



Ethnomedicines of Tharu Tribes of Dudhwa National Park, India

Rajesh Kumar and Kumar Avinash Bharati

Research

Abstract

Ethnomedicines play an important role in the healthcare practices of the Tharu tribes of Dudhwa National Park. A study was conducted to document their ethnomedicine and identify potential species for phytochemical and pharmacological studies. Fieldwork was conducted over a period of two years in Dudhwa National Park, utilizing the "transect walk" method of Participatory Rural Appraisal (PRA). The data was analyzed using frequency of citation and informant consensus factor (F_{IC}). This research details 95 species of medicinal plants and 97 ethnomedicines used in the treatment of 49 ailments of humans. The ailments are categorized into 14 categories (symptoms/similarities, etc). The F_{IC} values indicate that there was a high degree of consensus among informants on how to treat injuries, respiratory ailments, circulatory system ailments, digestive disorders, colds, and fevers. The most useful medicinal species, ranked according to their perceived F_{IC} were: *Moringa oleifera* Lam. (high blood pressure), *Piper longum* L. (cough), *Nicotiana tabacum* L. (dermatitis/skin itching), *Cleome viscosa* L. (boil), *Ceriscoides turgida* (Roxb.) Tirveng. (stomach ulcer), *Lawsonia inermis* L. (dysentery), *Cissampelos pareira* L. (stomachache), *Andrographis paniculata* (Burm. f.) Nees (fever, anorexia), *Tamilnadia uliginosa* (Retz.) Tirveng. & Sastre (dysentery), and *Tridax procumbens* (L.) L. (nocturnal emission). In remedy preparations, the leaves were the most frequently used plant part (33 instances), and most of the preparations were in the form of extraction or juice. Herbs were the most frequently used source of medicine (48%), followed by trees (23%) and shrubs (17%). A total of 34 medicinal claims were new to ethnomedicine of India. Those plants which received high citation frequency may prove useful for pharmacological studies in new drug development projects.

Introduction

The Terai region of the southern foothills of the Himalayas along the Indo-Nepal border is home to the Tharu tribes. More than 90% of the Tharu population is engaged in agriculture (Singh 1965, Verma 2011). Rice is a staple food, and **daru** (local liquor) is a favorite drink that is prepared using jaggery and the flowers of *Madhuca longifolia* (J. König ex L.) J.F. Macbr. Tharus still prefer to live in forest areas to meet their day to day needs. The Tharu villages are situated inside the border areas or in the buffer zone of the Dudhwa National Park. The park lies within Lakhimpur Kheri District, Uttar Pradesh, India, between 28°31.8'N–28°42'N latitudes and 80°28'E–80°57'E longitudes, with an area of 680 km² (Figure 1). The climate is humid subtropical with dry winter, and the vegetation is Himalayan subtropical broadleaf forest (Bharucha 1983). Summers are hot with temperatures up to 42°C, and winter temperatures average 5°C.

The ethnobotany of Tharu tribes of India and Nepal have been previously studied by Acharya and Acharya (2009), Bhattarai *et al.* (2009), Dangol and Gurung (1991), Gaur *et al.* (1980), Joseph *et al.* (2003), Kumar *et al.* (2006), Kumar *et al.* (2012), Maheshwari *et al.* (1980, 1981), Manandhar (1985), Nautiyal (1981), Negi *et al.* (1985),

Correspondence

Rajesh Kumar, Department of Botany, Bareilly College, Bareilly 243005, INDIA

Kumar Avinash Bharati, Raw Materials Herbarium and Museum Delhi (RHMD), CSIR-National Institute of Science Communication and Information Resources, New Delhi 110012, INDIA, kumaravinashbharati@rediffmail.com

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Purohit and Gaur (1985), Saini (1996), Shah and Joshi (1971), Singh *et al.* (2011), Singh *et al.* (1987), Singh (1994), Singh and Maeshwari (1992), and Singh and Maeshwari (1994). There has been no ethnobotanical study within Dudhwa National Park that uses a quantitative consensus analysis. Keeping this in mind, we set out to investigate the ethnomedicines of Tharu tribes using quantitative statistical techniques. The aim of this study was: (1) to document the knowledge on ethnomedicines of Tharu tribes of Dudhwa National Park and (2) to identify potential plants for phytochemical and pharmacological studies.

Methods

Field survey and data collection

An ethnomedicinal survey was conducted from June 2010 to August 2012 in 9 villages within Dudhwa National Park inhabited by Tharu tribes (Figure 1). After consultation with local people the sample villages were identified (Bajahi, Balera, Chandan Chowk, Dhavanpur, Kanjariya, Kiratpur, Puraina, Ram Nagar, and Saria Para), and prior informed consent was obtained from the respondents before interviewing them. Sixty-seven people (43 men and 24 women) were interviewed during the field survey. A transect-walk method of a Participatory Rural Appraisal (PRA) was ad-

opted (Cunningham 2001). This method involves semi-structured interviews and discussion with key-research participants such as community elders, traditional healers, and farmers. The non-medical ethnobotanical results of this study have been published elsewhere (Kumar *et al.* 2013).

Common ailments, medicinal plants and other raw materials, methods of preparation, and dosage of remedies used were recorded. Plant voucher specimens were collected with key informants in the areas where they normally collect medicinal plants as part of the transect-walk process. Plants were identified using Duthie (1933), Raizada (1976), and Singh (1996). Additional identification was carried out by matching voucher specimens with previously identified specimens held in local herbaria (BSA and DD). Voucher specimens from this study have been deposited at the Department of Botany, Bareilly College, Bareilly, India. The botanical names of the plant specimens were updated according to The Plant List (www.theplantlist.org). A comparative assessment in the form of a literature review was also conducted to differentiate between new findings and similarities with past research.

