  $44.10 \pm 0.01$  (> 65 years). In addition, the average number of species identified by each educational status of the respondent ranged from  $12.8 \pm 2.01$  (University) to  $33.18 \pm 2.11$  (Elementary School). Some plants were recognized by all respondents include bawang mirah (*A. cepa*), bawang putih (*A. sativum*), and cabe mirah (*C.*

*annuum*). On the contrary, some other species were familiar to less than 20% of the respondents. Jeruk kunci/kesturi (*C. amblycarpa*) and bebuas (*Premna serratifolia*) are some examples for such less known species.

Relying on the ethnobotanical knowledge of the Tamiang tribe, the spice and condiment plants were divided into four categories, i.e. flavoring, seasoning, coloring, and preservation. Flavoring was the most important category among all communities followed by seasoning, preservation, and coloring (Table 3).

Of the total of 31 species recorded, some were used in more than one of the categories used. Accordingly, the Tamiang tribe used 31 plant species in flavoring, 26 species for seasoning, 3 species for preservation, and 2 species for coloring. This study in line with reported by Bharali et al. (2017) that flavoring was the most important category among all communities of Assam. In this study, several species have been identified which are used for various purposes. For example, the fruits of *A. moluccanus* are used both for flavoring and seasoning. However, the categories of use of a species may be different across sub-districts. *A. moluccanus* fruit is generally used for flavoring in Bendahara and Rantau, while this plant is used as condiments by local communities in the Seruway sub-district. This difference can be triggered by the assumption that individuals may have different interests, perceptions, and knowledge of plants. The frequency of the use of a plant species has been reported to depend on the way people live in contexts of their social and cultural (Shrestha and Dhillion 2006; Kumar et al. 2014).

The fruits (36%) were the most used as spice and condiment, followed by leaves (16%), seed (13%), rhizome and flower (10% each), bulb (6%), and stem and bark (3% each). The use of leaves as spices is similar reported in Sikkim, Manipur and Tripura, and Arunachal Pradesh (Gudade et al. 2015; Salam and Jamir 2016; Chakraborty and Chaturvedi 2015; Bharali et al. 2017). The leaves were mainly used for flavoring and seasoning which may be due to the presence of active secondary metabolites than other parts of the plants (Hidayati et al. 2017; Ismail and Ahmad 2019). Tamiang tribe use of *Alpinia galanga*, *Curcuma longa*, *Zingiber officinale* as spices. *C. longa* besides being a natural coloring in cooking can also give a distinctive flavor to the cuisine, while *Z. officinale* is also used to treat coughs. Most of the *Zingiberaceae* family is useful as a cooking spice, medicines, spices, ornamental plants, cosmetics, and drinks (Saranggana et al. 2013).

*Cocos nucifera* the most widely used by Tamiang tribe in making traditional cuisines such as *bubur pedas*, *anyang*, and *ikan cang rebong*. The processing method is shredded pulp to be processed into coconut, relaxed, and ground coconut. In addition, *Capsicum annum* and *C. frutescens* are used to provide natural color and spicy taste of food. *Allium cepa* and *A. sativum* are usually processed by being ground up to a fine or thinly sliced then mixed with other spices such as *Aleurites moluccanus* and *Anethum graveolens*. However, *A. sativum* reported being used by local communities in Niger Delta, Nigeria as a seasoning and flavoring agent for the treatment of fever and chills (Ndukwu and Ben-Nwadibia 2005).

