Nature Conservation & Health Care Council
Biratnagar, Nepal

ISSN: 1991-2951 (Print)
ISSN: 2091-2781 (Online)

Our Nature

Journal homepage: http://nepjol.info/index.php/ON

Ethnobotanical study of plants used by Thami community in Ilam District, eastern Nepal

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Abstract

An ethnobotanical survey was carried out on the utilization of plants by *Thami* communities in Gorkhe, Jogmai and Nayabazar areas of Ilam by interviewing traditional herbalists and different age groups of men and women in June 2016. A total of 30 plants belonging to 24 families and 29 genera have been documented. These plants were used for food, fodder, firewood, medicine and in rituals. The documented medicinal plants were used to treat various human ailments of 12 categories; with the highest number of species being used for gastro-intestinal disorders (15 spp.) followed by ENT problems (14 spp.). Most of the medicines were prepared from underground parts in the form of paste and used orally. Informant Consensus Factor (F_{ic}) ranges from 0.6 to 0.9 with an average of 0.82. Dermatological disorders have the highest F_{ic} (0.90) and other categories have the lowest (0.6). *Aconitum palmatum*, *Begonia picta*, *Bergenia ciliata*, *Astilbe rivularis*, *Swertia chirayita*, *Drymaria cordata* and *Remusatia pumila* have the highest fidelity level (100% each) and *Galium asperifolium* has the lowest FL (16%). According to the use value, *Swertia chirayita* (UV=2.83) was the most important with uses against 6 ailments and *Hypericum cordifolium* has the least (UV=0.08), used in only one ailment. A variation in ethnobotanical knowledge was found according to age, gender and occupation in this community.

Key words: Ethnobotany, Informant consensus factor, Medicinal plants, Use value

DOI: http://dx.doi.org/10.3126/on.v16i1.22123

Manuscript details: Received: 24.09.2018 / Accepted: 16.11.2018

Citation: Bhattarai, K.R. 2018. Ethnobotanical study of plants used by Thami community in Ilam District, eastern Nepal, *Our Nature* 16(1): 55-67. DOI: http://dx.doi.org/ 10.3126/on.v16i1.22123

Introduction

Traditional beliefs about the diverse uses of plants are deeply rooted in Nepalese culture. The various ethnic groups of the country have developed their own knowledge systems for the use of plants in food, clothing, shelter, medicine and their spiritual needs (Rajbhandari and Wrinkler, 2015). From time immemorial many medicinal plants are well known in Nepal for various ailments (Bhattarai and Basukala, 2016). Therefore, country was mentioned as a sacred heaven of medicinal and aromatic plants in *Vidic* and *Pauranic* literature (Baral and Kurmi, 2006), which founded the base of the Ayurvedic system of medicine (Bajpai *et al.*, 2016). Plants are the most important source of traditional medicines throughout the world (Bhattarai, 1989) and are the source of many major pharmaceutical drugs (Sarwar *et al.*, 2011). At present, about 30,000 to 70,000 plant species are using medicinally across the world and 70% of the world's rural people depending upon such plants for their primary health care (WHO, 2002). In Nepal, a total 1950 species of plants are found to be medicinal of which 1614 species are native (Ghimire, 2008) and much more yet to be explored (Manandhar, 2002). Baral and Kurmi (2006) reported 1792

plant species of medicinal uses comprising indigenous, endemic, cultivated, exotic and naturalized taxa.

Nepal is a multi-ethnic, multi-lingual and multi-cultural country where, 26.5 million people, under 125 caste or ethnic groups speak 123 different kinds of languages (CBS, 2013). Thami is one of the 59 communities officially recognized as indigenous nationalities (HMG, 2002), whose settlements are centered in Tamakoshi area and northern part of Dolakha District (Budathoki *et al*., 2008). The majority of them live in Dolakha, Sindhupalchok and Ramechap Districts, with notable smaller populations in Ilam, Jhapa, Udayapur and Bhojpur Districts (Shneiderman and Turin, 2006). There were 28671 individuals of Thami (CBS, 2013), of which 912 live in Ilam (CBS, 2014a). There is also Thami community in north-east India (Darjeeling and Sikkim), Tibet and Bhutan (Shneiderman and Turin, 2000, 2006; URL, 2018 a, b). Thami is a Nepali term used by other castes in place of Thangmi means 'people of pasture land' or 'people living in border land' (Shneiderman and Turin, 2000). They speak Tibeto-Burman language having lexical similarities with Newari language (Turin, 2004). They were originally a nomadic tribe. In the past, they had ample land areas under *Kipat land*. Later on, other castes immigrated and encroached over their land. Their main occupation is agriculture and livestock rearing. They also engage in stone quarrying, masonry, carpentry, bamboo work, weaving *bhangra* and colleting herbs. Very few people are involved in driving, local business, teaching and foreign employment. Their main religion is Hinduism, followed by Buddhism, Animist, and Kiranti (Budathoki *et al.*, 2008), and many people are diverted to Christianity (URL, 2018 a, b). Udhauli, Uvauli, Baisakh Purnima, Dashain, Tihar, Janai purnima, Maghi sankrati etc. are some main festival of Thami people (Budathoki *et al.*, 2008; Thami, 2017).

