



The ethnomedicine of the Batak Karo people of Merdeka sub-district, North Sumatra, Indonesia

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Abstract

Background: Ethnomedicine can serve as a platform for studying specific relationships between indigenous cultures and using medicinal plants, thus to identify new chemical compounds used as drugs.

Objective: To document the medicinal plants and traditional medicines used by Batak Karo people and to provide information on the pharmacological properties of the most commonly used plants in the preparation to treat of various ailments especially preventive healthcare.

Methods: The ethnobotanical study was conducted in Merdeka sub-district, Karo regency, North Sumatra, Indonesia. An intensive field survey was conducted to collect information on medicinal plants used by the people. Data was collected applying semi-structured interviews (individual and group discussions) and questionnaires.

Results: A total of 124 plants species have been documented to treat various diseases. Zingiberaceae is the highest number of species being used as traditional medicines especially concoction of preventive healthcare. The study revealed that fever is treated using the highest number of different medicinal species (23 species).

Conclusion: Batak Karo people in Merdeka sub-district have a rich local knowledge about medicinal plants. It is a need to extend the documentation of medicinal plants in the area and evaluation its biological activity as a basis for developing future medicines.

Keywords: Ethnomedicine; Batak Karo; Indonesia.

1. Introduction

Based on old records Heyne there are about 5000 species of useful plants in Indonesia which constitutes 3 % of the medicinal plants (Kartawinata 2004). Approximately the total number today is greater than those earlier results. To overcome this, an effective way to find new medicinal plants is to follow the indigenous knowledge (Mendelsohn & Balick 1995, Balick & Cox 1997, Sam et al. 2008, Guimbo 2011). Ethnobotanical can serve as a platform for studying specific relationships between indigenous cultures and using medicinal plants, thus to identify new chemical compounds used as drugs (Balick & Cox 1997, Heinrich 2000, Fabricant & Farnsworth 2001). Research based on local people perspective, will be good strategy to make conservation investment, and to identify what kind of sustainable incentives can be delivered.

The province of North Sumatra is home to Batak ethnic. It comprises six sub-ethnic: Karo, Toba, Simalungun, Mandailing, Pakpak and Angkola (Singarimbun 1975). The Karo is a group of local people who inhabit Karoland (Tanah Karo) in North Sumatra, Indonesia. The Karoland is an area mainly consisting of mountains (Sinabung and Sibayak) and highlands (Anderson 1971, Singarimbun 2007). These good circumstances has made Batak Karo people are known to have utilized plants which related to its cultural for many years and still practice and maintain it such as traditional medicine (Singarimbun 1975, Penny & Singarimbun 2007, Silalahi et al. 2015). They use many medicinal plant species which known to have efficacy to maintain the health or to cure disease. Ethnomedicinal plants used by Batak Karo in different

villages of Karo regency have also been reported recently such as in Tongkoh (Sembiring et al. 2013) and Kaban Tua (Silalahi 2014). Semangat Gunung, Jaranguda and Merdeka are closed to Bukit Barisan highland. They are arranged in a densely populated core, with forest and fields on the periphery. The dense forest near the villages has made them rich in floral resources and prosperous in medicinal plants species wealth. Based on our knowledge, there are no reports regarding to ethnomedicinal aspects of Karo of Merdeka sub-district. For that aim, an ethnobotanical research has been conducted on Batak Karo society in Merdeka sub-district. To analyze the role of medicinal plants of Karo, this research deals with the variety of medicinal plants and its uses.

2. Materials and methods

2.1. Study area

The ethnobotanical study was conducted during April – June 2014 in Semangat Gunung, Jaranguda, and Merdeka villages, Karo regency, North Sumatra, Indonesia (elevation 1,162-1,453 m above sea level) (Figure 1). The average annual temperature was 16 to 17 °C. Merdeka village is the capital of Merdeka sub-district. Semangat Gunung is about 8.39 km² and 16 km from Merdeka. Jaranguda is 5.46 km² and 2 km from Merdeka. More than 95% of the Batak Karo people in Merdeka sub-district are farmers. They plant tomato, cabbage, potato, chili and carrot.

2.1. Data collection

Ethnobotanical data were obtained through semi-structured interviews (individual and group discussions) and questionnaires. A snowball method was conducted to select the respondents beginning with the village leader and traditional doctors (Bernard 2002). There are 3 village leader and 3 traditional doctors in the research area. Surveys and interviews were carried out in 87 respondents. The standard interviews contained specific questions on gender, age and main users of plant products. Several questions concerning about medical plants were addressed to determine the local names of plants, parts of plants they used and for what purpose. This research was also used to collect specimens for identification of the used plants which organized by key informants. The identification of the specimens was deposited at the Herbarium of Universitas Indonesia, Depok, Indonesia. Scientific names of the plants species were verified using The Plant List online source.

3. Result

A total of 124 medicinal plant species are used by Batak Karo ethnic society in Semangat Gunung belonging to 107 genera and

52 families (Table 1). Among all the families, Zingiberaceae is the highest number of plant species, 15 species (Figure 2). The 124 medicinal plants species are used to treat of 39 different diseases. The highest numbers of medicinal plants (23 species) are used for the treatment of fever. Fever included a symptom caused by some diseases which mainly focusing on lowering body temperatures. Moreover, 71% of the species are collected from the wild. These are all plants naturally occurring in different vegetation types e.g.: forest, along roads, shrubbery and agricultural fields. Twenty three of the species are cultivated in home gardens, fields and along the village road. Six percent of the species are both taken from the wild and also grown in the agricultural fields or home gardens. Herbs (74 species) are found to be the most used plants followed by wood (36 species), shrubs (11 species), lianas (2 species) and lichen (1 species). Leaves are most commonly used by Batak Karo, comprising 51% of all the results on use of plant parts. This is followed by root (10%), rhizome (8%), flower (7%), stem (7%), fruit (6%), whole plant (6%), bark (2%), seed (2%), tuber (1%) and latex (1%) (Table 2). Traditional concoctions are *minak*, *tawar*, *kuning*, and *oukup*.

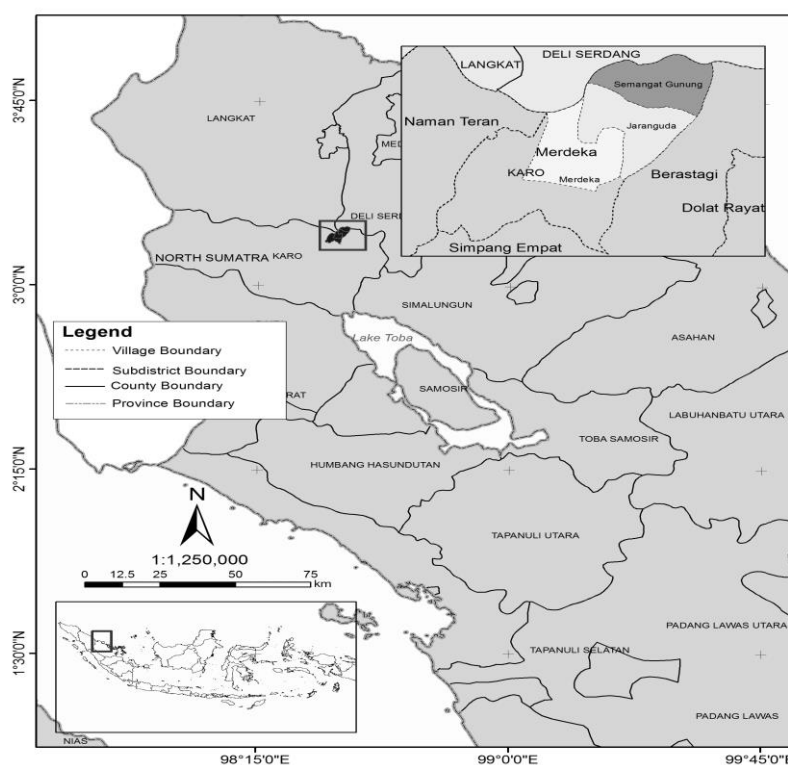


Fig. 1: Map of Merdeka Sub-District, Karo Regency, North Sumatra, Indonesia.