**Table 2.** List of the spices and condiments plants and their utilization in the study area

Scientific name	Family	Vernacular Name	Part used	Habit	Used	FI (%)
<i>Aleurites moluccanus</i> (L.) Willd.	Euphorbiaceae	Kemiri	Fruit	Tree	Spices and condiment	63,3
<i>Allium cepa</i> L	Amaryllidaceae	Bawang mirah	Bulb	Herb	Spices and condiment	100
<i>Allium sativum</i> L	Amaryllidaceae	Bawang putih	Bulb	Herb	Spices and condiment	100
<i>Alpinia galanga</i> (L.) Willd.	Zingiberaceae	Lengkues	Rhizome	Herb	Spices	52
<i>Amomum uliginosum</i> J.Koenig	Zingiberaceae	Kapulage	Fruit	Herb	Spices	59,33
<i>Anethum graveolens</i> L	Apiaceae	Adas	Seed	Herb	Spices	50,67
<i>Averrhoa bilimbi</i> L	Oxalidaceae	Asam belimbing, Asam sunti	Fruit	Tree	Spices	84
<i>Capsicum annuum</i> L	Solanaceae	Cabe mirah	Fruit	Herb	Spices and condiment	100
<i>Capsicum frutescens</i> L	Solanaceae	Cabe kecil	Fruit	Herb	Spices and condiment	96
<i>Cinnamomum burmannii</i> (Nees & T.Nees) Blume	Lauraceae	Kayu manih	Bark	Tree	Spices and condiment	39,33
<i>Citrus amblycarpa</i> (Hassk.) Ochse	Rutaceae	Jeruk kunci/kesturi	Fruit	Tree	Spices	18,67
<i>Citrus aurantifolia</i> (Christm.) Swingle	Rutaceae	Jeruk nipis	Fruit	Tree	Spices	43,33
<i>Citrus hystrix</i> DC	Rutaceae	Jeruk purut	Fruit, leaves	Tree	Spices	60,67
<i>Cocos nucifera</i> L	Arecaceae	Kelambe	Fruit	Tree	condiment	68
<i>Coriandrum sativum</i> L	Apiaceae	Awas	Seed	Herb	Spices and condiment	54,67
<i>Cuminum cyminum</i> L	Apiaceae	Jintan	Fruit	Herb	Spices and condiment	48,67
<i>Curcuma longa</i> L	Zingiberaceae	Kunyik	Rhizome, leaves	Herb	Spices and condiment	98
<i>Cymbopogon citratus</i> (DC.) Stapf	Poaceae	Sere dapur	Stem	Herb	Spices	88
<i>Etilingera elatior</i> (Jack) R.M.Sm.	Zingiberaceae	Kecombrang	Flower	Herb	Spices	35,33
<i>Garcinia atroviridis</i> Griffith et Anders.	Clusiaceae	Asam gelugur	Fruit	Tree	Spices	55,33
<i>Illicium verum</i> Hook.f.	Schisandraceae	Pekak	Flower	Tree	Spices	50,67
<i>Murraya koenigii</i> (L.) Spreng.	Rutaceae	Daun kare	Leaves	Tree	Spices	98,67
<i>Myristica fragrans</i> Houtt.	Myristicaceae	Pala	Seed	Tree	Spices	37,33
<i>Ocimum × africanum</i> Lour.	Lamiaceae	Kemangi	Leaves	Herb	Spices	27,33
<i>Paederia foetida</i> L	Rubiaceae	Kentutan	Leaves	Climber	Spices	24,67
<i>Piper nigrum</i> L	Piperaceae	Lada	Seed	Climber	Spices and condiment	92,67
<i>Premna serratifolia</i> L	Lamiaceae	Bebuas	Leaves	Tree	Spices	19,33
<i>Syzygium aromaticum</i> (L.) Merr. & L.M.Perry	Myrtaceae	Cengkeh	Flower	Tree	Spices	36
<i>Syzygium polyanthum</i> (Wight) Walp.	Myrtaceae	Salam	Leaves	Tree	Spices	86
<i>Tamarindus indica</i> L	Fabaceae	Asam jawa	Fruit	Tree	Spices	68
<i>Zingiber officinale</i> Roscoe	Zingiberaceae	Halie	Rhizome	Herb	Spices and condiment	90