In recent years, there are many studies related to medicinal plants and associated indigenous knowledge in Nepal (Baral and Kurmi, 2006), but these studies less emphasized to highly marginalized groups including Thami. Till the date, there is only one ethnobotanical documentation related to Thami communities in Dolakha District of Nepal conducted by a British linguist and anthropologist, Dr. Mark Turin. While documenting the grammar of Thami language, Mark Turin listed 127 plants with their uses in agriculture, dye, furniture, construction, medicine, fish poison, fodder, food or in cultural and ceremonial occasions (Turin, 2003). Present study basically focused on the documentation of medicinal use of plants, their preparation and application in Thami community of Gorkhe area of Suryodaya Municipality, and Jogmai and Nayabazar areas of Maijogmai rural municipality of Ilam District. This study provides an inventory of medicinal plants used in Thami community against different human ailments.

Materials and methods

Study area

Ilam (Lat. 26º40'N - 27º08'N, Long. 87º40'E - 88º10'E, area 1,703 km^2) is a hilly district situated in the eastern region of Nepal in Province number 1. The district stretches from lower belt of terai and chure to the upper hilly belt of the Himalayan region with altitude ranging from 140 m to 3636 msl. The average annual temperature is 20.5ºC and the average annual rainfall is 2500 mm. The tropical to alpine vegetation is found in the district with forest coverage of about 55% (DFRS, 2015). There are 912 individuals of Thami residing in Jogmai (n=453), Nayabazar (n=164), Gorkhe (n=161), Phikkal (n=60), Pasupatinagar (n=47), Ilam Municipality (n=14) and Sri Antu (n=13) (CBS, 2014b). Jogmai, Nayabazar (Maijogmai rural municipality) and Gorkhe (Suryodaya municipality) areas were selected as study sites because highest number of Thami people found to live there. These study sites are located in the hilly area of north-east part of Ilam (Fig. 1).

Selection of informants

Prior to documentation of ethnobotanical information, first a meeting was organized in Jogmai with of pre-informed people from Jogmai, Gorkhe and Nayabazar areas. In that gathering, various medicinal plants available and used in their community were listed and collected. After gathering the collected plants, 30 specimens were selected randomly to document detail information. Among the participants, 12 people (Males=6, Females= 6) of three age groups (20-40, n=7; 40-60, n=3; and 60+, n=2) with different occupations were selected inclusively as key informants to compare their ethnobotanical knowledge. Each of them was provided to fill up 30 sheets of questionnaire, each sheet for individual plant.

Data collection

The ethnobotanical data were collected in June 2016 by using structured and semi-structured questionnaire with key informant interview. Twelve key informants were interviewed by showing the fresh plant specimens that were collected by them. Questionnaire survey was carried out in order to compare and analyze the knowledge among the informants about the habit

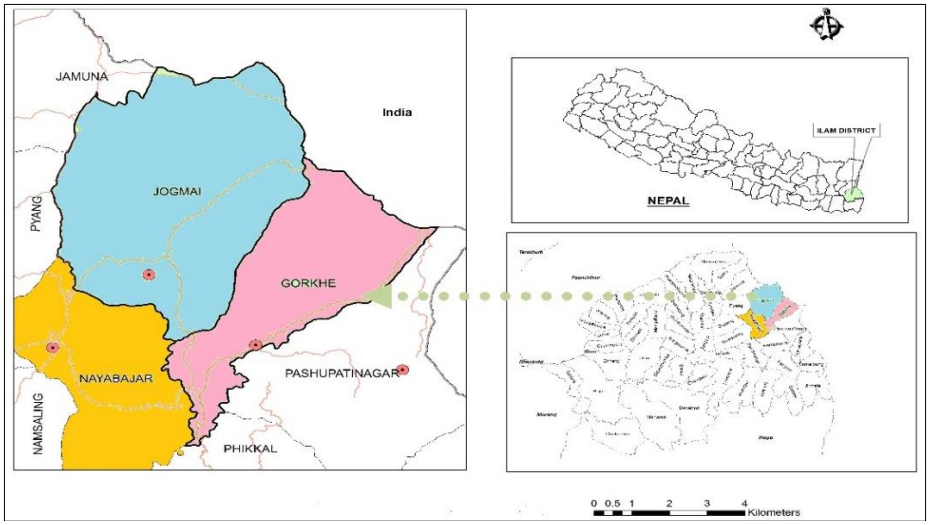

Figure 1. Map of study area

and habitat of plant, flowering period, local status, threat, cultivation practice, trade, uses, medication forms, dose and route of administration of medicines etc. Reported ailments were grouped into major categories following Heinrich *et al.* (1998).

The collected plant specimens were photographed, pressed in between newspapers and dried in the field using a natural drying technique in sunlight (Forman and Bridson, 1989). Scientific names were determined by using different books (Polunin and Stainton, 1984; Stainton, 1988; Shrestha, 1998; Manandhar, 2002; Baral and Kurmi, 2006). The nomenclature of APG III was followed (www.theplantlist.org). Voucher specimens were deposited at the herbarium of Plant Research Centre, Ilam (formerly known as District Plant Resources Office, Ilam).

Data analysis

(1) *Informant Consensus Factor* (F_{ic})

The level of homogeneity among information provided by different informants was calculated by the Informant Consensus Factor (F_{ic}) according to Heinrich *et al.* (1998) as:

$F_{ic} = (N_{ur} - N_t)/ (N_{ur}\text{-}1)$,

Where, N_{ur} = Number of use citations in each ailment category, N_t = Number of species used

(2) *Fidelity Level* (*FL*)

The fidelity level (*FL*) determines the most frequently used plant species for treating a particular ailment category by the informants. The FL was calculated following Friedman *et al.* (1986) as:

$FL(\%) = (N_p/N) \times 100$

Where, N_p = Number of informants that reported a use of a plant against a particular disease category, and N = Total number of informants that used the plants against any given disease.

(3) *Use Value (UV)*

The relative importance of ethnomedicinal plant species was calculated by using the use value (UV) for each species (Phillips and Gentry, 1993).