Analysis of quantitative data

The frequency of citation for each medicine was calculated using the following formula:

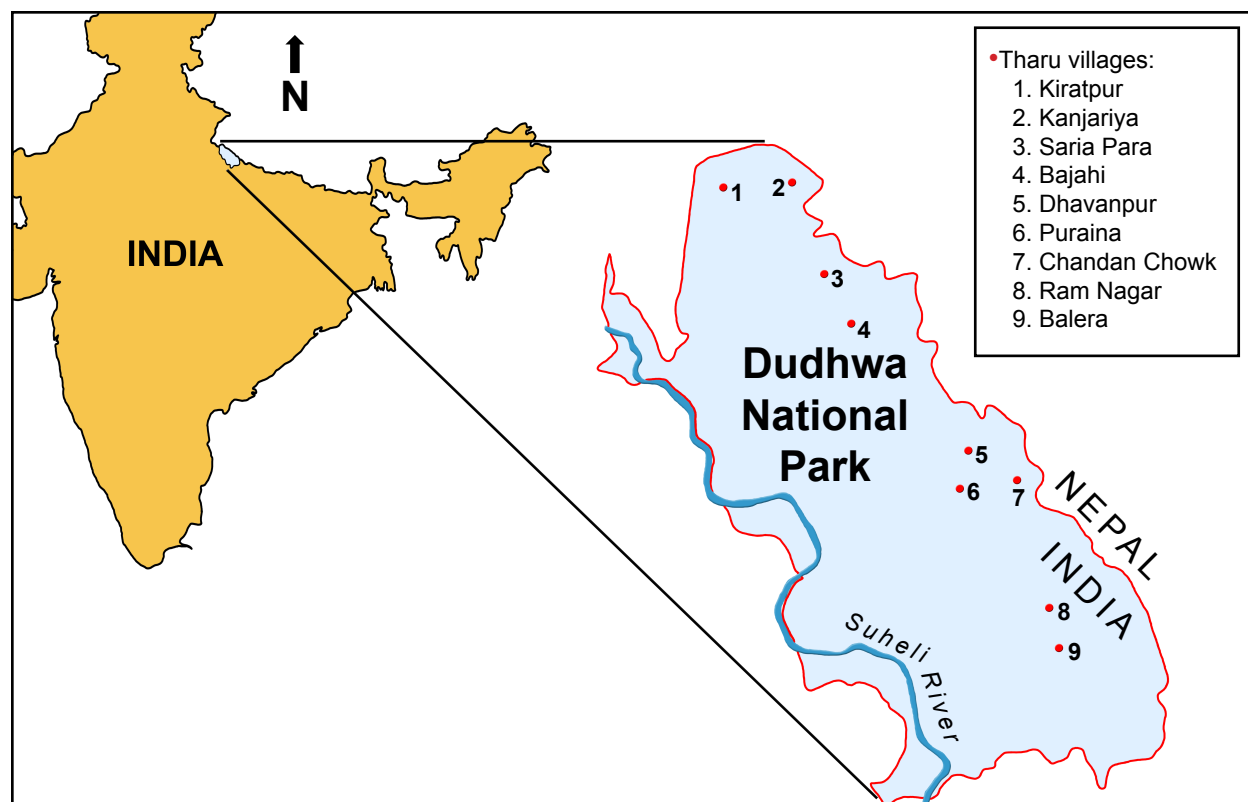


Figure 1. Location of Dudhwa National Park in Uttar Pradesh, India, and the Tharu villages where ethnomedicines were documented.

$$\text{Frequency of citation (\%)} = (N/T) \times 100,$$

where N is the number of informants who cited the medicine and T is the total number of informants interviewed. Logically, the most popular or common medicines among community member will get the highest number for the citation frequency. The informant consensus factor (F_{IC}) technique (also known as the informant agreement ratio (IAR)) was used to determine the consensus between informants for the treatment of a certain use category. The F_{IC} value illustrates the cultural coherence of the selection of a set of medicinal plants used in the treatment of a certain illness category. It is calculated as the number of use-reports or mentions in each usage category (n_{ur}) minus the number of taxa used in each category (n_t), divided by number of mentions in each usage category minus one (Andrade-Cetto 2009, Collins *et al.* 2006, Heinrich *et al.* 2009, Trotter & Logan 1986).

$$F_{IC} = (n_{ur} - n_t) / (n_{ur} - 1)$$

F_{IC} values range between 0 and 1, with a high F_{IC} value indicating greater agreement among informants for uses of species for certain categories of ailments.

Results and Discussion

A total of 95 plant species used by Tharus as ethnomedicine for the treatment of various ailments are documented and enumerated in Table 1. The plants in this study represent 50 families with the most prominent family being Asteraceae (12 species), followed by Fabaceae (8 species) and Lamiaceae (8 species). The 49 different ailments reported were grouped into 14 broad categories: digestive system, dermatological, skeletomuscular, cold & fever, male reproductive issues, eye & ear troubles, maternity-related issues, urinary system, parasitic/viral/bacterial infections, burns, respiratory troubles, circulatory system, teeth & gums, and injury or wound (Table 2). Over half of all species reported were used for digestive, dermatological, or skeletomuscular ailments. Leaves and roots/rhizomes were the most commonly used plant parts, with half of all plants reported being used for these parts (Figure 2). Herbs were the primary source of medicinal plants

Table 1. Enumeration of plant species used in ethnomedicines by Tharu tribes of Dudhwa National Park, Uttar Pradesh, India. *New claims. [¶]All the quantities are approximate equivalents in gm and ml. Abbreviations: ap (aerial part), bl (bulb), fl (flowers), fr (fruits), lf (leaves), rt (roots), rh (rhizome), rbk (root bark), sd (seeds), sbk (stem bark), st (stem), tu (tuber), wp (whole plant); 1×1 (once a day), 2×1 (twice a day), 3×1 (thrice a day), 4×1 (four times a day).

