The ethnobotanical study of edible and medicinal plants in the home garden of Batak Karo sub-ethnic in North Sumatra, Indonesia

MARINA SILALAHI1*, NISYAWATI2

1Departement of Biology Education, Faculty of Education and Teacher Training, Universitas Kristen Indonesia. Jl. Mayjen Sutoyo No. 2, Cawang, Jakarta 13630, Indonesia. Tel. +62-21-8009190, 8092425. Fax. +62-21-80886882. *email: marina.silalahi@uki.ac.id; marina_biouki@yahoo.com
2Departement of Biology, Faculty of Mathematics and Natural Sciences, Universitas Indonesia. Depok 16424, West Java, Indonesia

Abstract. Silalahi M, Nisyawati. 2018. The ethnobotanical study of edible and medicinal plants in the home garden of Batak Karo sub-ethnic in North Sumatra, Indonesia. Biodiversitas 19; 229-238. The cultivation of plants in home gardens for self-sufficiency is a long tradition in Karo District, but the documentation of local knowledge about edible and medicinal plants in home gardens in Karo District is limited. This study aimed to (i) document the uses of the edible and medicinal plants in home gardens; (ii) to analyze the diversity of edible and medicinal plants in home gardens. Data were collected using the ethnobotanical surveys and interviews methods. The Shannon Weiner and Margalef indices were calculated to determine the diversity levels of medicinal and edible species in the home gardens of Karo ethnic. The surveys were conducted in 30 home gardens (7 villages), Karo District, North Sumatra. The 85 recorded species belonged to 43 families, and 73 genera were used as edible and medicinal plants. The plants studied in the home gardens used for human consumption were i.e. fruits, vegetables, spices, tubers and medicinal plants. Among 85 plant species growing in home gardens, 52 species were cultivated, and the rest were semi cultivated. Home gardens had the Shannon Wiener index ranging from 1.164 to 3.123 while Margalef index ranging from 0.929-2.531.

Keywords: Edible plants, Flacourtia rukam, Batak Karo, Molineria latifolia

INTRODUCTION

The home garden is a complex agroforestry system, which is rich in biodiversity including perennial and annual plants such as wild plants, semi-cultivation, and cultivation (Kumar and Nair 2004, Moreno-Calles et al. 2010). For local people, home garden plays an important role in many aspects including the economy, ecology, social, and culture (High and Shackleton 2000; Méndez et al. 2001; Senanayake et al. 2009). Economically, the plants in the home garden provide a source of various materials for medicinal materials and ceremonials materials. Therefore, it becomes a valuable source of direct or indirect income for the owner. Ecologically, it has a function as shade, erosion prevention (Senanayake et al. 2009; Larios et al. 2013), conservation of biodiversity (Kehlenbeck and Maass 2004; Kaswanto and Nakagoshi 2012), and carbon sinks (Kaswanto and Nakagoshi 2012). The home garden is also used by the community as a place to transfer of local knowledge about ecology and utilization of plants (High and Shackleton 2000; Méndez et al. 2001;Thomas et al. 2008).

The prospective researches of the home garden in Indonesia had been carried out since 1930 by the Dutch in Java (Kaswanto and Nakagoshi 2012), which were then comprehensively studied in 1987 (Soemarwoto 1987). The further researches on this project are conducted partially by other researchers on various ethnic groups such as Java (Kehlenbeck and Maass 2004; Kusumaningtyas et al. 2006), Bali Aga (Sujarwo and Caneva 2015), and Batak Angkola-Mandailing (Silalahi 2016). The focus of the study varied, but it was mostly related to the documentation of the use of plants by local communities. However, studies on the diversity and abundance of plant garden have not been done, although the garden has long been used as a source of fruits, vegetables, and traditional medicines (Soemarwoto 1987; Kaswanto and Nakagoshi 2012; Sujarwo and Caneva 2015; Silalahi 2016).

The plant garden diversity is very high in both types and benefits. However, this diversity is also depending on various factors such as distance from the forest (Larios et al. 2013), culture, ethnics, climate, and topography (Senanayake et al. 2009). The distance of the garden to the forest affects the diversity of garden plants (Wezel and Bender 2003; Cruz-Garcia and Struik 2015), while the topography has implications in the composition of perennial and annual plant (Senanayake et al. 2009). Garden plants also have functioned as the reservoir for food plants (edible plants) or drugs (Ashagre et al. 2016), maintaining native biodiversity/native (Blancas et al. 2010; Parra et al. 2012), and the native biodiversity of plants especially the wild plants from forests (Casas et al. 2006; Parra et al. 2012).

Batak ethnic is the indigenous ethnic in Sumatra consisting of five sub-ethnic groups i.e Karo, Simalungun, Phakpak, Toba, and Angkola-Mandailing (Bangun 2010). Karo Batak is a sub-ethnic that still use the traditional medicines (oukup, tawar, parem) to maintain their health (Silalahi 2014; Purba 2015; Silalahi 2016). They also have traditional cuisine such as terites (soup from the rumen of...
cattle), *cimpa, cipera* (likes of curry chicken) (Purba 2015; Aini 2016). In order to supply those traditional medicines and food ingredients, they began to plant in the home garden (Silalahi 2014; Purba 2015; Aini 2016). This study aimed (i) to document the local knowledge of ethnic Karo in utilizing garden plants as a source of food and medicine, (ii) to know the diversity of food plants and cultivation drugs and semi-cultivation by Karo ethnic, Indonesia.

**MATERIALS AND METHODS**

**Location of study**

This study was conducted from April 2014 to August 2016 in seven villages in the Karo District, North Sumatra, Indonesia (Figure 1). There were three villages in Merdeka Sub-district i.e. Semangat Gunung Village, Cinta Rayat Village, and Merdeka Village; one village in the Berastagi Sub-district, i.e., Doulu Village; and three villages in the Simpang Empat Sub-district, i.e. Lingga Village, Pertegun Village, and Surbakti Village. Those villages are located in the Karo highlands surrounded by active volcanoes of Sinabung and Sibayak with altitude between 900 and 1,200 meters above sea level. More than 90% of the population work as horticultural farmers such as *Apium graveolens, Brassica sp.*, *Capsicum annuum*, and *Citrus sinensis*.