Table 1: Medicinal Plants Species Used By Batak Karo People in Merdeka Sub-District. Plant Sources: W (Wild), C (Cultivated). Part Utilized: B (Bark), L (Leaf), La (Latex), Fl (Flower), Fr (Fruit), Rh (Rhizome), Ro (Root), Se (Seed), St (Stem), T (Tuber), and Wp (Whole Plant).

Scientific name	Local name	Life form	W/C	Part utilized	Medicinal application
Acanthaceae					
<i>Graptophyllum pictum</i> (L.) Griff	Selantam	Wood	W	L	Fever
<i>Justicia gandarussa</i> Burm.F.	Besi-besi/Sangke simplet	Wood	W, C	L	Rheumatism, contusion, fever, weakness
<i>Strobilanthes crisper</i> Blume	Pijer keling	Shrub	W	L	Wounds, weakness
<i>Strobilanthes</i> sp.	Paris	Herb	W	L	<i>Minak, Kuning, Oukup</i>
Alliaceae					
<i>Allium cepa</i> L.	Pia	Herb	C	T	High cholesterol, <i>Tawar</i>
<i>Allium sativum</i> L.	Lasuna	Herb	C	T	Teeth problems, fever, cancer, <i>Kuning, Tawar</i>
<i>Allium schoenoprasum</i> L.	Gundera mbelang	Herb	C	Wp	Hookworm
Amaranthaceae					
<i>Alternanthera</i> sp.	Siberani jantan	Herb	W	L	Fever, rheumatism
Amaryllidaceae					
<i>Curculigo latifolia</i> Dryander	Singkut	Shrub	W, C	Ro	Eye problems
Apiaceae					

<i>Centella asiatica</i> (L.) Urb.	Pegaga	Herb	W	L	Abscesses, wounds, bone fractures, blood circulation problem, abscesses
<i>Coriandrum sativum</i> L. Araceae	Ketumbar	Herb	W	Fr	Diarrhea, <i>Oukup</i>
<i>Acorus calamus</i> L.	Jerango	Herb	W, C	L, Ro	Fever, coughs, <i>Oukup</i>
<i>Homalomena</i> sp. Arecaceae	Langge megara	Herb	W	L	Fever
<i>Areca catechu</i> L.	Mayang	Wood	W	Fr, St, Ro	Burns, heartburn, weakness, <i>Tawar</i> , <i>Minak</i>
<i>Arenga pinnata</i> (Wurmb) Merr	Pola	Wood	W	Ro, St	Fever, <i>Tawar</i>
<i>Calamus diepenhorstii</i> Miq.	Ketang	Liana	W	L, St, Ro	Stomache ache, <i>Tawar</i>
<i>Cocos nucifera</i> L.	Tualah	Wood	W, C	Fr, St, Ro	Smallpox, fever, <i>Tawar</i> , <i>Minak</i>
<i>Nipa fruticans</i> (Wurmb) Thunb Asclepiadaceae	Nipah	Wood	W	L, St, Ro	Gastritis, <i>Tawar</i>
<i>Hoya</i> sp. Aspleniaceae	Tawar ipoh	Herb	W	L	Weakness, cancer, <i>Tawar</i> , <i>Minak</i>
<i>Asplenium</i> sp. Asteraceae	Peldang	Herb	W	L	Bone fractures
<i>Bidens chinensis</i> Willd	Kalesi	Herb	W	L	Burns, blood circulation problem, appetite enhancer, liver,
<i>Artemisia vulgaris</i> Linn	Binara embang	Herb	W	L	Hemorrhoids, dysmenorrheal
<i>Centipeda minima</i> P.	Pecah pinggan	Herb	W	L	Weakness
<i>Chromolaena odorata</i> (L.) R.M. King & H. Rob.	Sipesel	Herb	W	L	Bone fractures, <i>Tawar</i>
<i>Crassocephalum crepidioides</i> (Benth.) S. Moore	Sabi-sabi	Herb	W	L	Wounds
<i>Dicrocephala integrifolia</i> (L. f.) Kuntze	Sirahrah	Herb	W	L	Fever
<i>Erigeron sumatrensis</i> Retz.	Ciak-ciak	Herb	W	L	Stomach ache, wounds
<i>Eupatorium odoratum</i> L.	Lenga-lenga	Shrub	W	L	Bladder stones
<i>Lagenophora lanata</i> A. Cunn	Sibelin urat	Herb	W	Wp	Weakness
<i>Spilanthes iabadicensis</i> A.H. Moore	Sibancir	Herb	W	L	Colds, Diabetes
<i>Tithonia diversifolia</i> (Hemsl) A. Gray Balsaminaceae	Pagit-pagit	Shrub	W	L	High cholesterol
<i>Impatiens balsamina</i> L.	Bunga sapa	Herb	W	Fl	Abscesses, <i>Kuning</i>
<i>Impatiens platypetala</i> Lindley	Bunga pancur	Herb	W	Fl	<i>Kuning</i>
<i>Impatiens</i> sp. Caricaceae	Kiung	Herb	W	Fl	Itches, <i>Kuning</i>
<i>Carica papaya</i> L. Costaceae	Bertik	Herb	C	L	Fever, cancer
<i>Costus</i> sp. Cucurbitaceae	Tabar-tabar	Herb	W	L	Weakness
<i>Benincasa hispida</i> (Thunb.) Cogn.	Gundur	Herb	C	Se, Fl	<i>Tawar</i> , <i>Kuning</i>
<i>Cucumis sativus</i> L.	Cimen	Herb	C	Se, Fl	<i>Tawar</i> , <i>Kuning</i>
<i>Cucurbita moschata</i> Duchesne Dennstaedtiaceae	Jambe	Herb	C	Se, Fl	<i>Tawar</i> , <i>Kuning</i>
<i>Pteridium aquilinum</i> (L.) Kuhn Equisetaceae	Ersam	Herb	W	L	Itches
<i>Equisetum ramosissimum</i> Desf. Ericaceae	Sendep-sendep	Herb	W	Wp	Heartburn, <i>Tawar</i>
<i>Gaultheria leucocarpa</i> Blume Euphorbiaceae	Kalincayo	Wood	W	L	Colds, <i>Oukup</i>
<i>Aleurites moluccanus</i> (L.) <i>Bischofia javanica</i> Blume	Kembiri Cingkam	Wood Wood	W W	Fr B	Appetite enhancer, abscesses Gastritis
<i>Triadica</i> sp. Fabaceae	Tawan gegeh	Herb	W	St	Weakness, <i>Minak</i>
<i>Spatholobus ferrugineus</i> (Zoll. & Moritzi) Benth. Gesneriaceae	Tawan iket manuk	Herb	W	Wp	Rheumatic, muscle pain
<i>Aeschynanthus albidus</i> (Blume) Steud <i>Aeschynanthus sumatranus</i> Ohwi Gleicheniaceae	Kapal-kapal Sigara tundal	Herb Herb	W W	L L	Cancer, <i>Minak</i> Fever
<i>Gleichenia linearis</i> (Burm. f.) C.B. Clarke Lamiaceae	Sumpilpil	Shrub	W	L	Abscesses, fever
<i>Leucas decemdentata</i> (Willd.) Sm. <i>Mentha spicata</i> L.	Silembur kumpa Sigarang garang kuda	Herb Herb	W W	Wp L	Contusion Bad breath, stomach ache
<i>Coleus amboinicus</i> Lour. <i>Coleus scutellarioides</i> L.	Terbangun meratah Terbangun megara	Herb Herb	W W	L L	Headache, sprue Fever, stomach ache, abscesses, constipation
<i>Pogostemon cablin</i> (Blanco) Benth. Lauraceae	Nilam	Shrub	W	L	Wounds, aphrodisiac, cancer
<i>Cinnamomum burmanni</i> (Nees & T.Nees) Blume. <i>Persea americana</i> Mill. Leguminosae	Kulit manis Pokat	Wood Wood	W W	B L	Colds, diabetes, <i>Minak</i> Back pain, bladder stone
<i>Erythrina fusca</i> Lour. <i>Cassia tora</i> L.	Dapdap Kicik-kicik	Shrub Herb	W W	L Ro	Weakness Diarrhea, fever