Species [family] collection number	Tharu name	Freq. citation (%)	Parts: Uses	Preparation	Application & dosage [¶]
<i>Acacia sinuata</i> (Lour.) Merr. [Fabaceae] RK23	Aila	41	Fr: Hair tonic for long hairs	Infusion	External
<i>Achyranthes aspera</i> L. [Amaranthaceae] KAB40	Chitchitta	19	Rt: Contraceptive	Decoction	Oral (250 ml); 2×1
<i>Ageratum conyzoides</i> (L.) L. [Asteraceae] KAB37	Kukrona	28	Lf: Headache	Snuff (mixed with black pepper)	Smell
<i>Alternanthera sessilis</i> (L.) R.Br. ex DC. [Amaranthaceae] RK62	Gidanisag	25	Rt: Cataract	Juice	Eye drop
* <i>Amorphophallus paeoniifolius</i> (Dennst.) Nicolson [Araceae] RK21	Suran	46	Corm: Interruption in menstrual cycle	Decoction (with carrot root)	Oral (250 ml); 2×1 for 1 week
<i>Andrographis paniculata</i> (Burm.f.) Nees [Acanthaceae] RK77	Kalmegh	66; 58	Wp: Fever; Wp: Anorexia	Decoction; Decoction	Oral (250 ml); 3×1; Oral (250 ml); 2×1
<i>Azadirachta indica</i> A.Juss. [Meliaceae] KAB91	Neem	55	Lf: Skin itching	Raw	Oral (1 handful); 2×1
<i>Bacopa monnieri</i> (L.) Wettst. [Plantaginaceae] KAB97	Palanibia	42	Wp: Wheezing & shortness of breath, cough	Decoction	Oral (250 ml); 2×1
<i>Blumea lacera</i> (Burm.f.) DC. [Asteraceae] RK103	Sabar barand	61	Lf: Wounds	Juice	Ointment

Species [family] collection number	Tharu name	Freq. citation (%)	Parts: Uses	Preparation	Application & dosage [¶]
<i>Buchanania cochinchinensis</i> (Lour.) M.R.Almeida; syn. <i>Buchanania lanzan</i> Spreng. [Anacardiaceae] RK46	Piyal	31	Kernel: Skin itching	Crushed	Ointment
<i>Caesalpinia bonduc</i> (L.) Roxb. [Fabaceae] RK109	Karang	28	Lf: Fever	2 handfuls mixed with 1 handful <i>Azadirachta indica</i> leaves	Oral; 2×1
* <i>Caesulia axillaris</i> Roxb. [Asteraceae] RK126	Gar gandh	36	Lf: Boils/blisters	Paste	Ointment
<i>Callicarpa macrophylla</i> Vahl [Lamiaceae] RK75	Daya	39	Fr: Boils/blisters on tongue	Paste	Ointment
<i>Cannabis sativa</i> L. [Cannabaceae] KAB153	Bhang	46	Lf: Sore eye	Extract	Ointment
<i>Capparis zeylanica</i> L. [Capparaceae] KAB115	Karralura	55	Rbk: Boil	Paste	Ointment
<i>Cardiospermum halicacabum</i> L. [Sapindaceae] MKS61	Kanpool	25	Lf: Inflammation, muscle stiffness, & pain	Extract	Ointment
<i>Cassia fistula</i> L. [Fabaceae] KAB133	Amaltas	31	Fr & sd: Yellow staining of skin, loss of appetite & weight	About 50 gm crushed	Oral; 1×1
<i>Centella asiatica</i> (L.) Urb. [Apiaceae] KAB142	Brahmi	18	Lf: Loose motion with blood	Juice	Oral (250 ml); 3×1
* <i>Centipeda minima</i> (L.) A.Br. & Asch. [Asteraceae] RK94	Nak-chikani	27	Wp: Toothache	Paste	Applied on gum
* <i>Ceriscoides turgida</i> (Roxb.) Tirveng. [Rubiaceae] RK135	Gud gudia	69	Rt: Vomiting, flatulence & stomachache	Extract	Oral (150 ml); 3×1
* <i>Chlorophytum tuberosum</i> (Roxb.) Baker [Asparagaceae] KAB140	Safed musali	45	Tu: Loose motion & muscle cramps	Extract	Oral (250 ml); 3×1
<i>Cirsium arvense</i> (L.) Scop. [Asteraceae]	Oont-katila	13	Rt: Little & frequent urine	Paste	Oral (300 ml); 2×1
<i>Cissampelos pareira</i> L. [Menispermaceae] KAB85	Madrachi	66	Lf: Stomachache	About 200 ml decoction mixed with 10 ml lemon juice, 10 ml garlic extract, and a pinch of salt	Oral; 3×1
<i>Cleome viscosa</i> L. [Cleomaceae] RK122	Hurhura	72	Lf: Boil	Paste	Ointment
<i>Cocculus hirsutus</i> (L.) W.Theob. [Menispermaceae] RK79	Chreta	25	Lf: Skin itching	Juice	Ointment
<i>Colebrookea oppositifolia</i> Sm. [Lamiaceae] RK117	Daya	34	Lf: Cuts, wounds	Paste	Ointment