$UV_s = (\sum U_s)/ (N_s)$

Where U_s = Total number of use-reports cited by each informant for a given plant species *s* and N_s = Total number of informants interviewed for plant species *s*.

Results and discussion

Plant diversity and uses

Of the randomly selected 30 plants (24 families and 29 genera), 28 were dicots and 2 monocots. These were represented by highest numbers of herbs (n=19) followed by trees (n=6), climbers (n=3) and shrubs (n=2). The dominant family was Rutaceae (with 3 species), followed by Apiaceae, Ranunculaceae, Rosaceae and Sexifragaceae (with 2 species each). Rest of the 19 families had one plant each (Table 1). The study showed that different parts of the same plants are used for different purposes (food,

Table 1. Enumeration of medicinal plants used for curing various ailments by Thami community in Ilam District.

Scientific name (Family; Voucher number), Vernacular name	Parts used; Types of preparations; Administrations	Ailments	Use value	Mode of administration and dose	Plant category; Life form	Local status of plant
Aconitum palmatum D.Don (Ranunculaceae; TKTh-28), Seto Bikhuma	Tuber; Paste; Oral	Diarrhoea, fever, *Nas-kapat,* high blood pressure	2.25	Very small piece (1-2 gm) of root is rubbed on mortar and paste is eaten 1 to 3 doses. Over dose may be poisonous	Dicot; Herb	Rare
Artemisia indica Willd. (Compositae; TKTh-19), Titepati	Root, Leaves, young shoot, flower; Juice, scent, smoke; Topical, droplet, inhalation	Cough and cold, Cut and wound, Cholera, epistaxis (*Nathri phutekoa*), fever, headache, sinusitis, and religious use	1.33	Rubbed between the palm and the scent is inhaled. leaves juice is squeezed and applied to control haemorrhage from cut and wound. In epistaxis juice is dropped in nose or scent is inhaled. In cholera, root juice is eaten. In sinusitis, leaf smoke is inhaled. (shoot is used to spray water to make some things pure during religious ceremonies.)	Dicot; Herb	Common
Astilbe rivularis Buch.–Ham. ex D.Don (Saxifragaceae; TKTh-06), Budho okhati	Root; Crude, decoction; Oral	Fracture, Pain in body and limbs, postpartum recovery	1.58	Root pieces are dried and taken raw as *betel nut* or decoction prepared along with *Rheum australe* is taken orally (about 25 ml.).	Dicot; Herb	Not so common
Begonia picta Sm. (Begoniaceae; TKTh-14), Magarkanche	Root, stem; Paste; Oral	Gastritis and stomach pain, Diarrhoea and dyspepsia both in cattle and human.	1.58	Root is crushed and juice (10-30 ml.) is eaten. Stem is used to make pickle as it is sour in taste.	Dicot; Herb	Not so common
Bergenia ciliata (Haw.) Sternb. (Saxifragaceae; TKTh-31), Pakhenved	Root, leaves; Paste, decoction, Crude; Oral, topical	Fracture, pain, tooth ache, diarrhoea	1.91	In case of fracture, root and leaves paste is eaten as well as applied as bandage along with the paste of *Astilbe rivularis* and *Viscum album.* In diarrhoea, crude root is chewed or its decoction is taken orally.	Dicot; Herb	Not so common
Buddleja asiatica Lour. (Scrophulariaceae; TKTh-29), Bhimsen pati	Whole plant, leaves	Religious	0	During *lungma*, *Bhume puja* the plant is used. Leaves are also used as incense. Stem is used as fodder and fire-wood.	Dicot; Tree	Not so common
Cannabis sativa L. (Cannabaceae; TKTh-26), Ganja	leaf, young shoot, inflorescence; Crude; Oral	Diarrhoea in cattle	0	5-10 gm or more is given to cattle by mixing with flour or in *khole* twice a day for about 4-5 days.	Dicot; Herb	Not so common
Centella asiatica (L.) Urb. (Apiaceae; TKTh-18), Ghodtapre/Dhungree jhar	Whole plant, leaves; juice; Oral, topical	Gastritis, Pneumonia in infants, rashes on tongue and in mouth, throat pain, fever, cut and wound	2.08	Whole plant or leaf can be eaten raw. In case of Pneumonia in infant, 5-10 ml of leaf juice is given 3-4 times a day for 2-3 days. In cut and wound, leaf juice is applied.	Dicot; Herb	Common
Clematis buchananiana DC. (Ranunculaceae; TKTh-22), Pinase lahara	Root, stem, leaves; fume/scent; Inhale	headache, sinusitis	1.16	Root is rubbed, warmed on fire and sent is smelled twice a day. This is practiced for 4-5 days for sinusitis. Tender stem and leaves are also rubbed and smelled for the treatment of headache/sinusitis.	Dicot; Climber	Not so common
Drymaria cordata (L.) Willd. Ex Roem. and Schult. (Caryophyllaceae; TKTh-24), Abijalo	Whole plant; Juice, scent; Oral, inhale	Pneumonia, throat pain, rashes in mouth, sinusitis	1.91	In pneumonia and throat pain, 5-10 ml of crushed leaf juice is eaten. In sinusitis, shoot is rubbed, warmed and smelled.	Dicot; Herb	Dominant
Euodia fraxinifolia (D. Don) Hook. f. (Rutaceae; TKTh-03), Khanakpa	Fruit; Paste, decoction, cooked; Oral	Fever, cough and Cold, fatigue, body pain, stomach pain, gastritis, dyspepsia etc. In both cattle and human	2.33	10-15 pieces of fruits are crushed and paste is eaten or decoction (30-50 ml.) is taken 3 times a day. For cattle, fruits are cooked with their meal (*khole*) and given to eat. It is more effective to mix few fruits of *Z. Armatum* also.	Dicot; Tree	Rare
Galium asperifolium Wall. (Rubiaceae; TKTh-13), Sano majitho	Whole plant; Paste, poultice; Topical	Snake bite, fracture, Cultural belief.	0.91	Used to tie just above snake bite and also paste is applied to the wound of the bite or skin lesions (*ghau-khatira*). In fracture its paste is also applied as poultice. There is a	Dicot; Climber	Abundant