<i>Mimosa pudica</i> L. Liliaceae	Pedem-pedem	Herb	W	L	Hypertension, bladder stone
<i>Cordyline fructicosa</i> (L.) A.Chev. Lindsaeaceae	Kaling juang	Wood	W	L	Fever
<i>Odontosoria</i> sp. <i>Odontosoria chinensis</i> (L.) J. Sm. Lycopodiaceae	Perik kuda Paku perik	Herb Herb	W W	L L	<i>Oukup</i> Itches, <i>Oukup</i>
<i>Lycopodium proliferum</i> L. Malvaceae	Terkal	Herb	W	L	Aphrodisiac
<i>Hibiscus rosa-sinensis</i> Linn	Rudang-rudang guru	Wood	W, C	L, Fl	Fever, cough
<i>Sida rhombifolia</i> L. <i>Urena lobata</i> L. Melastomaceae	Beras-beras Sampililit	Wood Wood	W W	Fl Ro	Rheumatism, teeth problems Colds, abscesses, bone fractures, headache
<i>Medinilla hypericifolia</i> Blume <i>Melastoma malabathricum</i> L. Meliaceae	Surindan kopi Senduduk	Herb Wood	W W	L Wp	Cancer Abscesses, sprue
<i>Aglaia odoratissima</i> Blume <i>Toona sureni</i> (Blume) Merr. Molluginaceae	Ukat-ukak Ingul	Wood Wood	W W	L B	Hypertension, bladder stone Weakness
<i>Molugo</i> sp. Moraceae	Rancang	Wood	W	L	Diarrhea
<i>Artocarpus heterophyllus</i> Lam. Musaceae	Nangka	Wood	C	Fr	Gastritis
<i>Musa paradisiaca</i> L. Myrtaceae	Galuh	Herb	C	L, St	Stomach ache, fever
<i>Eugenia aromatic</i> O.Berg <i>Melaleuca leucadendra</i> (L.) L. <i>Psidium guajava</i> L. Pandanaaceae	Cengkeh Kayu putih Galiman	Wood Wood Wood	W W C	Fl, L L L	Bad breath, cough, teeth problems, <i>Minak</i> Colds Gastritis, diarrhea
<i>Pandanus amaryllifolius</i> Roxb Piperaceae	Pandan	Shrub	W	L	<i>Oukup</i>
<i>Piper betle</i> L. <i>Piper nigrum</i> L.	Belo Lada mbiring	Shrub Liana	W W	L Fr	Burns Weakness, appetite enhancer, liver, <i>Oukup</i> , <i>Kuning</i> , <i>Tawar</i> , <i>Minak</i>
Plantaginaceae <i>Plantago major</i> L. Poaceae	Patah tulang	Herb	W	L	Diabetes, wounds
<i>Bambusa</i> sp. <i>Cymbopogon citratus</i> (DC.) Stapf <i>Eleusine indica</i> (L.) Gaertn <i>Imperata cylindrica</i> (L.) Raeusch. <i>Leersia hexandra</i> Swartz.	Buluh Sereh Padang teguh Rih Sayat-sayat	Wood Herb Herb Herb Herb	W C W W W	Ro, St Wp Ro Ro L	Cancer, <i>Tawar</i> Appetite enhancer, <i>Oukup</i> , <i>Minak</i> Heartburn, <i>Minak</i> Diabetes Teeth problems
<i>Saccharum officinarum</i> L. Polygalaceae	Tebu gara	Herb	W, C	St	<i>Minak</i>
<i>Polygala paniculata</i> L. <i>Polygala</i> sp. Polygonaceae	Rumput wangi Tongkap meringat	Herb Herb	W W	Ro L	Colds, <i>Oukup</i> Aphrodisiac
<i>Persicaria chinensis</i> (L.)H. Gross. Rosaceae	Siang-siang	Herb	W	L	Stomach ache
<i>Prunus acutissima</i> Urb <i>Rubus reflexus</i> Ker <i>Rubus pyriformis</i> Hook.f. & Thomson ex Hook.f. Rubiaceae	Kacihe Kopi-kopi kerangan Cancang dori	Wood Wood Wood	W W W	L L L	Itches Diarrhea, hemorrhoids, leprosy Gastritis
<i>Rubia cordifolia</i> L. <i>Uncaria gambir</i> (Hunter) Roxb. Rutaceae	Siraprap igung Gamber	Wood Wood	W W	L L, La	Bladder stones Gastritis, fever, abscesses, coughs, cancer, liver
<i>Citrus hystrix</i> DC. <i>Citrus nobilis</i> Lour. Solanaceae	Rimo mungkur Rimo puraga	Wood Wood	W, C W, C	L, Fr L, Fr	Fever, diabetes, <i>Oukup</i> , <i>Kuning</i> Fever, bone fractures, <i>Oukup</i> , <i>Tawar</i>
<i>Capsicum annum</i> L. <i>Physalis andiabetesta</i> L. <i>Nicotiana tabacum</i> L. <i>Solanum verbascifolium</i> L. Sterculiaceae	Cina Depuk-depuk Mbako Lancing	Shrub Herb Wood Wood	C W C W	Fr L L L	Abscesses Bone fractures, abscesses, dislocate, hypertension Wounds Dislocate
<i>Abroma</i> sp. Theaceae	Cuping-cuping	Wood	W	L	Heart disease
<i>Camellia sinensis</i> (L.) Kuntze Urticaceae	Teh	Shrub	C	L	Itches
<i>Elatostema strigosum</i> Hassk <i>Laportea decumana</i> (Roxb.) Wedd <i>Poikilospermum</i> sp. Usneaceae	Sisik naga Lateng Ober	Herb Herb Wood	W W W	L Ro L	Fever, weakness Itches, muscle pain Stomach ache
<i>Usnea barbata</i> Fr.	Nakan angin	Li- chene	W	Wp	Weakness