**Tabel 3.** Category of spices and condiment plants

Category	Species
Flavoring	<i>Aleurites moluccanus</i> , <i>Allium cepa</i> , <i>A. sativum</i> , <i>Alpinia galanga</i> , <i>Amomum uliginosum</i> , <i>Anethum graveolens</i> , <i>Averrhoa bilimbi</i> , <i>Capsicum annuum</i> , <i>C. frutescens</i> , <i>Cinnamomum burmannii</i> , <i>Citrus amblycarpa</i> , <i>C. aurantifolia</i> , <i>C. hystrix</i> , <i>Cocos nucifera</i> , <i>Coriandrum sativum</i> , <i>Cuminum cyminum</i> , <i>Curcuma longa</i> , <i>Cymbopogon citratus</i> , <i>Etilingera elatior</i> , <i>Garcinia xanthochymus</i> , <i>Illicium verum</i> , <i>Murraya koenigii</i> , <i>Myristica fragrans</i> , <i>Ocimum × africanum</i> , <i>Paederia foetida</i> , <i>Piper nigrum</i> , <i>Premna serratifolia</i> , <i>Syzygium aromaticum</i> , <i>S. polyanthum</i> , <i>Tamarindus indica</i> , <i>Zingiber officinale</i>
Seasoning	<i>Aleurites moluccanus</i> , <i>Allium cepa</i> , <i>A. sativum</i> , <i>Alpinia galanga</i> , <i>Amomum uliginosum</i> , <i>Anethum graveolens</i> , <i>Capsicum annuum</i> , <i>C. frutescens</i> , <i>Cinnamomum burmannii</i> , <i>Citrus amblycarpa</i> , <i>C. aurantifolia</i> , <i>C. Hystrix</i> , <i>Coriandrum sativum</i> , <i>Cuminum cyminum</i> , <i>Curcuma longa</i> , <i>Cymbopogon citratus</i> , <i>Garcinia xanthochymus</i> , <i>Illicium verum</i> , <i>Murraya koenigii</i> , <i>Myristica fragrans</i> , <i>Ocimum × africanum</i> , <i>Piper nigrum</i> , <i>Syzygium aromaticum</i> , <i>S. polyanthum</i> , <i>Tamarindus indica</i> , <i>Zingiber officinale</i>
Colouring	<i>Capsicum annuum</i> , <i>Curcuma longa</i>
Preservation	<i>Averrhoa bilimbi</i> , <i>Garcinia xanthochymus</i> , <i>Tamarindus indica</i>

**Table 4.** Trade of spice and condiment plants

Scientific name	Trade part	Number of respondents	Marketing	
			Mean quantity marketed per respondent (kg)	Market price (IDR/kg)
<i>Allium cepa</i>	Bulb	3	120 ± 1.25	50.000
<i>Allium sativum</i>	Bulb	2	80 ± 0.94	15.000
<i>Alpinia galanga</i>	Rhizome	3	8 ± 0.67	5.000
<i>Averrhoa bilimbi</i>	Fruit	1	20 ± 1.25	10.000
<i>Capsicum annuum</i>	Fruit	5	20 ± 0.94	20.000
<i>Capsicum frutescens</i>	Fruit	4	25 ± 2.36	50.000
<i>Citrus aurantifolia</i>	Fruit	2	7 ± 1.33	10.000
<i>Citrus hystrix</i>	Fruit	3	7 ± 1.33	30.000
	Leaves	3	2 ± 0.75	10.000
<i>Cocos nucifera</i>	Old fruit	50	200 ± 6.67	1.750
	Young fruit	50	100 ± 4.19	3.000
<i>Curcuma longa</i>	Rhizome	4	5 ± 0.94	5.000
	Leaves	4	1 ± 0.3	50.000
<i>Cymbopogon citratus</i>	Stem	6	8 ± 1.41	3.000
<i>Garcinia atroviridis</i>	Dried fruit	3	20 ± 2.31	6.000
	Wet fruit	3	300 ± 2.49	2.000

Several leaves of spices plants such as *Syzygium polyanthum* and *Citrus hystrix* are often used as a natural flavoring. These plants have essential oil content that provide a distinctive fragrance (Cahyadi 2006; Apriliani 2014). However, *Paedera foetida* and *Premna serratifolia* are very important condiments to making *bubur pedas*. These plants provide a distinctive taste and aroma. Spices that contain essential oils and are used by the community as natural flavorings are safe to use because they belong to the GRAS (Generally Recognized as Safe) group (Kim et al. 1995). *P. foetida* leaves also have benefits as a traditional medicine to treat digestive problems (Noprianti et al. 2018). *Averrhoa bilimbi*, *Tamarindus indica*, and *Garcinia xanthochymus* fruit can be used as a food additive for improving the aroma, taste, and food preservatives (Aqilah 2017).