				cultural belief that if there is bed wetting to late child hood, it is used to bit the back of children every morning after wake up and the problem will be solved.		
Gonostegia hirta (Blume ex Hassk.) Miq.(Urticaceae; TKTh-09), Bhuin chiple	Whole plant; Crude, paste, poultice; Oral, Topical	Sprain and fracture of both man and cattle	1.08	Raw stem is wrapped with rice flour and given to cattle for a month. Paste is applied as poultice along with slug, honey, raw simrik, red soil, toad (*Paha*) etc are also mixed. Its curry is eaten in fracture and sprain.	Dicot; Herb	Common
Heracleum nepalense D.Don (Apiaceae; TKTh-10), Chimphing	Fruit; Paste, decoction; Oral	Gastritis/stomach problems, diarrhoea, fever of man and cattle, numbness or tingling the muscle of hand and feet.	1.75	In gastritis, about 5 gm. fruits are crushed and eaten. In diarrhoea and fever 25-30 ml. decoction prepared by mixing with *Euodia fraxinifolia* and *zanthoxylum armatum* is taken thrice a day for 3-5 days. Pickle made of fruits should be taken regularly to avoid problems.	Dicot; Herb	Not so common
Hypericum cordifolium Choisy (Hypericaceae; TKTh-02), Jhakrani phool ,Yurgisuna	Young shoots; Crude; Oral	Throat pain; cultural use	0.08	Fresh young shoot is eaten raw to relieve throat pain. Used in *lungma,* a cultural activity where after 5-6 months of pregnancy, *dhami* pray to god for the unborn child become long lived and active.	Dicot; Herb	Common
Lindera neesiana (Wall. ex Nees) Kurz (Lauraceae; TKTh-15), Siltimur	Fruit; Powder, decoction; Oral	Gastritis, cough and cold, illness in cattle, called *saawane lageko*	2	Fruits are crushed, and the powder of about 10-15 gm directly eaten with water for 2-3 times; or boiled with water and 40-50 ml. decoction is eaten thrice a day for 2-3 days. For cattle, crushed fruit is given directly mixing with their food (*khole*).	Dicot; Tree	Not so common
Macropanax undulatus (Wall. Ex G. Don) Seem. (Araliaceae; TKTh-01), Chinde	Young shoot, bark; Juice, ash, cooked; Oral	Kidney problems, Jaundice, Diabetes, Worms in gastro-intestinal tract, gastritis	1.83	About 100 ml of aqueous extracts of stem bark is taken 3 times a day for 1-3 months in kidney problems and jaundice. In gastritis and stomach problems 10 ml juice is given thrice a day for about 3-5 days. In worms infestation single dose of about 5 gm. bark ash is eaten with water before eating meal. Similarly, pickle or curry of young shoot give relieve in diabetes and gastritis.	Dicot; Tree	common
Mentha spicata L. (Lamiaceae; TKTh-21), Pudina	Young shoot, leaves; Juice, paste; Topical, oral	Pickle, Otorrhea (ear ache), throat pain, cough and cold, tooth problem and gingivitis (gum swelling).	1.91	Leaf juice is applied in ear ache. Fresh pickle is used as stomach coolant.	Dicot; Herb	Not so common
Nasturtium officinale R.Br. (Brassicaceae; TKTh-20), Sim sag/sim rayoo	Shoot, leaves; Cooked, decoction; Oral	In high blood pressure, jaundice, body ache, chest problem and tuberculosis, remove poisonous effect of mushroom.	1.91	Cooked to make curry or decoction is prepared and eaten twice a day.	Dicot; Herb	Not so common
Paris polyphylla Sm. (Melanthiaceae; TKTh-27), Satuwa/Tintale	Tuber; Crude, paste, decoction; Oral, topical	Gastritis, ulcer, hemorrhage, wound, *Nas-kapat*, diarrhoea, Menorrhagia (over bleeding in menstruation) etc.	2.08	Small piece (4-5 g.) is chewed and eaten with water twice a day. In Menorrhagia, root is crushed and eaten with honey. Decoction can also be used in gastritis and ulcer. Paste is applied. in cut and wound.	Monocot; Herb	Rare
Piper mullesua Buch.-Ham. ex D. Don (Piperaceae; TKTh-07), Chabo	Fruit, leaves; Decoction, infusion; Oral	Gastritis and throat pain; religious *(chinta basda)*	1.08	Decoction or infusion of about 10-15 ml is taken orally.	Dicot; Climber	Not so common
Potentilla lineata Trevir. (Rosaceae; TKTh-16), Ban mula	Root; Juice, infusion, paste, crude; Oral, topical	Diarrhoea, gastritis, dysentery, sprain, tooth ache, throat ache	1.91	About 20-25 ml of aqueous extract of crushed root juice is eaten thrice a day for 2-3 days. In sprain, its paste is applied while in toothache or throat ache pieces are kept	Dicot; Herb	Common