Verbenaceae						
<i>Vitex trifolia</i> L.	Salagundi	Wood	W	L		Eye problems, cough
Violaceae						
<i>Viola inconspicua</i> Blume	Calung-calung	Herb	W	L		Stomach ache
Vitaceae						
<i>Vitis gracilis</i> BL.	Gagatan harimo	Herb	W	L		Aphrodisiac, stomach ache
Zingiberaceae						
<i>Alpinia</i> sp.	Laja	Herb	C	Rh		Appetite enhancer, diabetes, <i>Oukup</i> , <i>Kuning</i>
<i>Alpinia galanga</i> (L.) Willd.	Kelais	Herb	C	Rh		Coughs, weakness, <i>Oukup</i>
<i>Boesenbergia pandurata</i> (Roxb.) Schltr	Temu kunci	Herb	C	Rh		Appetite enhancer, <i>Oukup</i>
<i>Curcuma domestica</i> Valetton	Kuning gersing	Herb	C	Rh		Gastritis, appetite enhancer, weakness, coughs, diabetes, <i>Kuning</i>
<i>Curcuma heyneana</i> Valetton & Zijp	Kuning gajah	Herb	C	Rh		Coughs, wounds, Weakness, <i>Oukup</i>
<i>Curcuma xanthorrhiza</i> Roxb.	Temulawak	Herb	C	Rh		Appetite enhancer, diabetes, <i>Oukup</i> , <i>Kuning</i>
<i>Nicolaia speciosa</i> Horan	Cekala/Kincung	Herb	C	St, L		Weakness, <i>Oukup</i> , <i>Tawar</i>
<i>Hedychium coronarium</i> J.Koenig	Bunga ncole	Herb	W	Fl		Eye problems, <i>Kuning</i>
<i>Hedychium cylindricum</i> Ridl	Cekala kabang	Herb	C	L		Colds, cough
<i>Kaempferia galanga</i> L.	Kaciwer	Herb	C	Rh		Liver, diarrhea, stomach ache, appetite enhancer, <i>Oukup</i> , <i>Kuning</i> , <i>Tawar</i>
<i>Zingiber</i> sp.	Cekala rih	Herb	C	L		Appetite enhancer, coughs, colds
<i>Zingiber americanus</i> Blume	Lempuyang	Herb	C	Rh		Fever, Weakness, appetite enhancer, <i>Oukup</i> , <i>Kuning</i>
<i>Zingiber officinale</i> Blume	Bahing	Herb	C	Rh		Fever, appetite enhancer, <i>Oukup</i> , <i>Kuning</i> , <i>Tawar</i> , <i>Minak</i>
<i>Zingiber purpureum</i> Roscoe	Bungle	Herb	C	Rh		Appetite enhancer, <i>Oukup</i>
<i>Zingiber</i> sp.	Alia	Herb	C	Rh		Gastritis

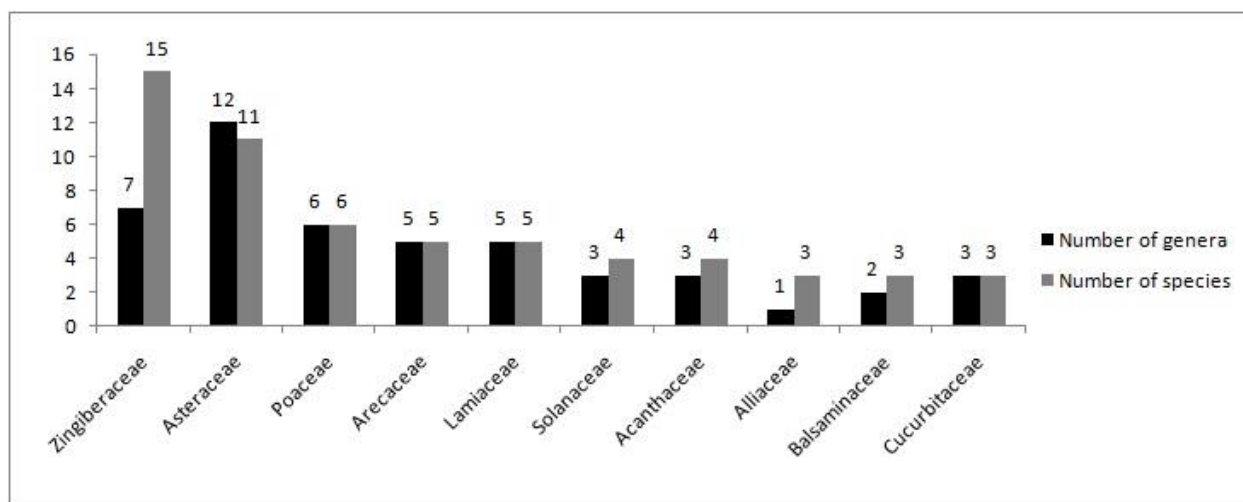


Fig. 2: Most Important Medicinal Plant Families Used by Batak Karo.

Table 2: Plant Parts Used

Plant Part	Number of Uses	%
Leaf	74	51
Root	14	10
Rhizome	11	8
Flower	10	7
Stem	10	7
Fruit	9	6
Whole plants	8	6
Bark	3	2
Seed	3	2
Tuber	2	1
Latex	1	1
	145	100

4. Discussion

4.1. Batak Karo's conceptions of health and diseases

Most of the respondents are familiar with the plants species which used to treat the common diseases such as fever, weakness, cold, cough and stomach ache. They considered that traditional medicines are important for the health care because it has no side effect to human body.

Indigenous people believe two types of diseases: naturalistic (diseases caused by nature) and personalistic (disease caused by supernatural) (Foster 1976, Florey & Wolff 1998). Batak Karo is no

exception to this case. For Batak Karo people, naturalistic diseases are called *bangger* and personalistic is *kelangen*. *Bangger* are those caused by the malfunctioning of human body such as cold, fever and stomach ache and *kelangen* are caused by supernatural powers such as evil spirit (*begu, kena si mentas-mentas*), bad people (*tama-tama*) and curse. *Kengalen* is treated with special ritual which conducted by traditional healers. Meanwhile *bangger* using some various plants species.

Most of the remedies are prepared using fresh plant material. They have some concoction to treat common disease or maintain healthcare of human body: *minak, kuning, tawarand oukup*. *Minak* is traditional oil which can be used to treat weakness problems,

dislocate, bone fractures, dislocate, wounds, burns and cuts. *Kuning* is used to warm body especially for children and after sickness. *Tawar* is used to treat common colds, warm bodies and as an appetite enhancer. *Oukup* is steam baths which usually for health care and treat women after childbirth. Though Batak Karo often uses mixtures of a variety of plants for many treatments, they use single plant species for some treatments. For example, *Crassocephalum crepidioides* - leaf paste is used to treat small cuts and wounds; *Hedychium coronarium* – the trapped water from its crown is dropped to treat irritated eyes; *Psidium guajava* – boiled leaves is used to treat diarrhea; *Gaultheria leucocarpa* – leaves are chewed to treat common cold.

To prepare *kuning*, some medicinal plants are used such as *Alpinia* sp., *Curcuma domestica*, *C. xanthorrhiza*, *Allium sativum*, *Kaempferia galanga*, *Impatiens balsamina*, *Impatiens* sp., *Piper nigrum*, *Hedychium coronarium*, *Benincasa hispida*, *Cucumis sativus*, *Cucurbita moschata*, *Zingiber americanus*, *Z. officinale*, *Z. purpureum*, *Citrus hystrix* and *Impatiens platypetala*. The paste of all the plants are shaped like small balls and dried. The dried *kuning* is mixed with some drops of water and applied to body after taking a shower in the afternoon or evening. It is caused by the cold temperature at the night.

Tawar is a paste of some plants which is drunk with hot drinking water. There are two types of *tawar* according to the informants. Firstly, *tawar* which is used for the special treatments such as male problems, gynecological problems and weak children. The plants are *Arenga pinnata*, *Calamus diepenhorstii*, *Areca catechu*, *Cocos nucifera*, *Nipa fructicans*, *Hoya* sp., *Chromolaena odorata*, *Bambusa* sp., *Allium cepa*, *Allium sativum*, *Piper nigrum*, *Equisetum ramosissimum*, *Zingiber officinale* and *Citrus nobilis*. The other one is *tawar* which used for common ailments such as weakness after sick or fatigue. The plants are *Nicolaia speciosa*, *Piper nigrum*, *Allium cepa*, *A. sativum*, *Zingiber officinale*, *Kaempferia galanga*, *Cucumis sativus*, *Cucurbita moschata*, and *Benincasa hispida*. The plants for *minak* are *Triadica* sp., *Areca catechu*, *Cocos nucifera*, *Zingiber officinale*, *Eugenia aromatic*, *Piper nigrum*, *Allium cepa*, *A. sativum*, *Hoya* sp., *Cinnamomum burmanni*, *Aeschynanthus albidus*, *Cymbopogon citratus* and *Eleusine indica*. The milk of *Cocos nucifera* is boiled until it become oil and mixed with the paste another plants.