#### The production and marketing of spice and condiment plants

Most of the respondents produced spices and condiment plants primarily for household consumption. Women and children were responsible for growing and selling the fresh produce of spices and condiment plants. Most of these plants are planting in the home garden. Approximately 57 % of the respondents have sold spices and condiment plants to increase household income. The widely produced home garden spices and condiments in the study area for both house consumption and sold in the local market were *A. galanga*, *A. bilimbi*, *C. longa*, and *G. atroviridis* (Table 4).

Most of the respondents sold spices and condiments to intermediary traders, some to consumers. The head of the household was responsible for selling spices and condiments in traditional markets. However, women usually sell small amounts of spices and condiment plants on the markets to meet basic needs, such as salt or eggs similar to the report of in South-West Ethiopia (Agize et al.

2013; Agize 2016) and in West Kalimantan (Robi et al. 2019). Generally, spices have been sold freshly, but several species have been dried, such as *G. atroviridis* before being sold, as is the case with the North Aceh people Indonesia (Navia et al. 2019b). The mean total annual contribution to the income of the household of the spices and condiment plants was around 38 %. From all respondents selling spices and condiment plants, 72 % were found to be earning annually less than 15,000,000 Indonesian Rupiah (IDR), 25 % earned between IDR 16,000,000 and IDR 30,000,000 while the remaining households earned more than IDR 30,000,000 but less than IDR 80,000,000.

*Capsicum annuum* were also commonly found in the study area as a similar report from in the Niger Delta Area of Nigeria (Ndukwu and Ben-Nwadibia 2005) and in Indonesia (Djarwaningsih 2005; Robi et al. 2019) and have high economic value. Indonesia was also one of the world's leading exporting countries in 2013, with the HS 904 group (Pepper, Chile, and *Capsicum*) among them (Hermawan 2015). This species widely consumed directly as vegetables or processed as spices in dried forms and also a primary ingredient in various hot sauces and pastes in different cuisines in Aceh Tamiang. The unique pungent flavor of *C. annuum* is due to the content of capsaicin and dihydrocapsaicin (Wang et al. 2009) which may increase appetite. The *C. annuum* was almost found in every home garden and the farmlands. Spices were sold separately or in various mixtures. Most of the traditional markets in Aceh Tamiang have been exceptionally well provided with indigenous and imported spices at all periods of the year.

#### Transfer of traditional knowledge among Tamiang Tribe

Culture plays a critical role in rural tribal livelihood, especially for the use of various spice and condiments plants (Bharali et al. 2017; Navia et al. 2019a). Each traditional cuisine has a special flavor that makes the taste

of the cuisine unique. Seventeen species used for made *babur pedas*, 5 species for *Anyang*, and 7 species for making *Ikan Cang Rebong*. However, *Ikan Cang Rebong* can be processed into two versions, namely *sayur lemak* and *pepes*. Traditional knowledge of the Tamiang tribe in the preparation and making of traditional cuisine has been passed down from generation to generation. Respondents from the study explained that knowledge of spices and condiments plants has been acquired mostly from parents and grandparents depicts that parents and grandparents account for 38% of knowledge, while 23% is mainly ancestors. Mothers always involve their daughters in the preparation and making of traditional cuisine. This study consistent with reported by Aqilah (2017) in Babah Dua Village, Aceh Jaya District, Aceh, Indonesia and in Kopen Dukuh Village, Banyuwangi District, East Java, Indonesia (Hakim et al. 2015). Van der Hoeven et al. (2013) reported elders to be the custodians of knowledge and transfer it to ensure it is not lost through generations. The study has recorded elders to be more knowledgeable about spices and condiment plants. In support of the study van der Hoeven et al. (2013) states that elders are the custodians of knowledge and they transfer their knowledge with such confidence so that it will not be lost through generations. Transfer of indigenous information within communities was mainly from parents to the younger generation (Ahmad and Pieroni 2016). The Tamiang tribe has always preserved traditional knowledge of the use of various spices and condiment plants for traditional cuisine.