				in mouth or between the infected teeth.		
Remusatia pumila (D.Don) H.Li and A.Hay (Araceae; TKTh-30), Dhunga ko maane	Tuber; paste; Topical	Boils	1.08	Tuber is rubbed on mortar and the paste is applied around the boils once or twice a day so that boils opens faster.	Monocot; Herb	Not so common
Rubus ellipticus Sm. (Rosaceae, TKTh-11), Ainselu kanda	Root, young shoot; Juice, crude; Oral	Diarrhoea, dysentery, throat pain, religious use	10.8	Root juice of *Rubus ellepticus* and bark juice of *Docynia indica* mixed together and about 10-15 ml mixture is taken thrice a day for 2-3 days. In throat pain, paste of young shoot or root is eaten. Also used in funeral ceremony.	Dicot; Shrub	Common
Rumex nepalensis Spreng. (Polygonaceae, TKTh-23), Halhale	Root, stem, leaves; Paste, juice; Topical	In leucoderma (albino), eczema and scar of burn.	1.25	Crushed and the paste or juice is applied twice a day as per required to remove spots and scars.	Dicot; Herb	Common
Swertia chirayita (Roxb. ex Fleming) Karsten (Gentianaceae; TKTh-08), Chiraito	Root, Whole plant; Decoction, infusion; Oral	Typhoid fever, headache, High blood pressure.	2.83	Root decoction (10-15 ml) or infusion of about 15-30 ml is taken thrice a day for 3-5 days.	Dicot; Herb	Rare; Common due to cultivation
Valeriana hardwickii Wall. (Caprifoliaceae; TKTh-17), Nakkali jatamansi	Root, leaves; Fume, smoke; Inhale	Headache, sinusitis, religious use	0.25	Root is rubbed, warmed on fire, wrapped with cloth and the sent is inhaled by nose. Also dried leaves are burnt and smoke is inhaled by nose. Root pieces are used in *jantar/buti.*	Dicot; Herb	Rare
Viscum album L. (Santalaceae; TKTh-46) Hadchur	Whole plant; Decoction, poultice; Oral	Fracture, body ache	1	Decoction is taken orally along with honey, unboiled milk, unboiled egg etc. and used in poultice	Dicot; hemi-parasitic shrub	Rare
Zanthoxylum armatum DC. (Rutaceae; TKTh-04), Ghar timur	Fruit; Decoction; Oral	Gastritis, stomach pain	1.66	Fruit decoction (20-25 ml.) taken thrice a day for 3-5 days.	Dicot; Tree	Rare
Zanthoxylum oxyphyllum Edgew. (Rutaceae; TKTh-05), Boke timur	Root, fruit; Decoction; Crude, paste; Oral, Topical	Gastritis, stomach pain, Cough and cold, tooth ache, worms in stomach; Used as fish poison, leech and lice repellent	1.83	Fruit decoction (20-25 ml.) taken thrice a day for 3-5 days. To cure tooth- ache, 2-3 pieces of fruits are chewed between the infected teeth for whole night. Root paste is used as fish poison and lice repellent. Root/fruit paste is used as leech repellent.	Dicot; Tree	Common

fodder, fuel wood etc.) and for different aliments. Among 30 plant species, *Buddleja asiatica* was found to be used only in rituals and *Cannabis sativa* had reported to treat only cattle ailment. Remaining 28 species were reported to treat human ailments and some had additional uses. Apart from medicine, there were 3 plant species (*Heracleum nepalense*, *Lindera neesiana* and *Zanthoxylum oxyphyllum*) used to give flavour in locally prepared alcohol, 2 species (*Macropanax undulates*, *Nasturtium officinale)* as vegetables, 3 species (*Begonia picta*, *Heracleum nepalense* and *Mentha spicata*) as pickle, one species (*Rubus ellipticus)* as wild fruit and one species (*Euodia fraxinifolia*) as making cover (*Daap*) of national weapon (*Khukuri*). In addition to this, 5 species (*Artemisia indica*, *Hypericum cordifolium*, *Piper mullesua*, *Rubus ellipticus* and *Valeriana hardwickii*) were used in Thami rituals and 5 species (*Begonia picta*, *Euodia fraxinifolia*, *Gonostegia hirta*, *Heracleum nepalense*, *Lindera neesiana*) were used against cattle ailments. It was found that *Aconitum palmatum*, *Lindera neesiana* and *Swertia chirayita* had high market value. The young shoots of *Macropanax undulates* commonly used as vegetable, so it could be sold in local market as well as international market (Darjeeling). The threat was found more in plants with multiple use value. These species with high use values are likely to be more vulnerable because of high demand and high collection pressure (Shrestha *et al.*, 2014). Some potential threats to medicinal plants identified in this study were unsustainable harvesting, habitat destruction, deforestation, illegal trade and loss of spring-water resources and wetlands. The questionnaire results showed that some medicinal plants (eg. *Macropanax undulates*, *Swertia chirayita*) were threatened due to over collection and grazing.

Based on information collected from the informants, all the human ailments were grouped into 12 categories. The highest number of plants was used against digestive system disorders (15 spp.) followed by ENT problems (14 spp.), fever and headache (11 spp.) and so on (Fig. 2). The scenario of having plant used mainly for gastro-intestinal disorders showed that there is enormous importance of this group of illnesses and may be the more frequent exchange of information for treating this ailment category (Heinrich *et al.*, 1998). This is similar to the findings of several studies in rural part in Nepal (Singh *et al.*, 2012; Thapa *et al.*, 2013; Luitel *et al.*, 2014; Shrestha *et al.*, 2014; Bhattarai and Acharya, 2015; Bhattarai, 2017). To avoid such ailments, people should have good sanitation practices and supplied with safe drinking water (Rokaya *et al.*, 2014). The uses of plants reported by the informants were compared with previous studies from the same ethnic group (Turin, 2003) and from various studies of the same region (Tamang and Singh, 2014; Bhattarai and Khadka, 2016; Subba *et al.*, 2016) showed that there were many similar use reports of the documented plants. This shows that their pharmacological effectiveness is highly reliable (Giday *et al.*, 2009) along with cultural influence and belief because traditional knowledge is influenced by ancestry, inter-cultural diffusion and interaction with natural environment (Saslis-Lagoudakis *et al.*, 2014).