Species [family] collection number	Tharu name	Freq. citation (%)	Parts: Uses	Preparation	Application & dosage ^w
<i>Cordia dichotoma</i> G.Forst. [Boraginaceae] KAB3	Lasoor	61	Fr: Cough, cold	Decoction	Oral (8–10 fruits); 2×1
<i>Cryptolepis dubia</i> (Burm.f.) M.R.Almeida; syn. <i>Cryptolepis buchananii</i> Roem. & Schult. [Apocynaceae] RK60	Dudhi	39	Wp: Abnormal bone shape bone in children	Juice	Oral (250 ml); 2×1 for 6 months
* <i>Curcuma amada</i> Roxb. [Zingiberaceae] KAB155	Amahaldi	55	Rh: Abdominal pain	1 medium rhizome crushed & given with jaggery	Oral; 3×1
<i>Datura innoxia</i> Mill. [Solanaceae] KAB158	Dhatura	21	Lf: Boils/blisters	Paste	Ointment
<i>Dicliptera paniculata</i> (Forssk.) I.Darbysh. [Acanthaceae] RK83	Choti hadjor	31	Ap: Bone fracture	Paste	External and bandage
<i>Diospyros exsculpta</i> Buch.-Ham. [Ebenaceae] RK86	Tendu	61	Sbk: Loose motion with blood	Paste/powder	Oral (100 gm); 3×1
* <i>Drimia indica</i> (Roxb.) Jessop [Asparagaceae] RK95	Ban piyaj	34	Bl: Swelling and chest pain	Extract	External
* <i>Dysphania ambrosioides</i> (L.) Mosyakin & Clemants; syn. <i>Chenopodium ambrosioides</i> L. [Amaranthaceae] RK137	Kirmani	42	Wp: Piles	Paste	Ointment
* <i>Echinops echinatus</i> Roxb. [Asteraceae] RK139	Yokhru	22	Rt: Abdominal pain	Root powder	Oral (50 gm); 3×1
<i>Eclipta prostrata</i> (L.) L. [Asteraceae] KAB80	Bhangra	58	Lf: Body-swelling	About 100 ml extract mixed with 4–5 black peppers	Oral; 3×1 for 2 weeks
* <i>Elephantopus mollis</i> Kunth [Asteraceae] KAB96	Jangali gobi	13	Rt: Filariasis	Powder	Oral (100 gm); 2×1 for 2 months
* <i>Enicostema axillare</i> (Poir. ex Lam.) A.Raynal [Gentianaceae] RK139	Chota chirayata	10	Wp: Headache, fatigue, frequent urination, & thirst	About 250 ml extract	Oral; 2×1
* <i>Eruca vesicaria</i> (L.) Cav. [Brassicaceae] RK96	Tara-mira	27	Sd: Burn injury	Oil	Ointment
<i>Erythrina stricta</i> Roxb. [Fabaceae] KAB9	Nasui	33	Bk: Interruption in menstrual cycle	Decoction	Oral (250 ml); 2×1 for 1 week
<i>Euphorbia fusiformis</i> Buch.-Ham. ex D.Don; syn. <i>Euphorbia acaulis</i> Roxb. [Euphorbiaceae] RK141	Banmuli	13; 25	Rt: Inflammation, muscle stiffness, & pain; Lf: Burn	Boiled in mustered oil; Juice	Ointment; Ointment
* <i>Euphorbia hirta</i> L. [Euphorbiaceae] KAB134	Laldudhi	21	Wp: Stomach worm in children	Powder	Oral (250 gm); 1×1 for 3 days
* <i>Evolvulus nummularius</i> (L.) L. [Convolvulaceae] KAB88	Musakan	48	Wp: Cough & cold	Extract	Oral (100 ml); 3×1