**Method**

The information of this study was obtained using three type of interviews, i.e., semi-structured, in-depth, and participative observation). Interviews were conducted on 30 people were aged from 35-70 years old at seven villages in the Karo District, North Sumatra, Indonesia. The determination of respondents and home gardens were done by purposive sampling. Interview guidelines were modified from previous ethnobotany study conducted by Martin (1995), Alexiades (1996), and Silalahi et al. (2015). Medicinal and edible plants found in the home garden were recorded in terms of local names, habitus, uses, and parts of used, which were then made as voucher specimens. The number of plants of each species was calculated, and the size of the garden was measured. The voucher specimens were then identified in the botanical laboratory in the Universitas Indonesia, and also in Herbarium Bogoriense (BO), research center for Biology, Indonesian Institute of Sciences (LIPI). The identified scientific name of the plant was verified using online sources (www.thepantlist 2017).

![Figure 1. Research location in seven villages in Karo District, North Sumatra, Indonesia](image-url)
Data analysis

The data obtained in this research was analyzed qualitatively and quantitatively. Qualitative data included the uses of plants, the part of used, sources of acquisition, and life form were recorded. The diversity index was calculated using Shannon-Wiener Index (H') equation; the index of similarity was calculated using Jaccard Index (Ji) (Mueller-Dombois and Ellenberg 1974), and the wealth index calculated using Margalef index (DMg) (Mueller-Dombois and Ellenberg 1974; Magurran 1988; Magurran 2003) with the equation patterns as follows:

Margalef index (DMg)

$$\text{DMg} = \frac{S - 1}{\ln(n)}$$

where S is the number of taxon, and n is the total number of individuals in all taxon.

Shannon-Wiener index (H')

$$H' = -\sum_{i=1}^{n} (pi) \ln(pi)$$

where ni is the number of taxon, and n is the total number of individuals in all taxon.

Jaccard index (Ji)

$$Ji = \frac{a}{a + b + c}$$

a = The number of species found in A and B villages  
b = The number of species found in A village but it is not found in B village  
c = The number of species found in B village and it is not found in A village

RESULTS AND DISCUSSION

Utilization of botanical plants by Batak Karo Sub-ethnic

In this study, the location of home garden belongs to the Karo Batak sub-ethnic community was relatively narrow with a size of 20-300 m². Initially, the home garden was used by local people for family activities and social activities so that the home garden size was limited. The activities undertaken in the home garden included parenting, socializing with neighbors, and drying agricultural products. The residential centers at Batak Karo sub-ethnic surrounded by Bambusa sp, which used as a barrier, windbreaker, construction materials, and a food ingredient (Silalahi 2014). In this study, many plants found in the home garden were mostly used as food and drug ingredients (Figure 2).

In this study, 85 plant species collected from home garden consisting of 43 families and 73 genera were used by sub-ethnic Batak Karo as food or medicines. Those families were, i.e., Solanaceae (10 species), Zingiberaceae (6 species), Myrtaceae (4 species), Rutaceae (3 species), Rosaceae (3 species), Poaceae (3 species), Fabaceae (3 species), Arecaceae (3 species), and Acanthaceae (3 species). Most of those families had the largest number of species, representing over 41% of the species utilized in this study.

Table 1 shows the ethnobotanical information of each species found in the study. The results showed that most of plant species found in the garden were used for many purposes such as food (60 species), medicinal plants (30 species), and other benefits (7 species). Foodstuffs include vegetables (20 species), fruit (30 species), spices (11 species), carboorbituric sources (10 species), and other benefits (7 species).

More than 25 species of plants listed in table 1 had multiple benefits such as Etlingera elatior was used as a spice, vegetable, medicine; while Musa paradisiaca was used as a vegetable, fruit, medicine. Plants used as fruit sources (Eriobotrya japonica, Psidium guajava, Persea americana), vegetables (Brassica sp., Solanum melongena, Capsicum annuum), medicinal ingredients and spices (Alpinia galanga, Curcuma longa, E. elatior, Cymbopogon citratus), ornamental plants and medicines (Hibiscus rosa-sinensis, Crinum asiaticum, Barberis sp. and Equisetum debile) were easily found in the yard. The plants found in this study are similar to those of the study conducted by Sujarwo and Cavera (2015) on the garden of Bali Aga ethnic, which mostly used as a source of vegetables (46%), drugs (23%), food (20%), spices (9%), and the edible seeds (2%).

In this study, 30 species of home garden plants used as medicine such as to overcome the fever (H. rosa-sinensis, Ceiba pentandra, E. elatior), digestive tract disorders (C. longa, Curcuma xanthorrhiza, Zingiber officinale), traditional steam-bathing (Z. officinale, E. elatior, C. longa, Cymbopogon citratus), and kidney disease (E. debile) (Table 1). In Batak Karo sub-ethnic, more food plants were planted in home garden (species) compared with medicinal plants. Community used home garden as a source of food and income (Galhena et al. 2013), especially fruit, vegetable, staple food (Sujarwo and Cavera 2015). Farmers always ensure the availability of food plants in the garden (Lok 2001), especially in the difficult plant season times. The home garden is an easy and accessible place for a food source (Sujarwo and Cavera 2015).

