

KARO'S LOCAL WISDOM: THE USE OF WOODY PLANTS FOR TRADITIONAL DIABETIC MEDICINES

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KARO'S LOCAL WISDOM: THE USE OF WOODY PLANTS FOR TRADITIONAL DIABETIC MEDICINES. This paper identifies the plant species used traditionally by Karo people in North Sumatra, to cure diabetes, analyses the cultural significance index of those plants for the Karo, and clarifies phytochemical contents of the plants. Data were collected using survey method from selected respondents (n=54) based on their knowledge and practices in utilising medicinal plants to cure diabetic disease. Index of Cultural Significance (ICS) of plants was determined using the method proposed by Turner. Results showed that twelve woody plant species have been used to cure diabetes: loning leaf (*Psychotria* sp.), kacihe leaf (*Prunus accuminta* Hook), umbrella tree leaf (*Maesopsis eminii* Engl), mutamba leaf (*Guazuma ulmifolia* Lamk), cepcepan leaf (*Villebrunea subescens* Blume), pirdot/cepcepan lembu leaf (*Saurauia vulcani* Korth), raru bark (*Cotylelobium melanoxylo*), breadfruit leaf (*Artocarpus altilis*), salam leaf (*Syzygium polyanthum* Wight), mahogany seed (*Swietenia mahagoni* (L.) Jacq), cinnamon bark (*Cinnamomum burmanni*), and yellow bamboo rod (*Bambusa vulgaris* Schrad). Five of those plants: loning, umbrella tree, mutamba, raru and salam have the highest cultural significance level. These five plants are highly needed in large quantities by the Karo people, so their availability in the forest should be securely conserved and protected. The plants used contained alkaloids, flavonoids, phenolics and terpenoids which can help to lower blood sugar level.

Keywords: Ethnobotany, Karo ethnic, diabetic medicines, Index of Cultural Significance (ICS), phytochemical

*KEARIFAN LOKAL MASYARAKAT KARO: PENGGUNAAN TANAMAN BERKAYU UNTUK OBAT TRADISONALPENYAKIT DIABETES. Tulisan ini mengidentifikasi jenis-jenis tanaman yang digunakan oleh masyarakat Karo secara tradisional di Sumatera Utara, Indonesia, untuk mengobati diabetes. Jenis-jenis tanaman tersebut dianalisis indeks kepentingan budayanya (ICS) dan diklarifikasi kandungan fitokimianya. Metode survey digunakan dengan responden terpilih (n-54) berdasarkan pengetahuan mereka dalam memanfaatkan obat-obat tradisional untuk diabetes. Indeks kepentingan budaya (ICS) dari masing-masing tanaman diukur menggunakan metode yang dipakai oleh Turner. Hasil penelitian menunjukkan terdapat 12 jenis tanaman berkayu untuk mengobati diabetes: loning (*Psychotria* sp.), kacibe (*Prunus accuminta* Hook), kayu afrika (*Maesopsis eminii* Engl), jati belanda (*Guazuma ulmifolia* Lamk), cepcepan (*Villebrunea subescens* Blume), pirdot/cepcepan lembu (*Saurauia vulcani* Korth), raru (*Cotylelobium melanoxylo*), sukun (*Artocarpus altilis*), salam (*Syzygium polyanthum* Wight), mahoni (*Swietenia mahagoni* (L.) Jacq), kulit manis (*Cinnamomum burmanni*), dan bambu kuning (*Bambusa vulgaris* Schrad). Lima jenis tanaman: loning, kayu afrika, jati belanda, raru dan salam memiliki tingkat kepentingan budaya tertinggi yang dibutuhkan dalam jumlah yang banyak dibandingkan tanaman lain sehingga ketersediaannya di hutan harus dikonservasi dan dilindungi. Tanaman-tanaman yang dipakai oleh masyarakat tersebut mengandung alkaloid, flavonoid, fenolik dan terpenoid yang mampu menurunkan kadar gula darah.*

Kata kunci: Etnobotani, Masyarakat Karo, obat diabetes, indeks kepentingan budaya (ICS), fitokimia