Species [family] collection number	Tharu name	Freq. citation (%)	Parts: Uses	Preparation	Application & dosage ^u
* <i>Ficus hispida</i> L.f. [Moraceae] RK99	Kalhgular	31	Sbk: White patches on skin	Decoction	Oral (250 ml); 2×1 for 2 weeks
<i>Glycosmis mauritiana</i> (Lam.) Tanaka [Rutaceae] KAB11	Ban nimbu	25	Rt: Fever	Crushed	Oral (100 gm); 3×1
* <i>Gmelina arborea</i> Roxb. [Lamiaceae] RK127	Gamhar	43	Lf: Fever	Decoction	Oral (250 ml); 3×1
* <i>Haldina cordifolia</i> (Roxb.) Ridsdale [Rubiaceae] RK58	Hardu	36	Rbk: Yellow staining of skin, loss of appetite & weight	Decoction	Oral (250 ml); 2×1 for 1 month
<i>Helicteres isora</i> L. [Malvaceae] RK101	Murra	55	Sd: Dysentery	Extract	Oral (100 ml); 3×1
<i>Hibiscus rosa-sinensis</i> L. [Malvaceae] RK22	Gurhal, sadaphool	58	Stamens: Little and frequent urination	Raw	Oral (1 handful); 2×1 for 2 weeks
* <i>Hygrophila auriculata</i> (Schumacher.) Heine [Acanthaceae] RK78	Talmakhana	16	Sd: Skin itching	Extract	Ointment
* <i>Ipomoea carnea</i> Jacq. [Convolvulaceae] KAB39	Behaya	40	Latex: Joint pain & inflammation	Latex applied and heated leaves are wrapped	External
* <i>Launaea acaulis</i> (Roxb.) Kerr [Asteraceae] RK44	Dudhia	12	Latex: Redness in eye, tears, & pain	Eye drop	External
* <i>Lawsonia inermis</i> L. [Lythraceae] KAB158	Mehndi	69	Lf: Frequent motion with blood	About 150 ml extract mixed with yogurt and a pinch of black pepper powder	Oral; 3×1
<i>Leea macrophylla</i> Roxb. ex Hornem. [Vitaceae] KAB144	Hathi kan, badi assidh	19	Rt: Bone fracture	Paste mixed with goat milk	External and bandage
* <i>Leucas aspera</i> (Willd.) Link [Lamiaceae] KAB59	Gumma, chota halkus	27	Lf: Boils/blisters	Paste	Ointment
<i>Leucas cephalotes</i> (Roth) Spreng. [Lamiaceae] KAB130	Goma, gum	54	Lf: Impotency (erectile dysfunction)	Extract	Oral (250 ml); 1×1 for 3 months
<i>Litsea glutinosa</i> (Lour.) C.B.Rob. [Lauraceae] RK100	Maida	22	Sbk: Sprain	Paste mixed with common salt	External
* <i>Luffa cylindrica</i> (L.) M.Roem. [Cucurbitaceae] RK34	Ghia taroi	33	Fr: Piles	Decoction with radish	Oral (250 ml); 2×1 for 1 month
* <i>Lygodium flexuosum</i> (L.) Sw. [Lygodiaceae] RK12	Bisma	58	Rt: Premature ejaculation	Extract	Oral (100ml); 2×1 for 2 weeks
<i>Mallotus philippensis</i> (Lam.) Müll.Arg. [Euphorbiaceae] KAB66	Rohini	27	Fr: Skin itching	Mixed with coconut oil	Ointment
* <i>Melia azedarach</i> L. [Meliaceae] KAB90	Bakaun	36	Lf: Boils/blisters	Paste	Ointment

Species [family] collection number	Tharu name	Freq. citation (%)	Parts: Uses	Preparation	Application & dosage ^u
* <i>Moringa oleifera</i> Lam. [Morinaceae] KAB14	Sanjna, sahan	88	Lf: Heaviness of head, uneasy feeling, wrist measurement shows high blood pressure	Decoction/extract	Oral (250ml); 2×1 for 2 days
* <i>Musa acuminata</i> × <i>balbisiana</i> Colla [Musaceae] KAB102	Kera	15	Rt: Stomach pain	Crushed	Oral (100gm); 3×1
<i>Nicotiana tabacum</i> L. [Solanaaceae] KAB47	Thambaku	72	Lf: Skin itching	Ash mixed with mustard oil	Ointment
<i>Oroxylum indicum</i> (L.) Kurz [Bignoniaceae] KAB93	Sona	40	Sbk: Diarrhea	About 100 gm stem bark crushed with 1 handful <i>Hordeum vulgare</i> L. seeds	Oral; 3×1
<i>Persicaria barbata</i> (L.) H.Hara; syn. <i>Polygonum barbatum</i> L. [Polygonaceae] KAB68 KAB146	Miriya	22	Lf: Contraceptive	Extract	Oral (100 ml); 1×1
* <i>Phragmites karka</i> (Retz.) Trin. ex Steud. [Poaceae] RK74	Narkul	19	Lf: Loss of sensation & movement of legs/hands	Paste	External
* <i>Phyla nodiflora</i> (L.) Greene [Verbenaceae] RK17	Bhuiokra	52	Lf: Headache	Extract	External on forehead
<i>Piper longum</i> L. [Piperaceae]	Peepramul	84	Fr: Cough	Decoction	Oral (250 ml); 2×1
* <i>Platyclusus orientalis</i> (L.) Franco; syn. <i>Thuja orientalis</i> L. [Cupressaceae] RK149	Morpankhi	9	Lf: Pain in urination & yellowish discharge	Extract	Oral (100 ml); 3×1
<i>Plumbago zeylanica</i> L. [Plumbaginaceae] RK24	Chita	42	Rt: Fever	Paste	Oral
<i>Pogostemon benghalensis</i> (Burm.f.) Kuntze [Lamiaceae] RK43	Kali bhant	34	Wp: Maggots	Ash is mixed with mustard oil	External
<i>Pterocarpus marsupium</i> Roxb. [Fabaceae] KAB69	Bijasal	46	Wood: Chest pain	Decoction	Oral (250 ml); 2×1 for 2 weeks
<i>Rothea serrata</i> (L.) Steane & Mabb.; syn. <i>Clerodendrum serratum</i> (L.) Moon [Lamiaceae] RK63	Bhant	55	Lf: Inflammation of eye-lids	Boil in mustard oil	Ointment
* <i>Saccharum bengalense</i> Retz. [Poaceae] RK148	Munj	55	Rt: Nocturnal emission	Extract	Oral (100ml); 1×1 for 2 days
<i>Semecarpus anacardium</i> L.f. [Anacardiaceae] RK147	Bhilawa	21	Kernel: Vermifuge	Raw	Oral (1 handful); 2×1 for 3 days
<i>Senna tora</i> (L.) Roxb.; syn. <i>Cassia tora</i> L. [Fabaceae] KAB84	Chakwad	48	Lf: Ring worm	Juice	Ointment
<i>Shorea robusta</i> Gaertn. [Dipterocarpaceae] KAB73	Shaku	42	Gum: Dysentery	About 50 gm mixed with yogurt	Oral; 3×1 for 2 days