Figure 2. The home garden structure of Batak Karo sub-ethnic in Karo District, North Sumatra, Indonesia
Table 1. List of cultivated plants in Batak Karo sub-ethnic home garden, Karo District, North Sumatra, Indonesia

| Family            | Scientific name                      | Annual/perennial | Local name       | Parts used and how to use                                                                 | Villages | Life form |
|-------------------|--------------------------------------|------------------|------------------|------------------------------------------------------------------------------------------|----------|-----------|
| Acanthaceae       | Graptophyllum pictum (L.) Griff.      | Perennial        | Daun ungu        | Water decoction of leaves as a medicine for kidney disease                               | SG       | Shrubs    |
|                   | Andrographis paniculata (Burm.f.) Nees | Perennial        | Sambiroto        | Water boiled leaves as cough medicine, fever, and increase appetite                      | SG, L    | Herb      |
|                   | Justicia gendarussa Lour.            | Perennial        | Sangkil semplit  | Fever and mythical medicine leaves                                                      | L        | Herb      |
| Anacardiaceae     | Mangifera foetida Lour.              | Perennial        | Mbacang          | Fruit that has been cooked directly eaten                                                | L        | Tree      |
| Annonaceae        | Annona muricata L.                   | Perennial        | Tarutung         | Fruit that has been cooked directly eaten; leaf boiling water for kidney disease medicine | S        | Tree      |
| Apiaceae          | Apium graveolens L.                  | Annual           | Daun sop         | Leaves are used for vegetables, anti-hypertensive drugs, and cooking spices           | CR, SG   | Herb      |
| Araceae           | Daucus carota L.                     | Annual           | Wortel           | Bulbs are used as vegetables                                                            | S        | Herb      |
|                   | Acerus calanus L.                    | Perennial        | Jrango           | Rhizoma for fever and cough medicine                                                    | L, D     | Herb      |
|                   | Colocasia esculenta (L.) Schott.     | Perennial        | Talas            | Tubers are cooked as a source of carbohydrates                                          | S, SG, L, D | Herb |
| Areceae           | Arenga pinnata Merr.                 | Perennial        | Poula            | Fruit for "kolang kaling"; juice water to make brown sugar.                            | L        | Palm      |
|                   | Areca catechu L.                     | Perennial        | Mayang           | The roots for medicinal aphrodisiac; ripe fruit to mix betel meal                       | D        | Palm      |
| Asteraiceae       | Salacca zalacca (Gaertn.) Voss       | Perennial        | Salak            | Fruit that is cooked directly eaten                                                     | P, SG, L | Palm      |
|                   | Blumea balsamifera (L.) DC.          | Perennial        | Sembung          | Air leaf stew for diarrhea, fever, cough, and asthma                                      | D        | Herb      |
| Asparagaceae      | Asparagus officinalis L.             | Annual           | Asparagus        | Stems that are still young used as a vegetable                                           | S        | Herb      |
|                   | Dracaena angustifolia (Medik.) Roxb. | Perennial        | Suji             | Leaves as a food coloring                                                                | S, L     | Shrubs    |
| Berberidaceae     | Barberis sp.                         | Perennial        | Daun Mutiara     | Water decoction leaves to overcome kidney pain                                           | SG       | Shrubs    |
| Basellaceae       | Anredera cordifolia (Ten.) Steenis    | Perennial        | Binahong         | Water decoction of leaves for cough medicine                                            | SG       | Herb      |
| Brassicaceae      | Brassica oleracea L.                 | Annual           | Bunga kol        | Flowering is used as a vegetable                                                       | D        | Herb      |
|                   | Brassica rapa L.                     | Annual           | Sawi             | Young leaves are used as vegetables                                                    | CR, M, P, S, L | Herb |
| Bombaceae         | Durio zibethinus L.                  | Perennial        | Durian Kapas     | Leaf juice is used as a fever medicine                                                  | L, P     | Tree      |
| Bromeliaceae      | Ananas comosus (L.) Merr.            | Perennial        | Kenas            | Fruits that are cooked directly eaten, young fruit for abortion                          | L        | Herb      |
| Campanulaceae     | Isotoma longiflora (L.) C.Presl      | Annual           | Bunga katarak    | Flower water to cope with cataracts                                                     | L, SG    | Herb      |
| Caricaceae        | Carica papaya L.                     | Perennial        | Mbetik           | Boiled leaf is used as a vegetable and drug diabetes mellitus, fruits that are cooked directly eaten while the young fruit is used as a vegetable | L        | Herb      |
| Convolvulaceae    | Ipomoea batatas Poir.                | Annual           | Gadong enfjolor  | Young leaves are boiled as vegetables, tubers as a source of carbohydrates             | L        | Herb      |
| Cucurbitaceae     | Cucurbita moschata Duchesne          | Annual           | Jambe            | Fruit that has been boiled as a vegetable and seeds as a drug malnutrition             | SG, L, D | Herb      |
|                   | Sechium edule (Jack.) Sw.            | Annual           | Ropah            | The leaves are easy and the fruit is boiled into vegetables                              | SG, L, D | Herb      |
| Family               | Scientific Name                                      | Life Form | Use                                                                 | Part Used                      | Plant Type |
|---------------------|------------------------------------------------------|-----------|---------------------------------------------------------------------|--------------------------------|------------|
| Dryopteridaceae     | *Polystichum setiferum* (Forsk.) Moore ex Woy.       | Perennial | Tenggiang; young leaves for fever medicine                           | D                              | Tree       |
| Euphorbiaceae       | *Saururus androgyrus* (L.) Merr.                    | Perennial | Daun katuk; the young leaves are used as a vegetable and boost breast milk | L                              | Shrubs     |
|                      | *Manihot esculenta* Crantz.                          | Perennial | Gadung; young leaves are boiled as vegetables, tubers as a source of carbohydrates | S, SG, L, D                    | Shrubs     |
| Fabaceae            | *Pachyrhizus erosus* (L.) Urb.                      | Annual    | Bengkoang; tuber is directly eaten                                   | L                              | Herb       |
|                      | *Phaseolus lunatus* L.                               | Annual    | Kacang koro; young fruit is boiled and used as vegetable             | SG, L                          | Tree       |
|                      | *Leucaena leucocephala* (Lam.) De Wit                | Perennial | Pote-pote; young seeds as *lalaban*                                  | S                              | Tree       |
| Flacourtiaceae      | *Flacourtia rukam* Zoll. & Moritzi                   | Perennial | Tenggolan; fruit that has been cooked directly eaten                 | D                              | Tree       |
| Hypoxidaceae        | *Moliniera latifolia* (Dried. ex WT Aiton) Herb. ex Kurz | Perennial | Singkut; leaves are used as a wrapper crop                           | S, SG, D, L                    | Herb       |
| Lamiales            | *Ocinum basilicum* L.                                | Annual    | Kumang; leaves as *lalaban* and spices arisk                       | L                              | Herb       |
| Lauraceae           | *Persea americana* Mill.                             | Perennial | Pokat; fruit that is cooked and is directly eaten                    | SG, L, S                       | Tree       |
|                      | *Cinnamomum burmannii* Blume *Crinum asiaticum* (L.) Urb. | Perennial | Kulit manis; stem bark for spices                                    | SG, D                          | Tree       |
| Liliaceae           | *Allium tuberosum* Rotter ex Spreng.                | Annual    | Ompu-ompu; leaves and pseudostem for fractures                     | SG, P, D                       | Herb       |
| Lythraceae          | *Panicum granatum* L.                                | Perennial | Gundara belang; leaves boiled as vegetables                          | L                              | Herb       |
| Malvaceae           | *Hibiscus rosa-sinensis* L.                          | Perennial | Delima; fruit that has been cooked directly eaten                    | L                              | Tree       |
| Moraceae            | *Artocarpus heterophyllus* Lam.                      | Perennial | Waren gegeh; leaf juice to overcome fever                           | CR, M, P, D, SG, D, L, D       | Shrubs     |
| Musaceae            | *Musa paradisiaca* L.                                | Perennial | Nangka; fruit that has been cooked directly eaten, fruit that is still used as a vegetable | SG, L, D                       | Herb       |
| Myrtaceae           | *Syzygium aqueum* (Burm.f.) Alston                   | Perennial | Jambu air; fruits that have been cooked is then directly eaten      | SG, L, D                       | Tree       |
|                      | *Psidium guajava* L.                                 | Perennial | Galiman; fruits that have been cooked and is directly eaten; young leaves are directly eaten as a medicine for diarrhoea | P, S, SG, L, D                 | Tree       |
| Orchidaceae         | *Sicygium malaccense* (L.) Merr & LM Perry           | Perennial | Jambu bol; fruits that have been cooked and is directly eaten       | S, L                           | Tree       |
|                      | *Melaleuca leucadendra* (L.) L.                      | Perennial | Kayu putih; leaves are used to make *minak alun*                    |                                | Tree       |
| Oxalidaceae         | *Hylocereus undatus* (Haw) Britton & Rose           | Perennial | Buah naga; fruits that have been cooked and is directly eaten       | L, D                           | Herb       |
| Equisetiaceae       | *Averrhoa carambola* L.                              | Perennial | Balimming; fruits that have been cooked and is directly eaten       | S, L                           | Tree       |
| Pandanaceae         | *Pandanus amaryllifolius* Roxb.                     | Perennial | Sendepeat; the boiled leaves to overcome                             | SG                             | Herb       |
| Piperaceae          | *Piper betle* L.                                     | Perennial | Pandan; leaves to give aroma and food color, and also for *Oukup*   | L, D                           | Herb       |
| Poaceae             | *Zea mays* L.                                        | Annual    | Belo; boiled leaves for medicine fever, wounds, *sprue*              | L                              | Herb       |
|                      | *Cymbopogon citratus* (DC.) Stapf.                  | Perennial | Sereh; pseudostem for seasoning, *Oukup*, square *Minak*            | P, S, SG, D, L                 | Herb       |
|                      | *Saccharum officinarum* L.                           | Perennial | Tobu; juice water used sugar                                         | L, D                           | Herb       |
Rosaceae