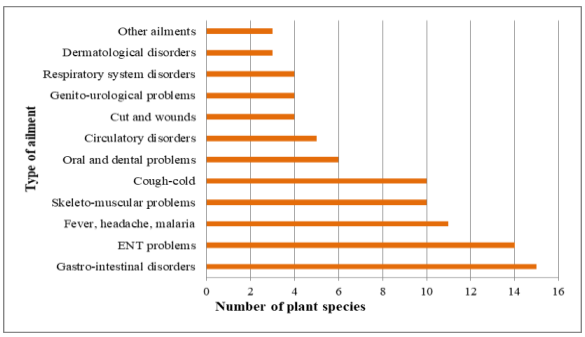

Figure 2. Number of medicinal plants used against different ailment categories

Parts used, preparations, mode of administrations and harvesting

Underground parts (roots/tubers) and leaves were the most frequently used plant parts followed by stem, fruits and flower/inflorescence (Fig. 3). The leaves, underground parts, seeds and fruits contain the high amount of biologically active substances compared to other parts (Srithi *et al.*, 2009). The frequent use of underground parts or fruits/seeds showed that the plant species are likely to face threat in the future as they are most important parts for regeneration (Ghimire *et al.*, 2008). It is thus important that cultivation techniques ought to be introduced in the areas to save the plant species and economic benefit of the community (Pradhan and Badola, 2008; Rokaya *et al.*, 2010). The most frequent forms of preparation were paste followed by decoction (Fig. 4). The most common mode of administrations was oral followed by topical applications (Fig. 5). Plant species that were used as medicine mainly collected from the wild i.e. from private or community forest. One

species (*Swertia chirayita*) was cultivated commercially. Few species (*Heracleum nepalense, Mentha spicata, Macropanax undulates, Lindera neesiana*) were domesticated either in their home garden or in the farm land. High valued medicinal plants were generally collected on the special day called *harelo*, first Tuesday after a Hindu festival-*Teej*, which falls in the month of August-September. It is believed that the medicinal plants collected on that day have good effects on the medicine which is similar to the ethnic community of Lepcha of Ilam (Bhattarai, 2017). Generally fresh parts of plants are used as medicine and all the informants agreed that the medicinal plants should be preserved for future.

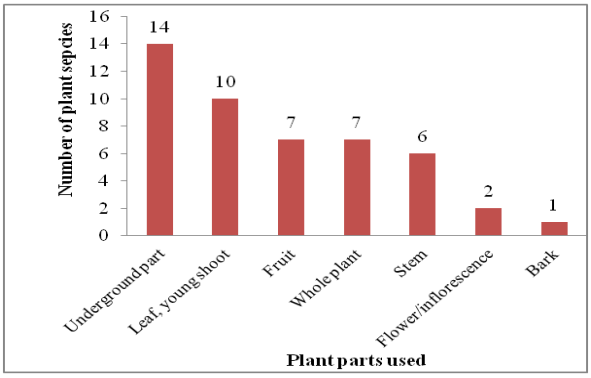

Figure 3. Different plant parts used for medicinal purpose

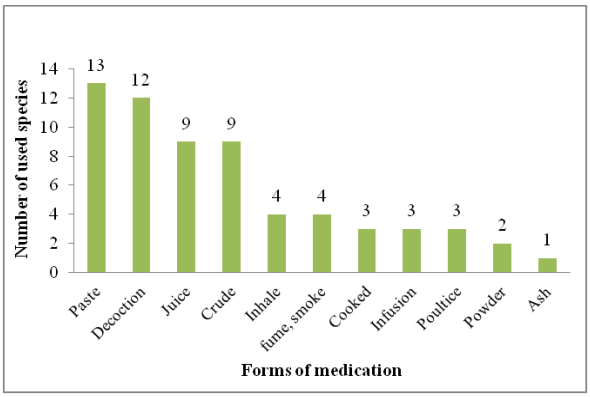

Figure 4. Medication forms used by Thami community

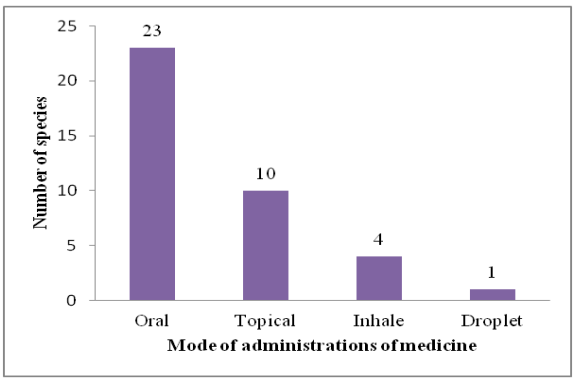

Figure 5. Mode of administrations of the medicine

Informant consensus factor, fidelity level and use value

The results of the informant consensus factor (F_{ic}) showed that the value ranges from 0.6 to 0.9. The dermatological disorder has the highest F_{ic} value of 0.90 with 32 use reports for 3 species. It is followed by gastro-intestinal disorder (134 use reports, 15 spp.). The others category (heat illness, antidote of mushroom-poisoning and lice repellent) has the lowest F_{ic} value 0.6 with 6 use reports for three plant species (Table 2). The high F_{ic} value (close to 1) indicates that relatively few species are used by a large proportion of the healers (Heinrich *et al.*, 1998). In this study the average F_{ic} value for all ailment categories was found 0.82, indicating a high level of agreement among the informants. This result is similar with the study in Rasuwa District, central Nepal (Uprety *et al.*, 2010; Shrestha *et al.*, 2014) and Rupandehi and Palpa District, Western Nepal (Singh *et al.* 2012; 2018), but different form the study in Humal District, western Nepal (Rokaya *et al.*, 2010).