Species [family] collection number	Tharu name	Freq. citation (%)	Parts: Uses	Preparation	Application & dosage [¶]
<i>Sida rhombifolia</i> L. [Malvaceae] KAB156	Bariari	54	Lf: Nocturnal emission	Juice	Oral (100 ml); 2×1 for 3 days
<i>Solanum virginianum</i> L.; syn. <i>Solanum surattense</i> Burm.f. [Solanaceae] KAB25	Bhatkataliyya	25	Fr: Toothache	Mixed with tobacco (2:1 ratio)	Smoke
<i>Sphaeranthus indicus</i> L. [Asteraceae] RK132	Lal mundi	13	Lf: Inflammation of eye	Raw	Oral (1 handful); 2×1
<i>Syzygium cumini</i> (L.) Skeels [Myrtaceae] RK19	Jamun	39	Ripe fr: Diarrhea	Raw	Oral; 2×1
<i>Tamilnadia uliginosa</i> (Retz.) Tirveng. & Sastre; syn. <i>Catunaregam uliginosa</i> (Retz.) Sivar. [Rubiaceae] RK7	Pindar	64	Ripe fr: Loose motion with blood	Raw	Oral (4–5 fruits); 2×1
<i>Tectaria zeylanica</i> (Houtt.) Sledge; syn. <i>Helminthostachys zeylanica</i> (L.) Hook. [Tectariaceae] RK65	Kamraj	51	Rh: Impotency (erectile dysfunction)	Decoction	Oral (100 ml); 1×1 for 2 months
* <i>Tephrosia purpurea</i> (L.) Pers. [Fabaceae] KAB92	Sarpoka	51	Lf: Skin itching	Paste mixed with honey	Ointment
<i>Terminalia bellirica</i> (Gaertn.) Roxb. [Combretaceae] KAB104	Bahera	21	Fr: Constipation	Fruit	Oral; 1×1
<i>Tinospora cordifolia</i> (Willd.) Miers [Menispermaceae] KAB72	Giloh	27	Fr: Loose motion with blood	Paste	Oral (50 gm); 4×1
* <i>Trachyspermum ammi</i> (L.) Sprague [Apiaceae] KAB152	Ajwan	37	Sd: Cough & cold	About 100 gm mixed with paste of <i>Curcuma longa</i> L. (50 gm) and warm milk (250 ml)	Oral; 2×1 for 5 days
<i>Tribulus terrestris</i> L. [Zygophyllaceae] KAB82	Gokhura	54	Fr: Little and frequent urine	Crushed	Orally (100 gm); 2×1
* <i>Tridax procumbens</i> (L.) L. [Asteraceae] KAB26	Phoolni	63	Wp: Nocturnal emission	Extract	Oral (250 ml); 1×1 for 1 week
<i>Uraria lagopodoides</i> (L.) DC. [Fabaceae] RK70	Eksoria	16	Rt: Boils and blisters	Crushed with mustard oil	Ointment
<i>Ventilago denticulata</i> Willd. [Rhamnaceae] RK42	Hariabori	28	Sd: Skin burn	Oil	Ointment
<i>Vernonia anthelmintica</i> (L.) Willd. [Asteraceae] RK35	Kalajiri	12	Lf: Fever	Juice	Oral (250 ml); 2×1
<i>Vitex negundo</i> L. [Lamiaceae] KAB105	Sambhalu	34	Lf: Fever	Extract	Oral (100 ml); 3×1
<i>Wrightia tinctoria</i> R. Br. [Apocynaceae] RK45	Dudhi	22	Bk: Vomiting, diarrhea, or both & stomach pain	Extract	Oral (100 ml); 2×1 for 2 weeks

as categorized by plant life form (48%), followed by trees (Figure 3). The most common method of remedy preparation was extraction or juice (31%), followed by paste (20%) and decoction (15%) (Figure 4).

Ailments treated

The common ailments in the area are diarrhea, injuries, cold & fever, jaundice, anorexia (loss of hunger), dermatitis (skin itching), and sprains. The role of allopathic treatments has increased among Tharu tribes because it provides quick relief, but traditional therapies are still used in primary health care due to the lack of hospitals and wide-spread poverty in the study area. Some of the ailments like minor injuries, dermatitis, bone dislocation, toothache, male reproductive ailments, and maternity-related issues are still preferably treated by ethnomedicines. Similar observations have been reported from different parts of India by Bharati and Sharma (2012), Dey and De (2012), Kumar and Bharati (2012), and Kumar *et al.* (2012).

Informant consensus factor (F_{IC}) and frequency of citation

The data were evaluated by two quantitative statistical tools of ethnobotany: informant consensus factor (F_{IC}) and frequency of citation. The major aim of the statistical analysis was to identify the frequently used medic-

inal plants among Tharu tribes. The frequency of citation was highest for the following ten plants: *Moringa oleifera* Lam., *Piper longum* L., *Nicotiana tabacum* L., *Cleome viscosa* L., *Ceriscoides turgida* (Roxb.) Tirveng., *Lawsonia inermis* L., *Cissampelos pareira* L., *Andrographis paniculata* (Burm. f.) Nees, *Tamilnadia uliginosa* (Retz.) Tirveng. & Sastre, *Tridax procumbens* (L.) L., and *Hibiscus rosasinensis* L. (Table 3). The greatest number of taxa (24) were used to treat digestive ailments. This is similar to observations reported by Dey and De (2012), and Sen *et al.* (2011). The conservation-related aspects are not included in the present study because the species recorded during the investigation are not mentioned in red-data book of plants (Nayar & Sastry 1987–90, Schippmann *et al.* 2002).