**Eriobotrya japonica** (Thunb.) Lindl.  
**Diospyros kaki** Lf.  
**Fragaria virginiana** Mill.  
**Murraya koenigii** (L.) Spreng

**Perennial**

- Mbiwa: Fruit that has been cooked and is directly eaten  
- Kesemek: Fruits that have been cooked and is directly eaten

- Stroberi: Fruits that have been cooked and is directly eaten  
- Rimo: Fruits that have been cooked and is directly eaten

- Rimo bunga: Fruit for cooking spices, k-stone and leaf medicine as a sufficient ingredient

Rutaceae

**Citrus sinensis** (L.) Obsbect  
**Rutaceae**

**Murraya koenigii** (L.) Spreng

**Perennial**

- Daun kari: Leaves as a spice ingredient

Rubiacae

**Coffee arabica** L.  
**Dimocarpus longan** Lour.  
**Nephelium lappaceum** L.  
**Capsicum annuum** L.  
**Solanum betaceum** Mill  
**Solanum americanum** Mill  
**Solanum nigrum** L.  
**Solanum melongena** L.  
**Solanum tuberosum** L.  
**Solanum verbascifolium** L.  
**Solanum Lycopersicum** L.  
**Solanum xanthochymus** L.  
**Teucrium fruticans** Jacq.  
**Teucrium polium** L.  
**Zingiber officinale** Rosc.  
**Zingiber zerumbet** (L.) Rosc. ex Sm.  
**Alpinia galanga** (L.) Sw.