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#### REFERENCES

- Achinewu SC, Aniena MI, Obomanu FG. 1995. Studies on spices of food value in the South eastern states of Nigeria 1: Antioxidants properties. *J Afr Med Plants* 18: 135-139.
- Agize M, Demissew S, Asfaw Z. 2013. Indigenous knowledge on management of home gardens and plants in Loma and Gena Bosa Districts (Weredas) of Dawuro Zone, Southern Ethiopia: Plant biodiversity conservation, sustainable utilization and environmental protection. *Intl J Sci: Basic Appl Res* 10 (1): 63-99.
- Agize M. 2014. Ethnobotany of spice and condiment plants and the associated indigenous knowledge on management, utilization and conservation of them in and around home gardens in Loma and Gena Bosa Districts (Weredas) of Dawuro Zone, Southern Ethiopia. *Intl J Agric Innov Res* 4 (3): 426-442.
- Agize M. 2016. Spice and medicinal plants production and value chain analysis from South-West Ethiopia. *J Pharm Altern Med* 10: 126-144.
- Ahmad K, Pieroni A. 2016. Folk knowledge of wild food plants among the tribal communities of Thakhte-Sulaiman Hills, North-West Pakistan. *J Ethnobiol Ethnomed* 12: 1-15.
- Apriliani A, Sukarsa, Hidayah HA. 2014. Study of plant ethnobotany as a food additive traditionally by the community in the Sub-district of Pekuncen, Banyumas District. *Scripta Biologica* 1 (1): 76-84.
- Aqilah CS. 2017. Ethnoecology and ethnobotany of spice plants Aceh community. [Thesis]. Bogor Agricultural University, Bogor. [Indonesian]
- Arif A, Suwarna B, Gentong AW. 2013 Maret 31. Tales of trade and war in Aceh Curry. *Kompas, Archipelago Culinary Exploration Rubric*, Maret 31, 2013, 33-36. [Indonesian]
- Bharali P, Sharma M, Sharma CL, Singh B. 2017. Ethnobotanical survey of spices and condiments used by some tribes of Arunachal Pradesh. *J Med Plants Stud* 5 (1): 101-109.
- Cahyadi S. 2006. Analysis and Health Aspects of Food Additives. First Edition. PT Bumi Aksara, Jakarta. [Indonesian]
- Chakraborty S, Chaturvedi HP. 2015. Some wild edible genetic resources of vegetables andspices of Tripura. *Indian Res J Genet Biotechnol* 7 (1): 132-137.
- Djarwaningsih T. 2005. *Capsicum* spp. (chilli): Origin, distribution, and its economical value. *Biodiversitas* 6 (4): 292-296.
- Elfrida, Mubarak A, Suwardi AB. 2020. The fruit plant species diversity in the home gardens and their contribution to the livelihood of communities in rural area. *Biodiversitas* 21 (8): 3670-3675.
- Gadegbeku C, Tuffour MF, Katsekor P, Atsu B. 2014. Herbs, spices, seasonings and condiments used by food vendors in Madina, Accra. *Caribb J Sci Technol* 2: 589-602.
- Gudade BA, Babu S, Deka TN, Vijayan AK, Chhetri P. 2015. Spices biodiversity and their ethnomedicinal uses by tribal community of Sikkim, India. *Vegetos* 28 (1): 141-145.
- Hakim L. 2015. Spices and Herbs of Community Home Gardens: Diversity, phytopharmaca Sources and Health-fitness Tourism. Diandra Creative, Yogyakarta. [Indonesian]