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I. INTRODUCTION

Traditional communities have high dependency on a variety of plants as a source of food, medicine and for traditional ceremonial purposes (Winarti & Nurdjanah, 2005; Gerique, 2006; Das, Gupta, Nath, & Mustapha, 2013). Local knowledge of existing vegetation is developed based on experiences that has been tested for centuries and adapted to the local culture and environment (Martin, 1995; Waluyo, 2008; Hasibuan, 2011). This knowledge is known as local wisdom. Local wisdom is a basic knowledge gained from living in balance with nature. It is related to culture in the community which is accumulated and passed on from generation to generation. This wisdom can be both abstract and concrete, but the important characteristics come from experiences or evidences gained from life. The wisdom from real experiences integrates the body, the spirit and the environment (Mungmachon, 2012).

Karo people are spread in many regions of North Sumatra Province, Indonesia, but their origin are from the Karo Regency. They migrated to various places such as Medan City, Binjai, Deli Serdang, Langkat, and Simalungun Regency. The size of Karo regency is 2.97 % of the North Sumatra Province. Karonese population in North Sumatra in 2011 was about 913.000 people or 6.90 % of the total population of North Sumatra (North Sumatra Statistical Bureau, 2012; Karo Regency Statistical Bureau, 2012).

Karo people use various plant species for their daily life including for medicines. In terms of illness treatment, they have a philosophy "*lit bisa lit tamar*" which means that all diseases can be treated or cured. They strongly believe that the nature provides medicines to cure diseases. The use of natural resources as medicines for curing diseases including diabetes practiced by Karo as part of their culture since long time ago.

Widowati, Dzulkarnain, and Sa'roni (1997) stated that diabetes mellitus is a carbohydrate metabolism disorder characterised by high blood sugar level (hyperglycaemia) and the presence of glucose in urine (glucosuria).

Complications of the disease can increase the risk of heart attack and stroke. This disease is also closely associated with the blood circulation if left untreated, diabetes can cause many complications like kidney's damage, eye problems, nerve cell damages, depressions, slow healing of skin diseases, gum and urinary tract infections (Widowati et al., 1997; Alexious & Demopoulos, 2010). Ministry of Health of Republic Indonesia (2012) stated that diabetes is the sixth fatal disease in Indonesia. Due to the seriousness of this disease, people with diabetes usually take many types of treatment including traditional medicine.

Ethnobotany research is conducted to explore the cultural heritage as well as elaborating the potential of existing plants in the forest and environment (Windadri, Rahayu, & Uji, & Rustiami, 2006; Waluyo, 2008). The study primarily aimed to discover chemical compounds which are useful in the manufacturing of modern medicines to cure dangerous diseases such as cancer, AIDS, and others. Many researchers, especially those from Europe, have been conducting ethnobotany researches to obtain new chemical material for modern medicine. In the last decade, they began to shift ethnobotany research to Asia. Indonesia is preferred by the ethnobotany researchers as one of the research sites because its biodiversity richness is the second largest to Brazil (Ministry of Forestry of Republic Indonesia, 2010).

Raw materials of traditional medicines are generally supplied from the forests. Harianja (2012) stated that traditional medicine entrepreneurs in Karo Regency still utilise the natural forest to obtain the raw materials for the medicine. Forest area in Karo Regency is about 125,536.50 ha and 78.58 % of the total forest area and it is a protected forest (Karo Regency Statistical Bureau, 2012). The forest area is dominated by local and exotic woody plants, such as *Pinus merkusii*, *Altingia exelsa*, *Schima wallichii*, *Podocarpus* sp., *Toona sureni*, local fruit plants such as durian (*Durio zibethinus*), dadap (*Erythrina subumbrans*), rambutan (*Nipbellium lappacium*), pulai (*Alstonia scholaris*), palm sugar (*Arenga pinnata*), and rattan (*Calamus caesius*)