**Annual**

- Kopi: Seeds to make coffee

- Leci: Fruits that have been cooked and is directly eaten

- Lasina: Fruits that have been cooked and is directly eaten

- Leunca: Fruits that have been cooked and is directly eaten

- Lancing: Leaf juice as a drug broken bones

- Leuh: Leaves are cooked as vegetables

- Depuk-depuk: Fruit that has been cooked directly eaten and the whole part is boiled to deal with smallpox

- Sapo: Fruit that has been cooked directly eaten

- Kopi coklat: Seeds for cocoa powder

- Kuning: The juice rhizoma used as medicine for diarrhea, dye eat; the leaves are used materials

- Cekala: Pseudostem fluid is used for cough, fever, enough, sambal; leaves for enough; flowers for spices arsik, chopped, terites; fruit for terities and arsik

- Pincouli: Leaves as a spice arsik

- Alia: Rhizoma for wound drugs, fever

- Lempuyang: The juice of rhizoma diarrhea and overcome malnutrition

- Lempuyang: Rhizoma for rheumatic drugs and adequate

- Kelawas: Rhizoma used for itch and seasoning, Oukup; leaves ingredient Oukup

Note: CR (Cinta Rayat), D (Doulu), L (Lingga), M (Merdeka), P (Pertegun), SG (Semangat Gunung), S (Surbakti)
Part of plant used as food and medicines included fruit (37 species), leaves (34 species), tubers (7 species), and stems (6 species) (Figure 3). Leaves are used as medicine (Andrographis paniculata, Justicia gendarussa, Blumea balsamifera, Anredera cordifolia, Solanum verbenasculum) and vegetables (Brassica rapa, Carica papaya, Saururus androgynus, Ipomoea batatas). Part of plant known as rhizoma is used as a medicine and spices i.e (A. galanga, C. longa, and Z. officinale), while tubers are used as a source of carbohydrates or staple foods (I. batatas, Colocasia esculenta, Manihot utilissima, S. tuberosum). Some plants found on the grounds of Batak Karo sub-ethnic typically from tropical regions were M. paradisiaca, M. indica, P. americana, C. papaya, C. sinensis, M. utilissima, and J. bataetas (Wezel and Bender 2003; Sunwar et al. 2006; Sujarwo and Caneva 2015).

Specific type of Plants found in the home garden of Karo Batak sub-tribe garden

In this study, there were several plants in Karo ethnic garden, but rarely found in other Indonesian ethnic such as Bali Aga (Sujarwo and Caneva 2015), Java (Kusumaningtyas et al. 2006) such as tenggolan (Flacourtia rukam), singkut (Moliniera latifolia), and cekala (Etlingera elatior).

Flacourtia rukam Zoll. & Moritz

Flacourtia rukam is a plant wild found in the forest around of the Sibayak Mount, but it has been cultivated in the home garden by the community especially in the Doulu Village. Although only found in the village of Doulu, but most respondents recognize that this plant provides a source of fruit. The reasons people didn’t cultivate of tenggolan because it’s easy and widely found in the forest and most of them didn’t know how to cultivate. Moreover, it is rarely found the saplings of the plant, and it is difficult to be grown although it grows well most of it rarely bears fruit. These findings were in line with the function of the garden as an important location for the process of plant domestication and also the development and cultivation of economic value crops (Miller and Nair 2006; Ashagre et al. 2015). F. rukam fruits contain other secondary metabolites which were very useful for medicinal purposes such as saponins, flavonoids, polyphenols, and tannins (Barcelo 2015). This fruit became a source of fruit for tribal of Anak Dalam in Jambi (Setyowati 2003).

Moliniera latifolia (Dryand. Ex WT Aiton) Herb. ex Kurz

Moliniera latifolia synonymous with Curculigo latifolia is a plant which is easily cultivated and found in five villages in this study, Batak Karo sub-ethnic used singkut leaves as wrapper of cimpa (the traditional cuisine from glutinous rice) and as drug of the fracture. The M. latifolia leaves used as a food wrapper because it has a strong fiber, bending, a distinctive flavour, and more durable. Empirically, M. latifolia is cultivated in the home garden which can be also used to facilitate access. The utilization of M. latifolia in this study for medicinal purposes is different from other ethnic such as anti-cancer (Ismail et al. 2010), anti-diabetes (Kant 2005), and anti-hepatitis B (Mohamed et al. 2007).

Benefits of the leaves and roots singkut for fractures medicines had also been known widely by the local communities of Borneo. As a drug fracture, the leaves are applied as wrapping in the sick bone so that the bone can re-seal. The bioassay results showed that the leaves and roots of M. latifolia had anti-microbial properties (Hong and Ibrahim 2012), while fruits and roots had activity as an anti-diabetic, anti-cholesterol (hypolipidemic) through regulation of glucose and lipid metabolism (Ishak et al. 2013). In addition, fruits have a high potential as a natural low-calorie sweetener (Suzuki et al. 2004) because they contain curculin and neoculin compounds (Suzuki et al. 2004; Kant 2005). Curculin and neoculin is a sweet protein with a unique flavor (Suzuki et al. 2004; Kant 2005), and has the quality taste 500-9000 times sweeter than sucrose (Yamashita et al. 1995). Therefore, it is very potential to be developed in the industry scale as a low-calorie sweetener. However, singkut has relatively small fruits, and the amount is relatively small so it is important to do further research to increase the size and number of fruits.

Etlingera elatior (Jack) RM Sm.

In this study, E. elatior was found in five villages from seven villages research location. This plant was used as traditional medicine and food. The flowers and fruit of E. elatior are used as a mixture of cincaang and terites. The cincaang is a traditional cuisine of Batak Karo sub-ethnic made from a mixture of cassava leaves (M. utilissima), banana pseudostem (M. paradisiaca), and flowers of E. elatior. The terites is a traditional soup of Karo Batak sub-ethnic, which is also known as pagit-pagit (pagit = bitter) obtained from grass extract from rumen of ruminant animals (cattle and goats). The addition of E. elatior on terites serves to neutralize the “smell” of fermented grass on the rumen. E. elatior contains essential oil derived from sesquiterpenoid class (Jaafar et al. 2007; Azemi 2008; Abd elmageed et al. 2011), which is volatile (Croteau et al. 2000), resulting in a distinctive aroma. The addition of E. elatior to various foods makes food more delicious, fresher, more durable, and has a distinctive aroma. E. elatior has a bioactive compound of phenolic and fla vonoid (Cushnie and Lamb 2005; Xie et al. 2015), which could apparently inhibit bacterial growth (Abdelwahab et al. 2010) such as...
Diversity and abundance of plants in home garden