- Hakim L, Batoro J, Sukenti K. 2015. Ethnobotany spices in the Kopen Dukuh Village of Banyuwangi District. *Jurnal Pembangunan dan Alam Lestari* 6 (2): 133-142. [Indonesian]
- Hermawan I. 2015. The competitiveness level of Indonesian spices in ASEAN market before and after global economic crisis. *Buletin Ilmiah Litbang Perdagangan* 9 (2): 153-178. [Indonesian]
- Hidayati MD, Ersam T, Shimizu K, Fatmawati S. 2017. Antioxidant activity of *Syzygium polynthum* extracts. *Indon J Chem* 17 (1): 49-53.
- Ismail A, Ahmad WANW. 2019. *Syzygium polyanthum* (Wight) Walp: A Potential Phytomedicine. *Pharm J* 11 (2): 429-438.
- Kim JM, Marshall MR, Wei CI. 1995. Antibacterial activiti of some essential oil components against five foodborne pathogen. *J Agric Food Chem* 43 (11): 2839-2845.
- Kumar N, Singh AK. 2014. Plant profile phytochemistry and pharmacology of Avartani (*Helicteres isora* Linn.): A review. *Asian Pac J Trop Biomed* 4 (1): 22-26.
- Kumar P, Singh V, Singh A. 2014. Ethnobotanical studies of plant species associated with *Hippophae* sp. in Chandra Valley a part of cold desert biosphere reserve Himachal Pradesh, India. *Ann Plant Sci* 3 (7): 754-757.
- Madikizela B, Ndhkala AR, Finnie JF, Van Staden J. 2012. Ethnopharmacological study of plants from Pondoland used against diarrhoea. *J Ethnopharmacol* 141: 61-71.
- Maheshwari S, Tomar SS, Sharma A. 2018. A study of ethnobotanical knowledge of tribal plants: a review of decade. *Intl J Adv Sci Res Manag* 1: 2455-6378.
- Mahwasane ST, Middleton L, Boaduo N. 2013. An ethnobotanical survey of indigenous knowledge on medicinal plants used by the traditional healers of the Lwamondo area, Limpopo province, South Africa. *S Afr J Bot* 88: 69-75.
- Manangka CA, Linda R, Mukarlina. 2017. Utilization of plants as natural flavors by the Kanayatin Dayak Tribe, Sebatih Village, Sengah Temila Sub-district, Landak District. *Protobiont* 6 (3): 158-164.
- Manoj P, Soniya EV, Banerjee NS, Ravichandran P. 2004. Recent studies on well-known spice, *Piper longum* Linn. *Nat Prod Radiance* 3 (4): 222-227.
- Mulu M, Ntelok ZRE, Sii P, Mulu H. 2020. Ethnobotanical knowledge and conservation practices of indigenous people of Mbeliling Forest Area, Indonesia. *Biodiversitas* 21(5): 2085-4722.
- Navia ZI, Chikmawati T. 2015. *Durio tanjungpurensis* (Malvaceae), a new species and its one new variety from West Kalimantan, Indonesia. *Bangladesh J Bot* 44 (3): 429-436.
- Navia ZI, Suwardi AB, Saputri A. 2019a. Characterization of local fruits in the Leuser Ecosystem of Aceh Taming District, Aceh. *Buletin Plasma Nutfah* 25 (2): 133-142. [Indonesian]
- Navia ZI, Suwardi AB, Nuraini, Seprianto. 2019b. Ethnobotany of wild edible fruit species and their contribution to food security in the North Aceh Region, Indonesia. *Intl Conf ASEAN* 2019: 203-210. DOI: 10.1515/9783110678666-027.
- Navia ZI, Suwardi AB, Harmawan T, Syamsuardi, Mukhtar E. 2020. The diversity and contribution of indigenous edible fruit plants to the rural