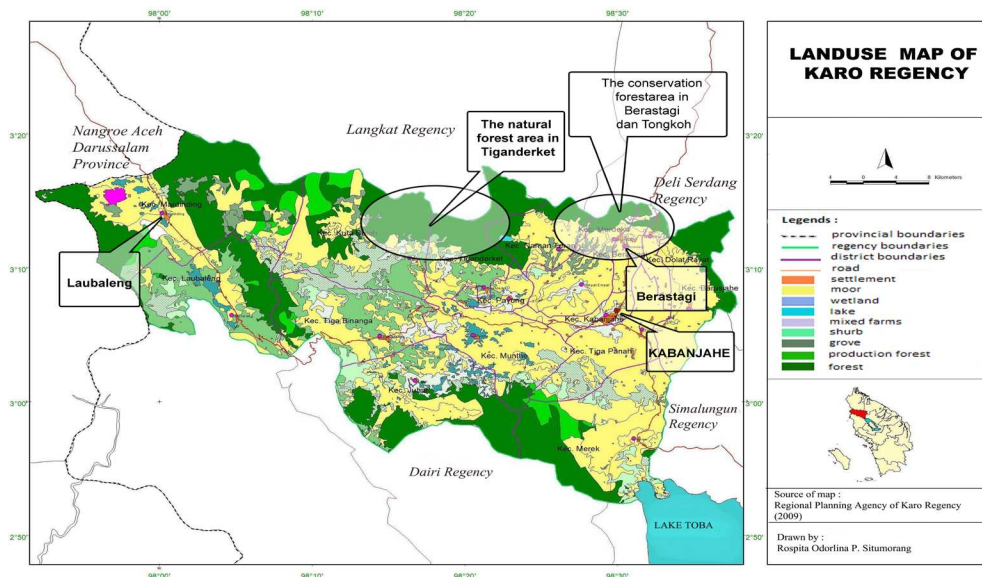


Figure 1. Research location in Karo Regency, North Sumatra, Indonesia

(Forestry Planning Agency, 2002).

Ethnobotanical research of medicinal plants is also important for conserving forests, endangered plant species, and cultural heritages; increasing the potential economic value of useful plants, and introducing natural drugs. Karo community is used to consume traditional medicines (Harianja, 2012), so they know the potential of various raw materials for ethnobotany study. Research on utilisation of plants for medicines has been done by many researchers (Bailey & Day, 1998; Batubara, Darusman, Mitsunaga, Rahminiwati, & Djauhari, 2010), but research on woody plants for treatment of diabetes is still limited. This paper aims to identify the woody plant species, parts of the plants used and processed by the Karo people for diabetes treatment, to assess the cultural significance value of those woody plants, and to analyse their phytochemical contents.

II. MATERIAL AND METHOD

A. Location and Time

The research was conducted in Karo Regency, North Sumatra Province, Indonesia, that is geographically located between 2050' – 3019' North and 97055' – 98038' East

(Karo Regency Statistical Bureau, 2012). Survey on utilisation of various woody plants for traditional medicine was conducted at Kabanjahe (3° 5'52.70"N and 98°29'30.78"E), Berastagi (3°11'24.68"N and 98°30'34.94"E), Tongkoh (3°12'28.72"N and 98°32'15.41"E), Katepul (3° 5'55.64"N, 98°30'16.09"E), and Laubaleng Villages (3°11'9.62"N and 98° 2'34.01"E). Sample plants were collected from conservation forest in Tiganderket (3°10'56.35"N and 98°19'39.13"E), Berastagi and Tongkoh Villages (03001'10"-03019'37" N and 98012'16"-98041'00" E). The research was undertaken from April to November 2013.

B. Data Collection and Sampling Techniques

Primary data were gathered through observations and surveys. Respondents and informants were selected purposively comprising of 48 respondents of patients, farmers, local merchants, processors, and collectors, and 6 government officials as key informants. Sample trees used by the respondents to cure diabetes were collected from the conservation forest for identifying their scientific names according to a systematic plant classification in the Conservation and Rehabilitation Research and

Development Centre in Bogor. Parts of plants identified were leaves, flowers, barks, and fruits.