The F_{IC} technique was applied to calculate the consensus of informants for the treatment of a certain use category (Heinrich *et al.* 2009). In our study, the F_{IC} value ranged from 0.94 to 0.98, with a high value for F_{IC} indicating greater agreement among informants for medicinal uses of species for certain categories of ailments (Table

Table 2. Number of plant taxa (n_t), number of use-reports of those taxa by all informants (n_{ur} ; $N = 67$), and the informant consensus factor (F_{IC}) for ailment categories relative to ethnomedicinal practices of the Tharu tribes of Dudhwa National Park, India. $F_{IC} = (n_{ur} - n_t) / (n_{ur} - 1)$.

Ailment category	n_t	n_{ur}	F_{IC}
Digestive system	24	656	0.96
Dermatological	17	444	0.96
Skeletomuscular	13	287	0.95
Cold & fever	10	266	0.96
Male reproduction-related	6	224	0.97
Eye & ear	5	102	0.96
Maternity-related	4	81	0.96
Urinary system	3	84	0.97
Parasitic, viral, & bacterial	3	38	0.94
Burns	3	54	0.96
Respiratory system	3	107	0.98
Circulatory system	2	66	0.98
Tooth & gums	2	49	0.97
Wound/injury	2	64	0.98

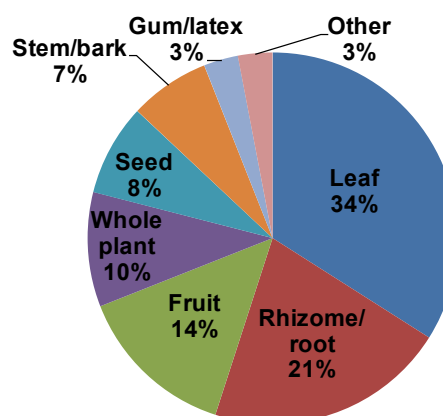


Figure 2. Percentage of plant parts used in the preparation of remedies as reported by Tharu tribes of Dudhwa National Park in Uttar Pradesh, India.

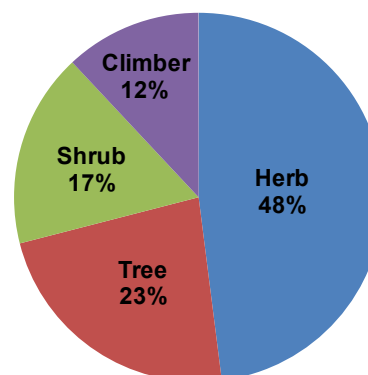


Figure 3. Percentage of life forms of ethnomedicinal plants used by Tharu tribes of Dudhwa National Park in Uttar Pradesh, India.

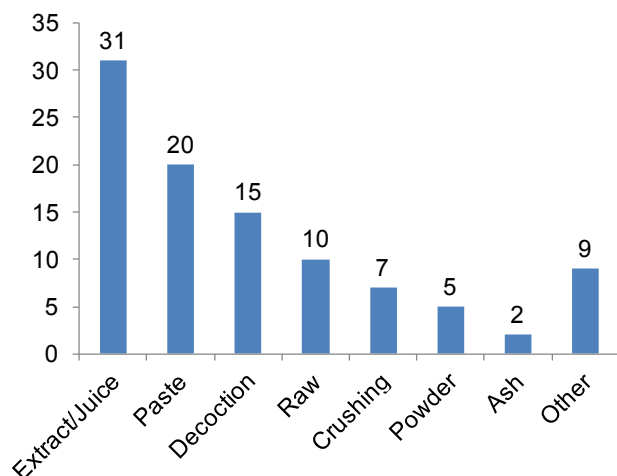


Figure 4. Reported methods of ethnobotanical remedy preparation among Tharu tribes within Dudhwa National Park, India.

2). The frequency of citation technique was used to determine the level of consensus among informants for a particular medicine for an ailment (Table 3). The species having both high frequency of citation and high F_{IC} value are promising plants for phytochemical and pharmacological studies (Cragg *et al.* 1997, Heinrich 2000, Miller 2010, Newman & Cragg 2007).

New findings

Information on 95 species of plants and 97 ethnomedicines were recorded. The review of literature revealed that 34 species are reported here for new ethnomedicinal uses for this region of India. These species have been previously reported here and elsewhere for different medicinal properties (see taxa marked with * in Table 1), but

the new medicinal uses are highlighted separately in Table 4.

Conclusions

In this study, 95 medicinal plants were identified and documented. Informants preferred to treat some ailments like minor injuries, dermatitis, bone dislocation, toothache, male reproductive ailments and maternity-related issues with traditional medicines. Quantitative data analysis revealed agreement among informants for the use of *M. oleifera* (high blood pressure), *P. longum* (cough), *N. tabacum* (dermatitis), *C. viscosa* (boil), *C. turgida* (stomach ulcer), *L. inermis* (dysentery), *C. pareira* (stomachache), *A. paniculata* (fever, anorexia), *T. uliginosa* (dysentery), and *T. procumbens* (nocturnal emission). Preparations identified in this research as having higher informant consensus factors may have potential for wider use elsewhere.