- community in the Gayo Highlands, Indonesia. *J Agric Rural Dev Trop Subtrop* 121 (1): 89-98.
- Ndukwu BC, Ben-Nwadibia NB. 2005. Ethnomedicinal aspects of plants used as spices and condiments in the Niger Delta area of Nigeria. *Ethnobot Leaflets* 2005: 10.
- Noprianti D, Nugroho RA, Sudiastuti. 2018. Effect of healed leaf water extract (*Paederia foetida* Linn.) on morphometry and survival of mice fetus (*Mus musculus* L.). *Jurnal Biota* 4 (2): 49-53. [Indonesian]
- Rathore MS, Shekhawat NS. 2008. Incredible spices of India: from traditions to cuisine. *Am-Eurasian J Bot* 1 (3): 85-89.
- Robi Y, Kartikawati SM, Muflihati. 2019. Traditional Ethnobotany of Spices in the Village of Empoto, Sanggau District, West Kalimantan. *Jurnal Hutan Lestari* 7 (1): 130-142. [Indonesian]
- Salam S, Jamir NS. 2016. Common spices plant used as medicine by the Tangkhul tribe of Ukhul District, Manipur, India. *Intl J Sci Res Publ* 6 (7): 22-25.
- Sarangnga Y, Suaib, Wijayanto T. 2013. Morphological characterization of gingers (*Zingiberaceae*) in the Katangana River Basin of South Tiworo. *Berkala Penelitian Agronomi* 2 (2): 87-93. [Indonesian]
- Shrestha PM, Dhillion SS. 2006. Diversity and traditional knowledge concerning wild food species in a locally managed forest in Nepal. *Agrofor Syst* 66: 55-63.
- Supiandi MI, Mahanal S, Zubaidah S, Julung H, Ege B. 2019. Ethnobotany of traditional medicinal plants used by Dayak Desa Community in Sintang, West Kalimantan, Indonesia. *Biodiversitas* 20: 1264-1270.
- Suryadarma IGP. 2010. Diversity of plants of fitness material in the lontar rukmini tatwa manuscript of Balinese society. *Biota* 15 (2): 294-305
- Suwardi AB, Indriaty, Navia ZI. 2018. Nutritional evaluation of some wild edible tuberous plants as an alternative foods. *Innovare J Food Sci* 6 (2): 9-12.
- Suwardi AB, Navia ZI, Harmawan T, Syamsuardi, Mukhtar E. 2019. The diversity of wild edible fruit plants and traditional knowledge in West Aceh region, Indonesia. *J Med Plants* 7 (4): 285-290.
- Suwardi AB, Navia ZI, Harmawan T, Nuraini, Syamsuardi, Mukhtar E. 2020a. Ethnobotany, nutritional composition and sensory evaluation of *Garcinia* from Aceh, Indonesia. *Mater Sci Eng* 725 (1): 012064.
- Suwardi AB, Navia ZI, Harmawan T, Syamsuardi, Mukhtar E. 2020b. Ethnobotany and conservation of indigenous edible fruit plants in South Aceh, Indonesia. *Biodiversitas* 21 (5): 1850-1860.
- Suwardi AB, Navia ZI, Harmawan T, Syamsuardi, Mukhtar E. 2020c. Wild edible fruits generate substantial income for local people of the Gunung Leuser National Park, Aceh Tamiang Region. *Ethnobot Res Appl* 20: 1-13.
- Tamin R dan Arbain D, 1995. Biodiversity and Ethnobotany Survey. Workshop paper on Insulation of Efficacious Compounds. Cooperation of HEDS-F MIPA Andalas University, Padang. [Indonesian]
- The Central Bureau of Statistics of Aceh Tamiang District. 2020. Tenggulun Sub-district in figure 2019. The Central Bureau of Statistics of Aceh Tengah District, Aceh Tamiang District, Indonesia. [Indonesian]
- Van der Hoeven M, Osei J, Greeff M, Kruger A, Faber M, Smuts CM. 2013. Indigenous and traditional plants: South African parents' knowledge, perceptions and uses and their children's sensory acceptance. *J Ethnobiol Ethnomed* 9: 78. DOI: 10.1186/1746-4269-978.
- Wang Y, Xia Y, Wang J, Luo F, Huang Y. 2009. Capsaicinoids in chili pepper (*Capsicum annuum* L.) powder as affected by heating and storage methods. *Am Soc Agric Biol Eng* 52 (6): 2007-2010.