C. Determination of Index of Cultural Significance

Data of plants, parts of plant, processing methods and the application in diabetes treatment are presented in Table 1 tables and then analysed descriptively. While the level of respondents' preference in utilising this natural medicine is analysed by using the Index of Cultural Significance (ICS) with the following formula:

$$ICS = \sum_{i=1}^n (q \cdot i \cdot e) n_i$$

ICS = Total utilisation of a plant (1,...,n)

n = utility values

q = quality values

i = intensity values

e = exclusivity values

The value of quality, intensity and exclusivity are scored using the scoring method proposed by Turner (1988) as cited by Sari (2009) as described below:

Quality value is estimated by scoring the value of plant species, which are: 5 = staple; 4 = secondary material/extra + primary material; 3 = other materials + secondary + medicinal plant material; 2 = ritual, mythology, recreation and so forth; 1 = unknown significance. Intensity value describes the intensity of utilisation of plant species, which are: 5 = very high intensity; 4 = high intensity ; 3 = moderate intensity; 2 = low (minimum), and 1 = very rarely use;

Exclusivity value describes the preference levels, which are: 2 = most preferred (the ultimate choice) and unchangeable; 1 = there are several substitutions to the original plants; and 0,5 = secondary source.

D. Phytochemical screening

Phytochemical screening is a qualitative analysis of the secondary metabolite compounds (Harborne, 1987). Bioactive substances tested usually contain tannins, alkaloids, carbohydrates, terpenoids, steroids and flavonoids. These compounds are synthesised by primary or rather secondary metabolism of living (Mann, 1987;

Edoga, Okwu, & Mbaebie, 2005). The testing performed in this study was preliminary for testing the presence of the different chemical groups (Rajani & Kanaki, 2008).

Literature reviews of previous studies were used first to find out the chemical compounds of several medicinal plants used by Karo people and other plants and were tested using phytochemical screening method in the laboratory. This research conducted only a preliminary test of the chemical compounds. To find out more of the pharmacologically compounds, further testing is still required. Four samples were tested in the laboratory i.e. pirdot leaves, loning leaves, yellow bamboo, and umbrella tree leaves. The secondary metabolite compounds tested were alkaloids, steroids, flavonoids, tannins, terpenoids and saponins. The phytochemical analysis was conducted at the Phytochemistry Laboratory, Faculty of Pharmacy, North Sumatra University.

III. RESULT AND DISCUSSION

A. The species of woody plants used for diabetes treatment by the Karo.

There are 12 woody plant species from 11 families used by the Karo people in the treatment of diabetes. Most of the plants are dicotyledonous plants except bamboo which is monocotyledonous. Table 1 shows the scientific and local names of the plants, part of the plants used for diabetes treatment, and method of medicine preparation and suggested dosage/ consumption.

The plant samples were collected from the Karo forest areas at an altitude of about 850 – 1400 meters above sea level except raru barks which were taken from outside of Karo area. Raru (*Cotylelobium melanoxylon* Pierre and *Shorea balanocarpoides*) according to Pasaribu (2009), are grown in the Central Tapanuli and Simalungun Regency forests at an altitude of 100-800 meters above sea level.

Karo people commonly process medical plants into medical concoctions with a very simple technique through boiling the plant