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Table 3. Ten plants with highest frequency of citation (%) for a particular ailment as reported by Tharu tribes of Dudhwa National Park, India. Frequency of citation = (No. of informants citing a plant's use / Total no. of informants) × 100.

Scientific name	Freq. citation	Ailment
<i>Moringa oleifera</i> Lam.	88	High blood pressure
<i>Piper longum</i> L.	84	Cough
<i>Nicotiana tabacum</i> L.	72	Dermatitis (skin itching)
<i>Cleome viscosa</i> L.	72	Boil
<i>Ceriscoides turgida</i> (Roxb.) Tirveng.	69	Vomiting, flatulence, & stomachache
<i>Lawsonia inermis</i> L.	69	Loose motion with blood
<i>Cissampelos pareira</i> L.	66	Stomachache
<i>Andrographis paniculata</i> (Burm.f.) Nees	66	Fever
<i>Tamilnadia uliginosa</i> (Retz.) Tirveng. & Sastre	64	Loose motion with blood
<i>Tridax procumbens</i> (L.) L.	63	Nocturnal emission

Table 4. Newly documented ethnomedicinal uses for 34 plant species within Dudhwa National Park, India.

Ailment	Ethnomedicinal species
Abdominal pain	<i>Curcuma amada</i> Roxb.; <i>Echinops echinatus</i> Roxb.; <i>Musa acuminata</i> × <i>balbisiana</i> Colla
Boil	<i>Caesulia axillaris</i> Roxb.; <i>Leucas aspera</i> (Willd.) Link; <i>Melia azedarach</i> L.
Burn injuries	<i>Eruca vesicaria</i> (L.) Cav.
Cholera	<i>Chlorophytum tuberosum</i> (Roxb.) Baker
Cold & cough	<i>Evolvulus nummularius</i> (L.) L.; <i>Trachyspermum ammi</i> (L.) Sprague
Conjunctivitis	<i>Launaea acaulis</i> (Roxb.) Kerr
Dermatitis	<i>Hygrophila auriculata</i> (Schumach.) Heine; <i>Tephrosia purpurea</i> (L.) Pers.
Diabetes	<i>Encostema axillare</i> (Poir. ex Lam.) A.Raynal
Dysentery	<i>Lawsonia inermis</i> L.
Estrus regulation	<i>Amorphophallus paeoniifolius</i> (Dennst.) Nicolson
Fever	<i>Gmelina arborea</i> Roxb.
Filaria	<i>Elephantopus mollis</i> Kunth
Gonorrhoea	<i>Platyclusus orientalis</i> (L.) Franco
Headache	<i>Phyla nodiflora</i> (L.) Greene
High blood pressure	<i>Moringa oleifera</i> Lam.
Jaundice	<i>Haldina cordifolia</i> (Roxb.) Ridsdale
Joint pain	<i>Ipomoea carnea</i> Jacq.
Leucoderma	<i>Ficus hispida</i> L.f.
Nocturnal emission	<i>Saccharum bengalense</i> Retz.; <i>Tridax procumbens</i> (L.) L.
Paralysis	<i>Phragmites karka</i> (Retz.) Trin. ex Steud.
Piles	<i>Dysphania ambrosioides</i> (L.) Mosyakin & Clemants; <i>Luffa cylindrica</i> (L.) M.Roem.
Premature ejaculation	<i>Lygodium flexuosum</i> (L.) Sw.
Stomach worm	<i>Euphorbia hirta</i> L.
Stomach ulcer	<i>Ceriscoides turgida</i> (Roxb.) Tirveng.
Swelling & chest pain	<i>Drimia indica</i> (Roxb.) Jessop
Toothache	<i>Centipeda minima</i> (L.) A.Br. & Asch.

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Appendix 1. Plants with high frequency of citation (%) within 8 of the 14 major ailment categories with high informant consensus (F_{ic}) as reported by Tharu tribes of Dudhwa National Park, India.

Ailment category & Scientific name	Specific ailment	F_{ic}	%
Digestive system		0.96	
<i>Andrographis paniculata</i> (Burm.f.) Nees	Anorexia		58
<i>Ceriscoides turgida</i> (Roxb.) Tirveng.	Stomach ulcer		69
<i>Cissampelos pareira</i> L.	Skin itching		66
<i>Lawsonia inermis</i> L.	Loose motion with blood		69
Dermatological		0.96	
<i>Cleome viscosa</i> L.	Boil		72
<i>Nicotiana tabacum</i> L.	Skin itching		72
Skeletomuscular		0.95	
<i>Eclipta prostrata</i> (L.) L.	Anasarca		58
Cold & fever		0.96	
<i>A. paniculata</i>	Fever		66
<i>Cordia dichotoma</i> G.Forst.	Cough & fever		61
Male reproduction-related		0.97	
<i>Lygodium flexuosum</i> (L.) Sw.	Premature ejaculation		58
<i>Tridax procumbens</i> (L.) L.	Nocturnal emission		63
Eye & ear		0.96	
<i>Cannabis sativa</i> L.	Sore eye		46
<i>Rothea serrata</i> (L.) Steane & Mabb.	Inflammation of eye-lids		55
Maternity-related		0.96	
<i>Amorphophallus paeoniifolius</i> (Dennst.) Nicolson	Interruption in estrus cycle		46
<i>Erythrina stricta</i> Roxb.	Interruption in estrus cycle		33
Urinary system		0.97	
<i>Hibiscus rosa-sinensis</i> L.	Little & frequent urine		58
<i>Tribulus terrestris</i> L.	Little & frequent urine		54