The plants for *oukup* are *Alpinia galangal*, *Alpinia* sp., *Bosenbergia pandurata*, *Curcuma heyneana*, *Curcuma xanthorrhiza*, *Kaempferia galanga*, *Nicolaia speciosa*, *Zingiber americanus*, *Zingiber officinale*, *Zingiber purpureum*, *Strobilanthes* sp., *Gaultheria leucocarpa*, *Pandanus amaryllifolius*, *Piper nigrum*, *Cymbopogon citratus*, *Polygala paniculata*, *Coriandrum sativum*, *Acorus calamus*, *Odontosoria* sp., *Odontosoria chinensis*, *Citrus hystrix* and *C. nobilis*. *Oukup* is used to treat women after giving birth. The plants are added to boiling water and put in a bucket. The woman is placed in a small and closed room. Once the woman is seated, the bucket of decoction is put near the woman.

4.2. Diseases treated with medicinal plants

Zingiberaceae tend to be found most frequently used in Indonesia as medicinal plants (Siagian & Sunaryo 1996, Kuntorini 2005, Susiarti et al. 2008, Silalahi 2014). *Curcuma*, *Zingiber*, *Alpinia*, *Kaempferia* and *Hedychium* plants are extensively studied for their phytochemistry and pharmacological properties (Hartati et al. 2014). *Curcuma domestica* is an important plant of *Curcuma* that widely used as medicinal plants and spice in Indonesia. Batak Karo used it to treat gastritis, weakness problems, coughs, diabetes and appetite enhancer. *Curcuma domestica* has antibacterial (Lutomski et al. 1974, Banerjee & Nigam 1978, Shankar & Sreenivasa 1979), antifungal (Banerjee & Nigam 1978), antioxidant (Phan et al. 2001, Unnikrishnan & Rao 1996), anticarcinogenic (Goel et al. 2001, Shao et al. 2002). *Zingiber* is the most commonly used by Batak Karo, 5 species. This is followed by *Curcuma* (3 species), *Alpinia* and *Hedychium* (each 2 species) and *Kaempferia* (1 species). Although *Kaempferia galanga* and *Hedychium coronarium* are locally medicinally used in Indonesia,

knowledge on its biological or chemical activities is scarce so that more research needs to be developed in this field (Hartati et al. 2014, de Padua et al. 1999, van Valkenburg & Bunyapraphatsara 2001).

In addition to Zingiberaceae, Batak Karo uses some species plants of the Zingiberaceae for *oukup* to treat different ailments and weakness after childbirth. At least 10 species of Zingiberaceae are used to prepare *oukup*. People in Minahasa, North Sulawesi, Indonesia use 7 species (*Alpinia galanga* (L.) Willd., *Curcuma domestica* Valetton, *C. xanthorrhiza* Roxb., *Kaempferia galanga* L., *Zingiber montanum* (Koenig) Link ex Dietr, *Z. officinale* Roscoe and *Z. officinale* var. *rubrum* Theilade) for the steam bath, *bakera* (Zumsteg & Weckerle 2007). Meanwhile, Balinese use 6 species of Zingiberaceae (*Cheilocostus speciosus* (J. Koenig) C.D. Specht, *Curcuma purpurascens* Blume, *C. zanthorrhiza* Roxb., *Kaempferia rotunda* L., *Zingiber officinale* Roscoe and *Z. zerumbet* (L.) Roscoe ex Smith) for *loloh*, Balinese herbal drinks (Sujarwo et al. 2015).

The majority of respondents perceived that fever; weakness and loss of appetite are symptoms for all of the various diseases especially for children. Medicinal plants are often used to treat those symptoms. They used leaves or roots *Acorus calamus* and the flower of *Hibiscus rosa-sinensis* to treat fever for children. The boiled of *Acorus calamus* is applied to head and body. The paste of flower of *Hibiscus rosa-sinensis* is applied to forehead. Batak Simalungun people also use those plant species to treat fever (Silalahi et al. 2015). Weakness can be caused by excessive fatigue and after childbirth or sickness. Nineteen plants species are used to treat weakness. Most of them are the Zingiberaceae such as *Alpinia galanga*, *Curcuma domestica*, *C. heyneana*, *Nicolaia speciosa*, and *Zingiber americanus*. The remedies consist of concoction of various plants species that is boiled and drunk as tea or *minak*, *kuning* that is applied to whole body.

Mostly medicinal plants are used for health promotion and boost immunity. A total of 46 of 124 plants species are used for traditional decoction: *minak*, *kuning*, *tawar* and *oukup*. Those traditional decoctions are used to maintain health and immunity for both children and adults. The top three commonly used plants are *Zingiber officinale*, *Piper betle* and *Kaempferia galanga*. *Zingiber officinale* and *Piper betle* are used for *minak*, *kuning*, *tawar* and *oukup*; and *Kaempferia galanga* is used for *kuning*, *tawar* and *oukup*. The following is a short review of these three plants species.

4.2.1. *Zingiber officinale*

Zingiber officinale is one of the commonly used spices and medicinal plants in Indonesia and around the world. *Zingiber officinale* is used to treat fever, promote appetite and health in this study. They acknowledged that *Zingiber officinale* is a useful plant to warm body. Batak Karo lives in highland area so that they use concoction to maintain their body from cold weather such as *tawar*, *kuning* and *minak*. Batak Simalungun use *Zingiber officinale* to treat gastrointestinal disorders, stomach ache, fever, aphrodisiac, and wound (Silalahi et al. 2015). People in Ben En National Park, Vietnam consider *Zingiber officinale* is the most important medicinal plants of Zingiberaceae to treat common diseases such as fever, colds, flu, weakness and for treating women after childbirth (Sam et al. 2008) and also people in Singapore use it to treat bruises, cold, fever, fibromyalgia, hyperlipidemia, gastroenteritis, hair loss, menstrual cramps and menopause symptom (Siew et al. 2014).

Zingiber officinale has been extensively studied for its biological and chemical activities. The rhizomes contain essential oil and oleoresins which responsible for the characteristics ginger flavor and pungency (Singh et al. 2008). It has been studied for its antioxidant (Stoilova et al. 2007, Ali et al. 2008, Singh et al. 2008, Bellik et al. 2013, Bellik et al. 2014), antiviral of human respiratory syncytial virus (HRSV) (Chang et al. 2013), antiemetic (Philips et al. 1993, Sharma et al. 1997), and anti-inflammatory (Penna et al. 2003, Grzanna et al. 2005).

4.2.2. Piper betle

Piper betle is widely used for cultural and religious practices (Chaveerach et al. 2006, Sujarwo et al. 2015,) and medicinal plant in Southeast Asia region (Kumar et al. 2010). It is known that the leaves have antiseptic and activity. In Indonesia, *P. betle* is commonly known as sirih. Indonesian have had a long relationship with *P. betle* and are familiar with its uses. The leaves are frequently boiled to treat bad breath and vaginal discharge. Batak Karo people use the leaves for chewing with areca nut (*Areca catechu* L.), calcium carbonate, and latex of *Uncaria gambir*. The medicinal importance of *P. betle* is widely acknowledged in some ancient Thai traditional medicine textbooks and traditional healers, whereby leaves alleviate kidney inflammation and thirst from diabetes; treat cough, asthma, and bronchitis.

In our study, respondents used *P. betle* to treat liver, weakness and to boost appetite. The most common method of preparation is to drink the boiled water of *P. betle* leaves. To promote the health, they mixed the leaves with some medicinal plants to make decoction such as *oukup*, *kuning*, *tawar* and *minak*.

Due to the prevalence of its uses, many studies have been conducted to evaluate its compounds. Some example of the studies include anticancer (Kumar et al. 2010, Fathilah et al. 2010), antibacterial (Ramji et al. 2002, Nalina & Rahim 2007, Gupta et al. 2009, Tan & Chan 2014), antioxidant (Fathilah et al. 2010, Pin et al. 2010, Arambewela et al. 2006, Sharma et al. 2009, Tan & Chan 2014), antidiabetic (Arambewela et al. 2006), anti-inflammatory (Sharma et al. 2009, Kumar et al. 2010, Pin et al. 2010), antiallergic (Kumar et al. 2010), and antifungal (Phongpaichit et al. 2005, Kumar et al. 2010, Ali et al. 2010, Caburian & Osi 2010).