Table 1. The woody plant species utilised by the Karo people to cure diabetes

No.	Scientific name/Family	Local name	Part used	Material preparation and dosage/consumption
1.	<i>Psychotria</i> sp./ Rubiaceae	Loning	Leaf	A handful of dried leaves are mixed with 2 liter of water and then boiled until the water is reduced to about one third of its original volume. The remaining water/liquid is consumed twice a day.
2.	<i>Prunus acuminata</i> Hook/ Rosaceae	Kacihe	Leaf	9-10 pieces of dried leaves are boiled in 1 liter water until approximately 1/2 part of water is remaining, and then consumed twice a day.
3.	<i>Maesopsis eminii</i> Engl/ Rhamnaceae	Umbrella tree/ Kayu Afrika	Leaf	Fresh leaves or dried leaves (5-8 pieces) are boiled in 1 liter water until 2/3 part is remaining and then consumed twice up to three times a day.
4.	<i>Guazuma ulmifolia</i> Lamk/ Sterculiaceae	Mutamba/ Jati belanda	Leaf	A handful of dried leaves are boiled in 2 liter of water until 1/3 part is remaining and then consumed twice a day.
5.	<i>Bambusa vulgaris</i> Schrad/ Grammineae	Yellow bamboo	Rod	10-12 pieces of a 1 cm cubes from the rod are boiled in 2 liters of palm sap until 1/2 part is remaining and then consumed twice a day.
6.	<i>Saurauia vulcani</i> Korth/ Actinidiaceae	Pirdot, Cepcepan lembu	Leaf	Dried leaves (5-8 pieces) are boiled in 1 liter of water until half part is remaining and then consumed twice up to three times a day.
7.	<i>Cotylelobium melanoxylon</i> Pierre/ Dipterocarpaceae	Raru	Bark	The bark of 3-4 cm long and 1-2 cm width is cut into smaller sizes. Then they are boiled in 2 liters of water until half part is remaining and consumed twice a day
8.	<i>Shorea balanocarpoides</i> Symington/ Dipterocarpaceae	Raru	Bark	The bark of 3-4 cm long and 1-2 cm width is cut into smaller sizes. Then they are boiled in 2 liters of water until half of it is remaining. Then it is drunk twice a day.
9.	<i>Artocarpus altilis</i> / Moraceae	Breadfruit	Leaf	The chopped dried leaves, approximately a half handheld quantity are taken and boiled in 2 liters of water until 1/3 part of the water is remaining and consumed twice a day.
10.	<i>Syzygium polyanthum</i> Wight/ Myrtaceae	Salam	Leaf	<ul style="list-style-type: none"> 5-8 pieces dried leaves boiled in 2 liter of water until about 1/2 part of extract left and it is consumed 2-3 times a day. A handful dried leaves mixed with dried cinnamon bark, the size of a finger pinkie. Materials are meshed to flour. A spoonful (approximately 1 gram) is brewed in a cup boiled water, then it is consumed 1-2 times a day.
11.	<i>Swietenia mahagoni</i> (L.) Jacq/ Meliaceae	Mahogany	Seed	Mahogany seeds are crushed to a finer size. A spoonful of mahogany fraction is boiled in 2 liters of water until 3/4 of it is remaining. The extract is consumed once up to twice a day.
12.	<i>Cinnamomum burmanni</i> / Lauraceae	Cinnamon	Bark	Bark size of 3 to 4 cm is boiled in 1 liter water until half of it is remaining, and then the extract is consumed 1-2 times a day.

parts at a certain dose and then drinking the remaining water. They believe that boiling is a simple way to separate the useful substances from the plants. Boiling aims to extract medicinal compounds that dissolve in the water (polar). Thus extraction using the boiling method can separate the chemical constituents from the plant tissue. Heating process can accelerate the extraction process because high temperature will soften plant tissue so that extraction becomes faster. The second method is flouring plant parts that are listed in Table 1 with other materials such as betel leaves, various palm (riman and pinang) roots, turmeric, ginger and lime. Karo people believe that this process can enrich and thus strengthen the efficacy of the medicinal plants.

Karo people gather medical plants from nearby forests, fields, home gardens or purchasing it from local vendors. The forests are spread over Mount Sinabung, Simpang Empat, Namanteran, Tiganderket, Payung, Laubaleng and Mardingding Districts, Bukit Barisan Mountain, Merek, and Forest Conservation Park in the Districts of Berastagi and Dolatrayat. The knowledge of traditional medicine among Karo people has been passed from generations to generations. These traditional medicines are widely known as "Karo medicines" which are easily found at traditional markets in Karo Regency and neighboring areas. The raw materials for the medicines such as leaves, stems, roots and dried fruits are also available at the traditional markets in Kabanjahe and other markets in Berastagi and Tigapanah.

B. The Level of Cultural Significance

The level of cultural significance of various woody plants used for the treatment of diabetes is listed based on intensity and exclusiveness of its utilisation. The value of cultural significance (ICS) of each plant is presented in Table 2.