A total 85 species of plants (43 families, 71 genera) were grown as traditional medicine and foodstuffs by sub-ethnic Batak Karo. A total of 43 species of plants were found in the Semangat Gunung Village, 54 species in the Lingga Village, 36 species in the Doulu Village, 18 species in the Surbakti Village, 8 species in the Pertegun Village, 11 species in the Cinta Rayat Village, and 5 species in the Merdeka Village (Table 1). C. esculenta, B. rapa, M. esculenta, M. latifolia, P. guajava, C. citratus, E. japonica, C. arabica, C. annuum, and E. elatior were the most common crop in more than 50% of surveyed villages. The differences in the number of species and the individual number of these plants found in each village had implications on the differences in the similarity index and the index of diversity. Table 2 shows the similarity index of medicinal plants and food plants found in each village.

In this study, it was found that the adjacent villages had the high similarity of Jaccard index (Ji) of the medicinal and edible plants compared to others. Table 2 shows that the plant species was relatively similar such as Brassica sp, H. rosa-sinensis, and C. annuum. The lowest commonality index of the medicinal and edible plants is owned by the Merdeka Village and the Doulu Village (0.030), followed by the Semangat Gunung Village and the Merdeka Village (0.048). The Jaccard equality index is influenced by the species as well as the number of species found in the two different villages. If the number of found species is much different, the index of similarity is small. The number of plant species found in the research location was relatively different, i.e., the Doulu Village (36 species), the Semangat Gunung Village (43 species), while the Merdeka Village (5 species). Coffee (C. arabica) is the only one species found in the three villages.

The number of individuals and the number of species found in the home garden also affect the diversity index and the abundance index. Average of Shannon-Wiener index of garden plants in the Karo ethnic group were moderate at 1.164-3.123 (Table 3). The Shannon-Wiener index obtained in this study was higher than that obtained in the home garden of Bali Aga ethnic in Bali island with the value of 0.92-1.13 (Sujarwo and Caneva 2015), and Cuba ethnic with the value of 1.63-1.79 (Wezel and Bender 2003). However, it was lower than in the home garden of ethnics in Nepal with the value ranging from 4.03 to 4.42 (Sunwar et al. 2006). Plant species found in the garden was influenced by various factors such as culture (Cruz-Garcia and Struik 2015), ethnics, climate, and topography (Senanayake et al. 2009). Cruz-Garcia and Struik (2015) state that the plant diversity in the home garden was higher during the dry season than rainy season.

The average index of Margalef showed that the abundance of plants located in Batak Karo sub-ethnic was ranging from 0.929 to 2.531. This was in contrast to Sujarwo and Caneva (2015) who found that the abundance index of home garden in Bali Aga was a lower with the value of 0.85-1.87. Each home garden has a unique structure, function, and composition depending on the natural ecological research sites (Galhena et al. 2012).

### Table 2. The similarity of Jaccard (Ji) of the medicinal and edible plants in home garden used by Batak Karo sub-ethnic in North Sumatra

| Village       | Doulu   | Semangat Gunung | Lingga | Merdeka | Cinta Rayat | Surbakti | Pertegun |
|---------------|---------|-----------------|--------|---------|-------------|----------|----------|
| Doulu         | -       | 0.418           | 0.364  | 0.030   | 0.081       | 0.130    | 0.075    |
| Semangat Gunung| -       | -               | 0.352  | 0.048   | 0.017       | 0.184    | 0.128    |
| Lingga        | -       | -               | -      | 0.054   | 0.088       | 0.200    | 0.088    |
| Merdeka       | -       | -               | -      | -       | 0.600       | 0.053    | 0.222    |
| Cinta Rayat   | -       | -               | -      | -       | -           | 0.110    | 0.154    |
| Surbakti      | -       | -               | -      | -       | -           | -        | 0.182    |
| Pertegun      | -       | -               | -      | -       | -           | -        | -        |

### Table 3. The diversity index (Shannon-Wiener) and the abundance index (Margalef) of medicinal and edible plants in 7 villages of Batak Karo sub-ethnic, North Sumatra

| Villages       | Number of species | Minimum | Average | Maximum | The Shannon Wiener diversity index |
|---------------|------------------|--------|---------|---------|-----------------------------------|
| Doulu         | 43               | 0      | 0.929   | 7.116   | 3.123                             |
| Lingga        | 66               | 0      | 1.896   | 22.859  | 3.150                             |
| Semangat Gunung| 43               | 0      | 2.531   | 43.667  | 2.395                             |
| Surbakti      | 19               | 0      | 1.164   | 5.582   | 1.164                             |
| Pertegun      | 13               | 0      | 1.032   | 5.649   | 1.840                             |
| Merdeka       | 5                | 0.063  | 1.148   | 1.595   | 1.575                             |
| Cinta Rayat   | 11               | 0.016  | 2.116   | 14.339  | 1.579                             |
Batak Karo Sub-ethnic had the local wisdom to benefit the home garden as a source of food and traditional medicine. The plants used as local staple food had been widely cultivated in home garden including *Singkong* (*M. latifolia*) as a material for cinampa (the traditional cuisine from glutinous rice) and cekala (*E. elatior*) as the main ingredient for terities (soup from grass extract from the runem of ruminant). The diversity index obtained in home garden of Batak Karo sub-ethnic was in moderate level. The plants in the home garden of Batak Karo sub-ethnic was relatively different among other villages. The adjacent village had a greater similarity index compared to other villages. *F. rukam* is one of wild plant, which had a high potential to be developed as a source of fruit, while *M. latifolia* had a potential as a low-calorie sweetener.