4.2.3. Kaempferia galanga

The rhizome of *K. galanga* is generally used for *oukup*, *kuning* and *tawar* to promote health; and to treat liver, diarrhea, stomach ache. It is widely used as a spice and food flavoring in traditional dishes to boost appetite. *K. galanga* is traditionally used by people in many regions for the treatment of cold, indigestion, headache, toothache, muscular swelling, rheumatism, pectoral and abdominal pains (Kanjapothi et al. 2004, Ridditid et al. 2008). In China, it is used as a spice and a medicinal plant which is used to treat hypertension, headache, toothache, rheumatism, dyspepsia, coughs, inflammatory tumor, pectoral and abdominal pains (Huang et al. 2008). The Japanese use the plant as ingredients in ascent bag which is indicated as improving sleep or minimizing stressful situations (Huang et al. 2008). In Malaysia, the leaves and rhizomes are chewed to treat coughs (Ridditid et al. 2008) and as a local tonic (Othman et al. 2006). In Thailand, the rhizomes are used to treat toothache, scabs, rheumatism, swelling and abdominal pain (Sirirugsa 1997).

The pharmacological activities of *K. galanga* reported thus far include antioxidant (Chanwitheesuk et al. 2005, Chan et al. 2009, Hanumantharaju et al. 2010, Sahoo et al. 2014), antimicrobial (Hanumantharaju et al. 2010, Sahoo et al. 2014), antinociceptive (Ridditid et al. 2008, Sulaiman et al. 2008, Thiengsusuk et al. 2013), antimalarial (Thiengsusuk et al. 2013), anti-inflammatory (Sulaiman et al. 2008, Vittalrao et al. 2011, Thiengsusuk et al. 2013), antibacterial (George & Pandalai 1949), amebicidal (Chu et al. 1998) and anticancer (Kosuge et al. 1985).

5. Conclusion

This study indicates that Batak Karo people in Merdeka sub-district, Karo regency, North Sumatra are still experimenting and maintaining the health tradition. They are still continue to depend on medicinal plants, at least for treating of some ailments such as fever, weakness, cold, abscesses, cough and stomach ache. They preserve the local knowledge so that it calls for initiatives to conserve the knowledge alongside the repository of medicinal plants in the research area. Furthermore, in the light of the concoction which used many plants species, some of them are need to conduct

phytochemical and biological activity studies to generate information which could be used in drugs development.

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References

- [1] Ali BH, Blunden G, Tanira MO, Nemmar A (2008) Some phytochemical, pharmacological and toxicological properties of ginger (*Zingiber officinale* Roscoe): A review of recent research. Food and Chemical Toxicology 46, 409–420. <http://dx.doi.org/10.1016/j.fct.2007.09.085>.
- [2] Ali I, Khan FG, Suri KA, Gupta BD, Satti NK, Dutt P, et al (2010) In vitro antifungal activity of hydroxychavicol isolated from *Piper betle* L. Annals of Clinical Microbiology and Antimicrob 9(7), 1–9. <http://dx.doi.org/10.1186/1476-0711-9-7>.
- [3] Anderson J (1971) Mission to the East Coast of Sumatra in 1823. Oxford University Press, Singapore.
- [4] Arambewela L, Arawawala M, Rajapaksa D (2006) *Piper betle* : a potential natural antioxidant. Int. J. Food Sci Technol 41, 10–14. <http://dx.doi.org/10.1111/j.1365-2621.2006.01227.x>.
- [5] Arambewela LSR, Arawawala LDAM, Ratnasooriya WD (2005) Antidiabetic activities of aqueous and ethanolic extracts of *Piper betle* leaves in rats. Journal of Ethnopharmacology 102, 239–245. <http://dx.doi.org/10.1016/j.jep.2005.06.016>.
- [6] Balick MJ, Cox PA (1997) Ethnobotanical research and traditional health care in developing countries. In Medicinal plants for forest conservation and health care, volume 92 (Bodeker G, Bhat KKS, Burley J, Vantomme P eds), Rome: Food and Agriculture Organization of the United Nations, pp. 12–23.
- [7] Banerjee a & Nigam SS (1978) Antimicrobial efficacy of the essential oil of *Curcuma longa*. Indian Journal of Medical Research 68, 864–866.
- [8] Bellik Y, Benabdesselam F, Ayad A, Dahmani Z, Boukraa L, Nenmar A, et al. (2013) Antioxidant activity of the essential oil and oleoresin of *Zingiber officinale* Roscoe as affected by chemical environment. International Journal of Food Properties 16(6), 1304–1313. <http://dx.doi.org/10.1080/10942912.2011.584257>.
- [9] Bellik Y (2014) Total antioxidant activity and antimicrobial potency of the essential oil and oleoresin of *Zingiber officinale* Roscoe. Asian Pacific Journal of Tropical Disease 49(1), 40–44. [http://dx.doi.org/10.1016/S2222-1808\(14\)60311-X](http://dx.doi.org/10.1016/S2222-1808(14)60311-X).
- [10] Bernard HR (2002) Research methods in anthropology: Qualitative and quantitative methods. 3rd ed. Alta-Mitra Press, United States.
- [11] Caburian AB & Osi MO (2010) Characterization and evaluation of antimicrobial activity of the essential oil from the leaves of *Piper betle* L. E-International Scientific Research Journal 2(1), 2–13.
- [12] Chan EWC, Lim YY, Wong SK, Lim KK, Tan SP, Lianto FS, Yong MY (2009) Effects of different drying methods on the antioxidant properties of leaves and tea of ginger species. Food Chemistry 113, 166–172. <http://dx.doi.org/10.1016/j.foodchem.2008.07.090>.
- [13] Chang JS, Wang KC, Yeh CF, Shieh DE, Chiang LC (2013) Fresh ginger (*Zingiber officinale* L) has anti-viral activity against human respiratory syncytial virus in human respiratory tract cell lines. Journal of Ethnopharmacology 145, 146–151. <http://dx.doi.org/10.1016/j.jep.2012.10.043>.
- [14] Chanwitheesuk A, Teerawutgulrag A, Rakariyatham N (2005) Screening of antioxidant activity and antioxidant compounds of some edible plants of Thailand. Food Chemistry 92, 491–497. <http://dx.doi.org/10.1016/j.foodchem.2004.07.035>.
- [15] Chaveerach A, Mokkalum p, Sudmoon R, Taneet T (2006) Ethnobotany of the genus *Piper* (Piperaceae) in Thailand. Ethnobotany Research and Applications 4, 223–231. <http://dx.doi.org/10.17348/era.4.0.223-231>.
- [16] Chu DM, Miles H, Toney D, Ngyuen C, Marciano-Cabral F (1998) Amebicidal activity of plant extracts from Southeast Asia on *Acanthamoeba* spp. Parasitology Research 84, 746–752. <http://dx.doi.org/10.1007/s004360050480>.