Table 2 shows five highest ICS values are belonging to loning tree, umbrella tree, mutamba, raru and salam. Result show that these plants are the most preferred and utilised intensively by the Karo people for diabetic

treatment that might will affect those plants' existence in the forest. In order to avoid the extinction of these medicinal plants in their habitats, they should be cultivated either in-situ or ex-situ. Cultivation techniques (silviculture) should be taught and disseminated to farmers. Some of those species such as raru (*Cotylelobium melanoxydon*) is listed as endangered species (IUCN, 2014) and mahogany (*Swietenia mahagoni* (L.) Jacq) is listed in APPENDIX II (CITES, 2012; lists species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled).

C. Chemical Compounds

Medical and pharmaceuticals technology in the world rely on the introduction of modern treatment and isolation of various chemical elements contained in the plant materials. One of the tests used to determine the chemical contents of a plant's material is through phytochemical screening which is described as a way to determine the qualitative content of the secondary metabolites of natural materials (Pasaribu, 2009).

Information of phytochemical contents of some woody plants that also are used by Karo people as diabetic medicines is gathered from literatures as presented in Table 3. Other woody plants tested in the laboratory with their results are presented in Table 4.

Tables 3 and 4 showed that alkaloids, flavonoids, phenolic (tannins) and terpenoids are present in pirdot leaf, mutamba leaf, cinnamon bark, loning leaf, umbrella tree leaf, salam leaf, raru bark, breadfruit leaf, and mahogany seed. While phytochemical screening of kacihe leaves (*Prunus acuminta* Hook) was not done in this study due to the very low level of usage of this species by the Karo community. This plant is less desirable in treatment of diabetes because it is considered less potent than other types so it had not been used lately.

According to previous research, those active compounds have hypoglycemic activity that decreases blood sugar level (Lumbanraja,

Tabel 2. Index of Cultural Significance (ICS) of diabetic medicinal plants

No.	Family name	Scientific name	Local name	ICS value
1.	Rubiaceae	<i>Psychotria</i> sp.	Loning (Karo)	170
2.	Rhamnaceae	<i>Maesopsis eminii</i> Engl	Kayu afrika	125
3.	Sterculiaceae	<i>Guazuma ulmifolia</i> Lamk	Mutamba/ Jati belanda	103
4.	Dipterocarpaceae	<i>Cotylelobium melanoxylon</i> Pierre	Raru (Batak, Karo)	93
5.	Dipterocarpaceae	<i>Shorea balanocarpoides</i> Symington	Raru (Batak, Karo)	93
6.	Myrtaceae	<i>Syzygium polyanthum</i> Wight	Salam	83
7.	Actinidiaceae		Cepcepan lembu (Karo), Pirdot (Batak)	49
8.	Meliaceae	<i>Swietenia mahagoni</i> (L.) Jacq	Mahogany	48
9.	Moraceae	<i>Artocarpus altilis</i> (Park.) Fosberg	Breadfruit	41
10.	Lauraceae	<i>Cinnamomum burmanii</i>	Cinnamon	28
11.	Gramineae	<i>Bambusa vulgaris</i> Schrad.	Yellow bamboo	25
12.	Rosaceae	<i>Prunus acuminata</i> Hook	Kacihe (Karo)	13

Remark: n = 48

2008; Pasaribu, 2009; Ngadiwiyana et al, 2011). Table 3 shows that mahogany seeds contain saponins, flavonoids and alkaloids. Lumbanraja (2008) stated that mahogany seeds extracted with ethanol would lower blood sugar levels. Raru wood extract contains flavonoids, tannins and saponins which are also lowering blood sugar levels through inhibition of the activity of α -glucosidase enzyme. This enzyme breaks polysaccharides into simple molecules that can be absorbed by the blood (Pasaribu, 2009). The most responsible chemical compounds for curing diabetes is belong to phenolic groups, namely cinnamaldehyde. Ngadiwiyana et al., 2011 stated that cinnamaldehyde isolated from cinnamon bark can inhibit the action of α -glucosidase enzyme, so it has the potential to decrease blood sugar level.