**ACKNOWLEDGEMENTS**

Authors would like to thanks the local society and the head villages of the Cinta Rayat Village, the Doulu Village, the Lingga Village, the Merdea Village, the Pertegun, the Semangat Gunung Village, and the Surbakti Village, at Karo District in North Sumatra, Indonesia especially for their assistance and information during the study. Thanks also to Endang Cristine Purba, Rani Nur Aini, Avif, Fajri, and Jiro for their assistance to data collection and Higher Education (DIKTI) No: 2709/UN2.R3.1/HKPOS.00/2017 for research funding.

**REFERENCES**

Abdelmageed AHA, Faridah QZ, Norhana FMA, Julia AA, Kadir MA. 2011. Micropopagation of *Eltingera elatior* (Zingiberaceae) by using auxiliary bud explants. J Med Plants Res 5 (18): 4465-4469.
Abdelwahab KSI, Zaman FQ, Mariod AA, Yacob M, Abdelmageed AHA, Khamis S. 2010. Chemical composition, antioxidant and antibacterial properties of the essential oils of *Eltingera elatior* and *Cinnamomum pubescens*. J Sci Food Agric 90: 2682-2668.
Ain RA. 2016. Etnobotani pangan masyarakat etnis Karo di Desa Semangat Gunung, Kecamatan Merdeka, Sumatra Utara. [Skripsi]. Departemen Biologi FMIPA, Universitas Indonesia, Depok [Indonesian].
Ashagre M, Asfaw Z, Kelbessa E. 2016. Etnobotanical study of wild edible plants in Burji District, Segan Area Zone of Southern Nations, Nationalities and Peoples Region (SNNPR), Ethiopia. J Ethnobiol Ethnopharmacol 12 (32): 1-15.
Azemia HB. 2008. Monitoring of Quality of Essential Oil from *Eltingera* sp. 2 (Zingiberaceae) by GC and GC-MS. [Thesis]. Chemical Engineering Faculty of Chemical & Natural Resources Engineering, Universiti Malaysia, Pahang.
Bangun P. 2010. Bataks Culture. In: Koentjaraningrat. Man and Culture in Indonesia. Djamabatan, Jakarta.
Barcelo R. 2015. Phytochemical screening and antioxidant activity of edible wild fruits in Benguet, Cordillera administrative region, Philippines. Electr J Biol 11 (3): 80-89.
Blancas J, Casas A, Rangel-Landa S, Moreno-Calles A, Torres I, Pérez-Negrón E, Solís L, Delgado-Lemus A, Parra F, Arellanes Y, Caballero J, Cortés L, Lira R, Dávila P. 2010. Plant management in the Tehuacán-Cuicatlán Valley. Econ Bot 64: 287-302.
Casas A, Cruse J, Otero-Arnaiz A. 2006. Valiante-Banuet A: Maintenance of phenotypic diversity of *Stenocereus stellatus* (Cactaceae) by indigenous people in central Mexico. Biodiv Conserv 15: 879-896.
Croteau R, Kutchan TM, Lewis NG. 2000. Natural products (secondary metabolites). In: Buchanan B, Grussim W, Jones R (eds.). Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists, Rockville, MD.
Cruz-Garcia GS, Struck PC. 2015. Spatial and seasonal diversity of wild food plants in home gardens of northeast Thailand. Econ Bot 69 (2): 99-113.
Cushine TT, Lamb AJ. 2005. Antimicrobial activity of flavonoids. Intl J Antimicrob Agents 26 (5): 343-56.
Gallhena DH, Reed F, Maredia KM. 2013. Home gardens: a promising approach to enhance household food security and wellbeing. Agric Food Secur 2 (8): 1-13.
Ghasemzadeh A, Jaafar HZE, Rahmat A, Ashkani S. 2015. Secondary metabolites constituents and antioxidant, anticancer and antibacterial activities of *Etlingera elatior* (Jack) R.M.Sm grown in different locations of Malaysia. BMC Complementary and Alternative Medicine 15 (335): 1-10.
High C, Shackleton CM. 2000. The comparative value of wild and domestic plant in homegarden of a South African rural village. Agroforestry system 48: 141-156.
Hong LS, Ibrahim D. 2012. Studies on antibiotic compounds of methanol extract of *Curculigo latifolia* dryrand. Proceedings of The 2nd Annual International Conference Syiah Kuala University 2012 & The 8th IMT-GT Uninet Biosciences Conference Band Aceh, 22-24 November 2012: 1-3.
Ishak NA, Ismail M, Hamid M, Ahmad Z, Asyiah S, Gafar A. 2013. Antidiabetic and hypolipidemic activities of *Curculigo latifolia* fruit: root extract in high fat fed diet and low dose stiz induced diabetic rats. Evid-Based Compl Altern Med 2013, Article ID 601838. DOI: 10.1155/2013/601838.
Ismael MF, Abdullah NA, Saleh G, Ismail M. 2010. Anthesis and flower visitors in *Curculigo latifolia* Dryand (Hypoxidaceae). J Biol Life Sci 1 (1): 13-15.
Jaafar FM, Osman CP, Ismail NH, Awang K. 2007. Analysis of essential oils of leaves, stems, flowers and rhizomes of *Etlingera elatior* (Jack) RM Smith. Malays J Anal Sci 11: 269-273.
Kant R. 2005. Sweet proteins-potential replacement for artificial low calorie sweeteners. Nutr J 4 (5): 1-6.
Kawwanto, Nakagoshi N. 2012. Revitalizing pekarangan home gardens, a small agroforestry lan dicape for a low carbon society. Hokkia 16: 161-171.
Kehlenbeck K, Maass BL. 2004. Crop diversity and classification of home gardens in central Sulawesi, Indonesia. Agrofor Syst 63: 53-62.
Kumar BM, Nair PKR. 2004. The enigma of tropical homegardens. Agrofor Syst 61: 135-152.
Kusumaningtyas R, Kobayashi T, Takeda S. 2006. Mixed species gardens in Java and the transmigration areas of Sumatra, Indonesia: a comparison. J Trop Agric 44 (12): 15-22.
Larios C, Casas A, Vallejo M, Moreno-Allen AI, Blancas J. 2013. plant management and biodiversity conservation in Náhuatl homegardens of the Tehuacán Valley, Mexico. J Ethnobiol Ethnomed 9 (74): 1-16.
Lok R. 2001. A better understanding of traditional homegardens through the use of locally defined management zones. Indigen Knowl Dev 9 (2): 14-19.
Magurran AE. 1988. Ecological Diversity and its Measurement. Princeton University Press, Princeton, USA.
Magurran AE. 2003. Measuring Biological Diversity. Blackwell Publishing, London.
Martin GJ. 1995. Etnobotanaty A People and Plants Conservation Manual. Chapman and Hall, London.
Méndez VE, Lok R, Somarriba E. 2001. Interdisciplinary analysis of homegardens in Nicaragua: Micro-zonation, plant use and socioeconomical importance. Agrofor Syst 51: 85-96.
Miller R, Nair P. 2006. Indigenous agroforestry systems in Amazonia: From prehistory to today. Agrofor Syst 66 (2): 151-164.
Mohamed FA, Rainatm W, Heng LY. 2007. Genetic Effects of Arsenic and Heavy Metals Pollutants on *Curculigo latifolia* (Lumbah). J Biol Sci 7: 1155-1162.
Moreno-Calles A, Casas A, Blancas J, Caballero J, Garcia-Barrios L, Perez-Negrón E. Ragel-Landa S. 2010. Agroforestry systems and biodiversity conservation in andid zones: the case of the Tehuacán Valley, Central México. Agrofor Syst 80: 315-331.
Müller-Dombos D, Ellenberg H. 1974. Aims and Methods of Vegetation Ecology. John Wiley and Sons, New York.
Parra F, Blancas J, Casas A. 2012. Landscape management and domestication of *Stenocereus pruinatus* (Cactaceae) in the Tehuacán Valley, Mexico.
Parra F, Blancas J, Casas A. 2012. Landscape management and domestication of *Stenocereus pruinatus* (Cactaceae) in the Tehuacán Valley, Mexico.
Valley: human-guided selection and gene flow. J Ethnobiol Ethnomed 8 (32): 1-17.