- [17] De Padua LS, Bunyapraphatsara N, Lemmens RHMJ (1999) Plant resources of South-East Asia No.12(1). Medicinal and poisonous plants. Backhuys Publishers, Leiden.
- [18] Fabricant DS, Farnsworth NR (2001) the value of plants used in traditional medicine for drug discovery. *Environmental Health Perspectives* 109 (1), 69-75. <http://dx.doi.org/10.1289/ehp.01109s169>.
- [19] Fathilah AR, Sujata, R., Norhanom, AW, Adenan MI (2010) Antiproliferative activity of aqueous extract of *Piper betle* L. and *Psidium guajava* L. on KB and HeLa cell lines. *Journal of Medicinal Plants Research* 4, 987-990.
- [20] Florey MJ & Wolff XY (1998) Incantations and herbal medicines: alone ethnomedicinal knowledge in a context of change. *Journal of Ethnobiology* 18(1), 39-67.
- [21] Foster GM (1976) Disease etiologies in non-western medical systems. *American Anthropologist* 78, 773-782. <http://dx.doi.org/10.1525/aa.1976.78.4.02a00030>.
- [22] George M & Pandalai KM (1949) Investigations on plant antibiotics (Part IV): further search for antibiotic substances in Indian medicinal plants. *Indian J Med Res* 37, 169-181.
- [23] Goel A., Boland CR, Chauhan DP (2001) Specific inhibition of cyclooxygenase-2(COX-2) expression by dietary curcumin in HT-29 human colon cancer cells. *Cancer Letters* 172, 111-118. [http://dx.doi.org/10.1016/S0304-3835\(01\)00655-3](http://dx.doi.org/10.1016/S0304-3835(01)00655-3).
- [24] Guimbo ID, Muller J, Larwanou M (2011) Ethnobotanical knowledge of men, women, and children in rural Niger: a mixed-methods approach. *Ethnobotany Journal* 9, 235-242. <http://dx.doi.org/10.17348/era.9.0.235-242>.
- [25] Gupta S, Kumar N and Gupta SM (2009) Antibacterial and antifungal activity in extract and oil of *Piper betle* (Linn) landrace Bangla Mahoba. *Adv Zool* 31, 16-20.
- [26] Grzanna R, Lindmark L, Frondoza CG (2005) Ginger-an herbal medicinal product with broad anti-inflammatory actions. *Journal of Medicinal Food* 8, 125-132. <http://dx.doi.org/10.1089/jmf.2005.8.125>.
- [27] Hanumantharaju N, Shashidhara S, Rajasekharan PE, Rajendra CE (2010) Comparative evaluation of antimicrobial and antioxidant activities of *Kaempferia galanga* for natural and micropropagated plant. *International Journal of Pharmacy and Pharmaceutical Sciences* 2(4), 72-75.
- [28] Hartati R, Suganda AG, Fidrianny I (2014) Botanical, phytochemical and pharmacological properties of *Hedychium* (Zingiberaceae)-A review. *Procedia Chemistry* 13, 150-163. <http://dx.doi.org/10.1016/j.proche.2014.12.020>.
- [29] Heinrich M (2000) Ethnobotany and its role in drug development. *Phytotherapy Research* 14, 479-488. [http://dx.doi.org/10.1002/1099-1573\(200011\)14:7<479::AID-PT958>3.0.CO;2-2](http://dx.doi.org/10.1002/1099-1573(200011)14:7<479::AID-PT958>3.0.CO;2-2).
- [30] Huang L, Yagura T, Chen S (2008) Sedative activity of hexane extract of *Kaempferia galanga* L. and its active compounds. *Journal of Ethnopharmacology* 120, 123-125. <http://dx.doi.org/10.1016/j.jep.2008.07.045>.
- [31] Kanjanapothi D, Panthong A, Lertprasertsuke N, Taesotikul T, Rujjanawate C, Kaewpinit D, et al (2004) Toxicity of crude rhizome extract of *Kaempferia galanga* L. (Proh Hom). *Journal of Ethnopharmacology* 90, 359-365. <http://dx.doi.org/10.1016/j.jep.2003.10.020>.
- [32] Kartawinata K (2004) Biodiversity conservation in relation to plants used for medicines and other products in Indonesia. *Journal Tropical Ethnology* 1(2), 1-11.
- [33] Kosuge T, Yokota M, Sugiyama K, Saito M, Iwata Y, Nakura M, et al (1985) Studies of anticancer principles in Chinese medicines. II. Cytotoxic principles in *Biota orientalis* (L.) ENDL. and *Kaempferia galanga* L. *Chemical and Pharmaceutical Bulletin* 33, 5565-5567. <http://dx.doi.org/10.1248/cpb.33.5565>.
- [34] Kuntorini EM (2005) Botani ekonomi suku Zingiberaceae sebagai obat tradisional oleh masyarakat di Kotamadya Banjarbaru. *Bioscientiae* 2(1), 25-36.
- [35] Kumar N, Misra P, Dube A, Bhattacharya S, Dikshuit M, Ranade S (2010) *Piper betle* Linn. a maligned Pan-asiatic plant with an array of pharmacological activities and prospects for drug discovery. *Current Research* 99(7), 922-932.
- [36] Lutomski J, Kedzia B, Debska W. Effect of an alcohol extract and of active ingredients from *Curcuma longa* on bacteria and fungi. *Planta Medica* 26(5), 9-19. <http://dx.doi.org/10.1055/s-0028-1097963>.
- [37] Mendelsohn R, Balick MJ (1995) the value of undiscovered pharmaceuticals in tropical forests. *Economic Botany* 49, 223-228. <http://dx.doi.org/10.1007/BF02862929>.
- [38] Nalina T & Rahim ZHA (2007) the crude aqueous extract of *Piper betle* L. and its antibacterial effect towards *Streptococcus mutans*. *Am. J. Biotechnol. Biochem* 3, 10-15. <http://dx.doi.org/10.3844/ajbbsp.2007.10.15>.
- [39] Othman R, Ibrahim H, Mohd MA, Mustafa MR, Awang K (2006) Bioassay-guided isolation of a vasorelaxant active compound from *Kaempferia galanga* L. *Phytomedicine* 13, 61-66. <http://dx.doi.org/10.1016/j.phymed.2004.07.004>.
- [40] Penna SC, Medeiros MV, Aimbire FSC, Faria-Neto HCC, Sertie JAA, Lopes-Martins RAB (2003) Anti-inflammatory effect of the hydroalcoholic extract of *Zingiber officinale* rhizomes on rat paw and skin edema. *Phytomedicine* 10, 381-385. <http://dx.doi.org/10.1078/0944-7113-00271>.
- [41] Penny DH & Singarimbun M (1967) Economic activity among the Karo Batak of Indonesia: a case study in economic change. *Bulletin of Indonesia Economic Studies* 6, 31-65. <http://dx.doi.org/10.1080/00074916712331331028>.
- [42] Phan TT, See P, Lee ST, Chan SY (2001) Protective effects of curcumin against oxidative damage on skin cell in vitro: its implication for wound healing. *Journal Trauma* 51, 927-931. <http://dx.doi.org/10.1097/00005373-200111000-00017>.
- [43] Phillips S, Ruggier R, Hutchinson SE (1993) *Zingiber officinale* (Ginger)-an antiemetic for day case surgery. *Anaesthesia* 48, 715-717. <http://dx.doi.org/10.1111/j.1365-2044.1993.tb07188.x>.
- [44] Phongpaichit S, Subhadhirasakul S, Wattanapiromsakul C (2005) Antifungal activities of extracts from Thai medicinal plants against opportunistic fungal pathogens associated with AIDS patients. *Mycoses* 48(5), 333-338. <http://dx.doi.org/10.1111/j.1439-0507.2005.01142.x>.
- [45] Pin KY, Chuah AL, Rashih AA, Mazura MP, Fadzureena J, Vimala S, et al (2010) Antioxidant and anti-inflammatory activities of extracts of betel leaves (*Piper betle*) from solvents with different polarities. *Journal of Tropical Forest Science* 22(4), 448-455.
- [46] Ramji N, Ramji N, Iyer R, Chandrasekaran S (2002) Phenolic antibacterials from *Piper betle* in the prevention of halitosis. *Journal of Ethnopharmacology* 83, 149-152. [http://dx.doi.org/10.1016/S0378-8741\(02\)00194-0](http://dx.doi.org/10.1016/S0378-8741(02)00194-0).
- [47] Riditid W, Sae-wong C, Reanmongkol W, Wongnawa M (2008) Antinociceptive activity of the methanolic extract of *Kaempferia galanga* Linn. In experimental animals. *Journal of Ethnopharmacology* 118, 225-230. <http://dx.doi.org/10.1016/j.jep.2008.04.002>.
- [48] Riditid W, Sae-wong C, Reanmongkol W, Wongnawa M (2008) Antinociceptive activity of the methanolic extract of *Kaempferia galanga* Linn. In experimental animals. *Journal of Ethnopharmacology* 118, 225-230. <http://dx.doi.org/10.1016/j.jep.2008.04.002>.
- [49] Sahoo S, Parida R, Singh S, Padhy RN, Nayak S (2014) Evaluation of yield, quality and antioxidant activity of essential oil of in vitro propagated *Kaempferia galanga* Linn. *Journal of Acute Disease*, 124-130. [http://dx.doi.org/10.1016/S2221-6189\(14\)60028-7](http://dx.doi.org/10.1016/S2221-6189(14)60028-7).
- [50] Sam HV, Baas P, Kessler PJA (2008) Traditional medicinal plants in Ben En National Park, Vietnam. *Blumea* 53, 569-601. <http://dx.doi.org/10.3767/000651908X607521>.
- [51] Sembiring R, Utomo B, Batubara R (2013) Keanekaragaman vegetasi tanaman obat di Hutan Pendidikan Universitas Sumatra Utara kaisan Taman Hutan Raya Tongkoh Kabupaten Karo Sumatra Utara. *Peronema Forestry Science Journal* 1, 19-22.
- [52] Shao ZM, Shen ZZ, Liu CH, Sartippour MR, Go VL, Heber D, et al (2002) Curcumin exerts multiple suppressive effects on human breast carcinoma cells. *International Journal of Cancer* 98, 234-240. <http://dx.doi.org/10.1002/ijc.10183>.
- [53] Shankar TNB & Sreenivasa Murthy V (1979) Effect of turmeric (*Curcuma longa*) fractions on the growth of some intestinal and pathogenic bacteria in vitro. *Indian Journal of Experimental Biology* 17, 1363-1366.
- [54] Sharma SS, Kochupillai V, Gupta SK, Seth SD, Gupta YK (1997) Antiemetic efficacy of ginger (*Zingiber officinale*) against cisplatin-induced emesis in dogs. *Journal of Ethnopharmacology* 57, 93-96. [http://dx.doi.org/10.1016/s0378-8741\(97\)00054-8](http://dx.doi.org/10.1016/s0378-8741(97)00054-8).
- [55] Sharma S, Khan IA, Ali I, Ali F, Kumar M, Kumar A, et al (2009) Evaluation of the antimicrobial, antioxidant, and anti-inflammatory activities of hydroxychavicol for its potential use as an oral care agent. *Antimicrobial Agents and Chemotherapy* 53, 216-222. <http://dx.doi.org/10.1128/AAC.00045-08>.
- [56] Siagian MH & Sunaryo (1996) Pemanfaatan suku Zingiberaceae sebagai obat tradisional oleh masyarakat Lembak Delapan, Bengkulu. In *Indeks Beranotasi Keanekaragaman Hayati* (Staf Peneliti Pusat Penelitian Biologi eds), LIPI Bogor, Indonesia, pp. 237-246.
- [57] Siew YY, Zareisehizadeh S, Seetho WG, Neo SY, Tan CH, Koh HL (2014) Ethnobotanical survey of usage of fresh medicinal plants in Singapore. *Journal of Ethnopharmacology* 155, 1450-1466. <http://dx.doi.org/10.1016/j.jep.2014.07.024>.