While selecting the most preferred plant species for each ailment category, the highest Fidelity level (*FL*) values were considered in each category of ailment. *Begonia picta* and *Aconitum palmatum* (Fl=100%, each) for gastro-intestinal ailments. *Clematis buchananiana* (*FL*= 91.6%) in ENT problems, *Astilbe rivularis* and *Bergenia ciliata* (*FL*=100% each) in skeleto-muscular problems, and so on (Table 3). The plant species with the highest *FL* value is considered the most preferred and important species for a particular purpose (Hoffman and Gallaher, 2007). The fact that the plants with highest *FL* values could be an indication of their good healing potential in their respective illness categories.

According to use value, *Swertia chirayita* (*UV*=2.83) was the most important with 34 uses reports from 12 informants. It was followed by *Euodia fraxinifolia* (*UV*=2.33) with 28 use reports and *Aconitum palmatum* (*UV*=2.25) with 27 use reports. The species with least importance in medicine were *Valeriana hardwickii* (*UV*=0.25) with 3 use reports and *Hypericum cordifolium* (*UV*=0.08) with single use report from 12 informants (Table 1). The highest use value of *Swertia chirayita* (*UV*=2.83) showed that it is the most preferred species in this community to treat fever, headache and malaria, and lowest of *Hypericum cordifolium* (0.08), which means people use alternatives of this species to treat ENT problems. Plant species

with low use values should not be ignored because failing to declare the importance of this plant to upcoming generations could decline the traditional knowledge (Mahmood *et al.*, 2012).

Comparison of ethnomedicinal knowledge according to age, sex and occupation

The socio-economic level, age, gender and profession, are some of the variables that may influence the distribution of the knowledge about the uses of plant within a community (Toledo *et al.*, 2009). The result showed that the age groups within the range 60^{+} found more knowledgeable and reported highest uses (39%) than the younger age group 40-60 (34%) and 20-40 (27%) (Table 4). Results of several studies conducted in different parts of the world (Giday *et al.*, 2009) as well as Nepal (Luitel *et al.*, 2014; Bhattarai and Tamang, 2017) revealed similar findings. This may be because the older generations of this community tend to function as keepers of traditional knowledge, they may know more traditional remedies and grew up with little or no exposure to modern health practices (Quinlan and Quinlan, 2007). Further, older individuals have had additional learning time to know about potential of plants and more exposure to illness events, treatments, and their outcomes than the younger generation. Women are predicted to be familiar with more herbal medicines than males. By the gender wise comparison, females documented slightly more use reports (50.3%) than males (49.6%). This may be because they are homemakers; they have to collect food, fodder, firewood and are responsible for the health of the family (Torres-Avilez *et al.*, 2016) and their cattle. Similar findings are reported in Mexico (Beltran-Rodriguez *et al.*, 2014), Nepal (Luitel *et al.*, 2014), Brazil (Meretika *et al.*, 2010) and in Ethiopia (Giday *et al.*, 2009). On the basis of occupation, there were 3 primary school teachers, 7 farmers and 2 traditional healers. The traditional healers were found most knowledgeable (use report=41%) than farmers (use reports=32%) and primary school teachers (use reports=27%) because they have assimilated the knowledge about the medicinal plants in their traditional health care system and they do practice it in their day to day life (Bisht *et al.*, 2006) as their profession.

The secrecy of ethnomedicinal knowledge is a common practice (Giday *et al.*, 2009) and traditional healers hardly share their knowledge to outsiders with the belief that effectiveness would decrease if knowledge is reveled (Shrestha *et al.*, 2014). This secrecy was also reported from the Humla District of western Nepal (Rokaya *et al.*, 2010), Makwanpur District of central Nepal (Luitel *et al.*, 2014) and Ilam District of eastern Nepal (Bhattarai, 2017). Non-sharing attitude is one of the strongest reasons for the depletion of traditional knowledge as pointed out by Pradhan and Badola (2008). The distinct pattern of modernization such as education, commercial occupation, acculturation etc. may help in erosion of traditional knowledge (Quinlan and Quinlan, 2007). The depletion is further accelerated by wider use of modern medicine and lack of successor of faith healers (Manandhar and Chaudhary, 1992) because successors are easily influenced by modernization (Bhattarai, 2017). The process of knowledge loss is further magnified by rural-urban migration. The next reason could be due to the depletion of plant resources as there are increasing human induced activities such as construction of roads, deforestations, fire, shifting cultivation, etc. Thus, it is obvious that there is degradation of language, culture and tradition in Thami community and in turn ethnobotanical knowledge is eroding. Additionally, this knowledge becomes danger if written documentation is insufficient or unavailable (Rani *et al.*, 2017). Thus, the present work would help to preserve ethnobotanical knowledge of Thami community as communication between indigenous community with scientific community help to preserve traditional knowledge (Subba *et al.*, 2016) through documentation and dissemination.