Purba EC. 2015. Etnobotani masyarakat etnis Karo di Kecamatan Merdeka, Sumatra Utara. [Tesis]. Program Studi Biologi, Program Pascasarjana, Universitas Indonesia, Depok. [Indonesian]

Senanayake RL, Sangakkara UR, Pushpakumara DKNG, Stamp P. 2009. Vegetation composition and ecological benefits of home gardens in the Meegahukiula Region of Sri Lanka. Trop Agric Res. 21 (1): 1-9.

Setyowati FM. 2003. Interrelationship between Kubu tribe people and plant resources at the Bukit Duabelas biosphere reserve, Jambi. Biodiversitas 4 (1): 47-54. [Indonesian]

Silalahi M, Supriatna J, Walujo EB, Nisyawati. 2015. Local knowledge of medicinal plants in sub-ethnic Batak Simalungun of North Sumatra, Indonesia. Biodiversitas 16 (1): 44-54.

Silalahi M. 2014. The Ethnopharmacology of The Medicinal Plants in Sub-ethnic Batak North Sumatra and the Conservation Perspective. [Disertation]. Program Studi Biologi, Program Pascasarjana, FMIPA, Universitas Indonesia. [Indonesian]

Silalahi M. 2016. Diversity of medicinal plants in homegardens in Tanjung Julu village, North Sumatra, Indonesia. Intl J Biol Res 4 (1): 78-82.

Soemarwoto O. 1987. Home gardens: a traditional agroforestry system with a promising future. In: Steppler HA, Nair PKR, (eds.), Agroforestry: A Decade of Development. ICRAF, Nairobi.

Sujarwo W, Caneva G. 2015. Ethnobotanical study of cultivated plants in home gardens of traditional villages in Bali (Indonesia). Human Ecol 43 (5): 769-778.

Sunwar S, Thornström CG, Subedi A, Bystrom M. 2006. Home gardens in Western Nepal: opportunities and challenges for on-farm management of agrobiodiversity. Biodiv Conserv 15 (13): 4211-4238.

Suzuki M, Kurimoto E, Nirasawa S, Masuda Y, Hori K, Kurihara Y, Shimba N, Kawai M, Suzuki E, Kato K. 2004. Recombinant curculin heterodimer exhibits taste-modifying and sweet-tasting activities. FEBS Lett 573: 135-138.

The Plantlist. 2017. The Plantlist Database. Royal Botanic Gardens, Kew and Missouri Botanical Garden. Downloadable from: www.theplantlist.org.

Thomas E, Vandebroek I, Goetghebeur P, Sanca S, Arrazola S, Van DP. 2008. The relationship between plant use and plant diversity in the Bolivian Andes, with special reference to medicinal plant use. Hum Ecol 36: 861-879.

Vogl CR, Vogl-Lukasser B, Puri R. 2004. Tools and methods for data collection in ethnobotanical studies of home gardens. Field Meth 16 (3): 285-306.

Wezel A, Bender S. 2003. Plant species diversity of home gardens of cuba and its significance for household food supply. Agrofor Syst 57 (1): 37-47.

Xie Y, Yang W, Tang F, Chen X, Ren L. 2015. Antibacterial activities of flavonoids: structure-activity relationship and mechanism. Curr Med Chem 22 (1): 132-49.

Yamashita H, Akabane T, Kurihara Y. 1995. Activity and stability of a new sweet protein with taste-modifying action, curculin. Chem Sens 20: 239-243.

Zheng XL, Xing FW. 2009. Ethnobotanical study on medicinal plants around Mt. Yinggeling, Hainan Island. China. J Ethnopharmacol 124: 197-210.