- [58] 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. <http://dx.doi.org/10.13057/biodiv/d160106>.
- [59] Silalahi M, Nisyawati, Walujo EB, Supriatna J, Mangunwardoyo W (2015) the local knowledge of medical plants trader and diversity of medicinal plants in the Kabanjahe traditional market, North Sumatra, Indonesia. *Journal of Ethnopharmacology* 175, 432-443. <http://dx.doi.org/10.1016/j.jep.2015.09.009>.
- [60] Silalahi M (2014) the ethnomedicine of the medicinal plants in sub-ethnic Batak, North Sumatra and the conservation perspective. Dissertation. Universitas Indonesia, Indonesia.
- [61] Singarimbun M (1975) Kinship, descent, and alliances among the Batak Karo. University of California, United States.
- [62] Singarimbun M (2007) Kutagamber: a village of the Karo. In *Villages in Indonesia* (Koentjaraningrat ed), Equinox Publishing, Singapore, pp. 115-128.
- [63] Singh G, Kapoor IPS, Singh P, de Heluani CS, de Lampasona MP, Catalan CAN (2008) Chemistry, antioxidant and antimicrobial investigations on essential oil and oleoresins of *Zingiber officinale* L. *Food and Chemical Toxicology* 46, 3295-3302. <http://dx.doi.org/10.1016/j.fct.2008.07.017>.
- [64] Siriruga P (1997) Thai Zingiberaceae: species diversity and their uses. In *The International Conference on Biodiversity and Biore-sources: Conservation and Utilization*, Phuket, Thailand, 23-27 November 1997.
- [65] Stoilova I, Krastanov A, Stoyanova A, Denev P, Gargova S (2007) Antioxidant activity of a ginger extract (*Zingiber officinale* L). *Food Chemistry* 102, 764-770. <http://dx.doi.org/10.1016/j.foodchem.2006.06.023>.
- [66] Sujarwo B, Keim AP, Savo V, Guarrera PM, Caneva G (2015) Ethnobotanical study of *Loloh*: traditional herbal drinks from Bali (Indonesia). *Journal of Ethnopharmacology* 169, 34-48. <http://dx.doi.org/10.1016/j.jep.2015.03.079>.
- [67] Sulaiman MR, Zakaria ZA, Daud IA, Ng YC, Hidayat MT (2008) Antinociceptive and anti-inflammatory activities of the aqueous extract of *Kaempferia galanga* leaves in animal models. *J Nat Med* 62, 221-227. <http://dx.doi.org/10.1007/s11418-007-0210-3>.
- [68] Susiarti S, Purwanto Y, Walujo EB (2008) Medicinal plant diversity in The Teso Nilo National Park, Riau, Sumatra, Indonesia. *Reinwardtia* 12(5), 383-390.
- [69] Tan YP & Chan EWC (2014) Antioxidant, antityrosinase and antibacterial properties of fresh and processed leaves of *Anacardium occidentale* and *Piper betle*. *Food Bioscience* 6, 17-23. <http://dx.doi.org/10.1016/j.fbio.2014.03.001>.
- [70] Thiengsusuk A, Chaijaroenkul W, Na-Bangchang K (2013) Antimalarial activities of medicinal plants and herbal formulations used in Thai traditional medicine. *Parasitology Research* 112, 1475-1481. <http://dx.doi.org/10.1007/s00436-013-3294-6>.
- [71] Unnikrishnan MK, Rao MN (1995) Inhibition of nitric-induced oxidation of hemoglobin by curcuminoids. *Pharmazie* 50, 490-492.
- [72] Van Valkenburg JLCH & Bunyaphatsara N (2001) *Plant resources of South-East Asia No.12 (2). Medicinal and poisonous plants 2*. Backhuys Publishers, Leiden.
- [73] Vittalrao AM, Shanbhag T, Kumari M, Bairy KL, Shenoy S (2011) Evaluation of antiinflammatory and analgesic activities of alcoholic extract of *Kaempferia galanga* in rats. *Indian Journal of Physiology Pharmacology* 55(1), 13-24.
- [74] Zumsteg IS & Weckerle CS (2007) *Bakera*, a herbal steam bath for postnatal care in Minahasa (Indonesia): documentation of the lants used and assessment of the method. *Journal of Ethnopharmacology* 111, 641-650. <http://dx.doi.org/10.1016/j.jep.2007.01.016>.