The few species were either highly preferred or have multiple uses in the study area. Some of the plant species fall in threat categories of IUCN (*Bergenia ciliata*), and IUCN and CAMP (*Aconitum* sp., *Paris polyphylla*, *Swertia chirayita*). Moreover, some threatened species are highly preferred over all the species such as *Swertia chirayita* (*UV*=2.83) *Euodia fraxinifolia* (*UV*=2.33), *Aconitum palmatum* (*UV*=2.25) and *Paris polyphylla* (*UV*=2.08). Therefore, such species should be prioritized for cultivation and sustainable management in order to ensure their long term availability (Shrestha *et al.*, 2014). Commercial cultivation of *Swertia chirayita* and in-situ conservation of *Paris Polyphylla* was already started in the study area and further, *Bergenia ciliata* should also be cultivated. This will reduce pressure on these species in their natural environments as well as provide

Table 2. Informants Consensus Factor (F_{ic}) by categories of diseases.

Disease categories	No. of species (N_t)	Use reports (N_{ur})	Informants consensus factors (F_{ic})
Dermatological disorders	3	32	0.9
Gastro-intestinal disorders	15	134	0.89
Respiratory system disorders	4	30	0.89
Skeleto-muscular problems	10	81	0.88
Circulatory disorders	5	33	0.87
Cut and wounds	4	23	0.86
Genito-urological problems	4	22	0.85
Fever, headache, malaria	11	65	0.84
ENT problems	11	70	0.81
Cough-cold	10	39	0.76
Oral and dental problems	6	22	0.76
Others	3	6	0.6

Table 3. Fidelity values of most frequently used medicinal plants used against a given disease category.

Disease categories	Medicinal plant	N_p	N	*FL* value (%)
Gastro-intestinal disorders	*Begonia picta*	12	12	100
	Aconitum palmatum	12	12	100
ENT problems	*Clematis buchananiana*	11	12	91.6
Skeleto-muscular problems	*Astilbe rivularis*	12	12	100
	Bergenia ciliata	12	12	100
	Gonostegia hirta	11	12	91.6
	Viscum album	11	12	91.6
Cough-cold	*Euodia fraxinifolia*	10	12	83.3
Fever, headache, malaria	*Swertia chirayita*	12	12	100
Circulatory disorders	*Nasturtium officinale*	9	12	75
	Swertia chirayita	8	12	66
Cut and wounds	*Galium asperifolium*	8	12	66
Oral and dental problems	*Zanthoxylum oxyphyllum*	7	12	58
Respiratory system disorders	*Drymaria cordata*	12	12	100
Dermatological disorders	*Remusatia pumila*	12	12	100
Genito-urological problems	*Macropanax undulatus*	8	12	66
Others (heat illness)	*Mentha spicata*	3	12	25

Table 4. Average use reports categorized by age, gender and occupation of informants.

Disease categories	Age group			Gender		Occupation		
	20-40	40-60	60 +	Male	Female	Teacher	Farmer	Traditional healer
Gastrointestinal disorders	7.8	13	20	11.5	10.8	7.6	10.1	20
ENT problems	5.5	5.3	7.5	5.8	5.8	5.6	5.4	7.5
Fever, headache, malaria	4.8	5	8	4.8	6	5.6	4.6	8
Skeleto-muscular problems	5.8	8.6	7.5	7.1	6.5	3.2	7.2	7.5
Cough-cold	3.8	2.6	2	2.8	3.6	4.3	3.1	2
Oral and dental problems	1.2	3	2	2.1	1.5	0.6	2.28	2
Circulatory disorders	2.85	2.66	2.5	3	2.6	2.6	2.85	2.5
Cut and wounds	1.57	3	1	2	1.4	1	2.4	1
Genito-urological problems	1.8	2.3	1	1.3	2.3	2	2	1
Respiratory system disorders	2.28	3	2.5	2.3	2.8	2.6	2.4	2.5
Dermatological disorders	2.57	3	2.5	2.8	2.5	2.6	2.7	2.5
Other ailments	0.1	0.66	2	0.3	0.6	0	0.28	2
Total (Percentage)	**40.07 (27%)**	**52.12 (34%)**	**58.5 (39%)**	**45.8 (49.6%)**	**46.4 (50.3%)**	**37.7 (27%)**	**45.3 (32%)**	**58.5 (41%)**

economic benefits to poor and marginalized community (Bhattarai, 2017). It is also important to have participatory management, education and awareness programs that will help to optimize the benefits of the medicinal plants sector in this area (Bhattarai and Khadka, 2016).

Conclusion

The present study reveals that some people of *Thami* community have immense knowledge regarding the use of medicinal plants and rely on them for treatment of various kinds of diseases. Many species used as medicine are under threatened due to more extensive use, over grazing, habitat destruction, high preference or rare existence. Hence, there is need for conservation of valuable medicinal plant species and also the young generations should be trained to acquire the knowledge which will otherwise get extinct.

Acknowledgements

I am grateful to the Department of Plant Resources, Thapathali, Nepal for necessary funding. I would like to thank Mr. Bhim Bahadur Thami, Mrs. Gau Maya Thami, Mrs. Kumari Thami and all the local people of the study area who helped in this study. Similarly, Mr. Dipen Bam, Mr. Yam Kafle and Padam Prasad Acharya of District Plant Research Centre, Ilam are highly acknowledged for their kind cooperation for questionnaire fill up and herbarium management. I am grateful to Dr. Maan Bahadur Rokaya for his immense help and valuable suggestions prior to the field study, questionnaire preparation, data collection and data analysis. Thank is also due to Mr. Madan K. Khadka for providing GIS map of the study area.

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