Based on above results, it can be concluded that indigenous knowledge of Karo people in identifying and utilising woody plants for traditional diabetic drugs is not contradicting to pharmacology. The varieties of the plants used by Karo people generally contain the active compounds that are studied in most researches (Table 3 and 4). A research conducted by Giri (2008) on the potency of salam leaf (*Syzygium polyanthum* Wight) to reduce the blood sugar level, concluded that the blood sugar level in the treated mice induced with hyperglycemia had significant effect on the decrease of the blood sugar level. However, to determine the most active compound that acts to degrade blood sugar level needs further tests on various types of pharmaceuticals that were not yet conducted in this study. The tests that should be done

Table 3. Phytochemical content of woody plants used by Karo people as diabetes medicine based on literature review

No.	Name/ part used	Chemical compounds							Literatures Source
		Alkaloids	Steroids	Flavonoids	Tannins	Saponin	Triterpenoids	Others	
1.	<i>Swietenia mahagoni</i> (L.) Jacq seed	+	-	+	-	+	-	-	Hariana, 2007; Lumbanraja, 2008.
2.	<i>Artocarpus altilis</i> (Park.) Fosberg / leaf	-	-	+	+	+	-	hydrocyanic acid, acetyl choline	Ministry of Health of Republic Indonesia, 1997
3.	<i>Cotylelobium melanoxylon</i> Pierre /bark	-	-	+	+	+	+	-	Pasaribu, 2009
4.	<i>Sborea balanocarpoides</i> Symington /bark	-	-	+	+	+	-	-	Pasaribu, 2009
5.	<i>Cinnamomum burmannii</i> /bark	+	-	+	+	+	+	-	Sufriadi, 2006
6.	<i>Guaşuma ulmifolia</i> Lamk/Leaf	+	+	+	+	+	+	-	Dzulkarnaen & Widowati, 1996; Umar, 2008
7.	<i>Syzygium polyanthum</i> Wight /leaf	-	-	+	+	+	-	-	Sulistiyani et al., 2010; Oktavia, 2011

should include isolation of active compounds and test on extracts or isolates in experimental animals.

IV. CONCLUSION

The Karo people in North Sumatra possess local knowledge that has been transferred from generations to generations for using parts of 12 woody plants as diabetic medicines, i.e. loning leaf (*Psychotria* sp.), kacihe leaf (*Prunus accuminata* Hook), umbrella tree leaf (*Maesopsis eminii* Engl), mutamba leaf (*Guaşuma ulmifolia* Lamk), cepcepan leaf (*Villebrunea subscens* Blume), pirdot/cepcepan lembu leaf (*Saurauia vulcani* Korth), raru bark (*Cotylelobium melanoxylon*), breadfruit leaf (*Artocarpus altilis*),

salam leaf (*Syzygium polyanthum* Wight), mahogany seed (*Swietenia mahagoni* (L.) Jacq), cinnamon bark (*Cinnamomum burmannii*), and yellow bamboo rod (*Bambusa vulgaris* Schrad). Five plants have proved to be the most preferred and utilised intensively by the Karo people for diabetic treatment, i.e. loning tree, umbrella tree, mutamba, raru and salam, so they need to be conserved through in-situ or ex-situ techniques to avoid extinction.

Chemical compounds in those 12 woody plants have proven to decrease blood sugar level. It means that the traditional knowledge of Karo people in utilising woody plants as diabetic medicine complies with pharmacology, however further research is still needed on

Table 4. The phytochemical contents of several woody medicinal plants tested in laboratory

No.	Samples of plants	Alkaloids			Steroids	Tannins	Flavonoids	
		Meyer	Dragendrof	Bouchardar			Zn reagent	Mg reagent
1.	Pirdot leaves	+	+	+	+	+	+	+
2.	Loning leaves	+	+	+	+	-	+	+
3.	Yellow bamboo	+	+	+	+	+	+	+
4.	Umbrella tree leaves	+	+	+	+	-	+	+

Remarks : + = contain tested elements

- = does not contain tested elements

isolation of active compounds and testing them on experimental animals.

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