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Plants used as Ethnoveterinary Medicines in Sikkim Himalayas

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Research

Abstract

Field work was conducted to document the ethnoveterinary medicine used by members of the indigenous community in Sikkim Himalayas, India, in order to treat ailments of their livestock. This research detailed the use of 37 medicinal plants to treat ailments in animals such as diarrhea, dysentery, digestive disorders, injury, wound, fever, maternity complications, skin disease, urinary problems, cough and cold, skeleto-muscular disorders, inflammation, scorpion sting, snake and insect bite, weakness, parasite, ulcer and bleeding. 12 medicinal plants being used in Sikkim Himalayas have not been documented in ethnoveterinary medicine elsewhere in the world. 15 plant species were found to contain previously unreported medicinal properties.

Introduction

Folk veterinary practices are seen as a holistic approach for livestock health care and management needs by the local indigenous population in Sikkim Himalayas. These practices have been transmitted orally from one generation to the next. In India, ancient literature such as the Vedas, and other written scriptures like Scand Puran (1000 BC), Devi Puran (2350 BC), Cherak and Shusruta (2500-600 BC) have long documented the treatment of animal disease by using medicinal plants (Dwivedi 2003, Kumar 2003, Shirlaw 1940, Swarup 2003). Modern research continues to contribute to this body of knowledge such as, Biswas (1956), Chopra *et al.* (1956), Kirtikar and Basu (1933) and Jain (1981). Research focusing on ethnoveternary medines also continues, with some interesting work having been done by Gaur (1992), Jain and Srivastava (1999), Kiruba *et al.* (2006), Pande *et al.* (2007), Srivastava *et al.* (2000).

Sikkim is a state in India, situated on the flanks of the eastern Himalayas between 27010' – 2805' N latitude and 88030' – 890 E longitude, bordered by China (Tibet) to the north-east, Bhutan to the south-east and Nepal to the west. Towards the south is the Indian state of West Bengal (Figure 1). Sikkim is geographically diverse, ranging in altitude from 244m to 8598m. The climate ranges from tropical to high alpine. Owing to its range of altitude the vegetation of Sikkim may be classified into five categories: Low Hill Forests (tropical to subtropical type *i.e.* Terai forest, up to 900m), Middle Hill Forests (subtropical type, 750-1500 m), Upper Hill forests (Warm or wet temperate type 1500-2700 m), Rhododendron-Conifer Zone (cold temperate or sub-alpine, 2700-3600 m), Alpine Scrub and Grasslands (3600-4300m and above) (Chaudhary 1951).

Sikkim possesses high plant diversity and is listed as one of the world's 25 biodiversity hotspots (Myers *et al.* 2000). Although it consists of only 0.2% of the total geographical area of India it has as many as 5,000 species of flowering plants and 362 species of ferns and ferns allies (Hara 1966, Mehra & Bir 1964, Rai & Sharma 1994, Singh &

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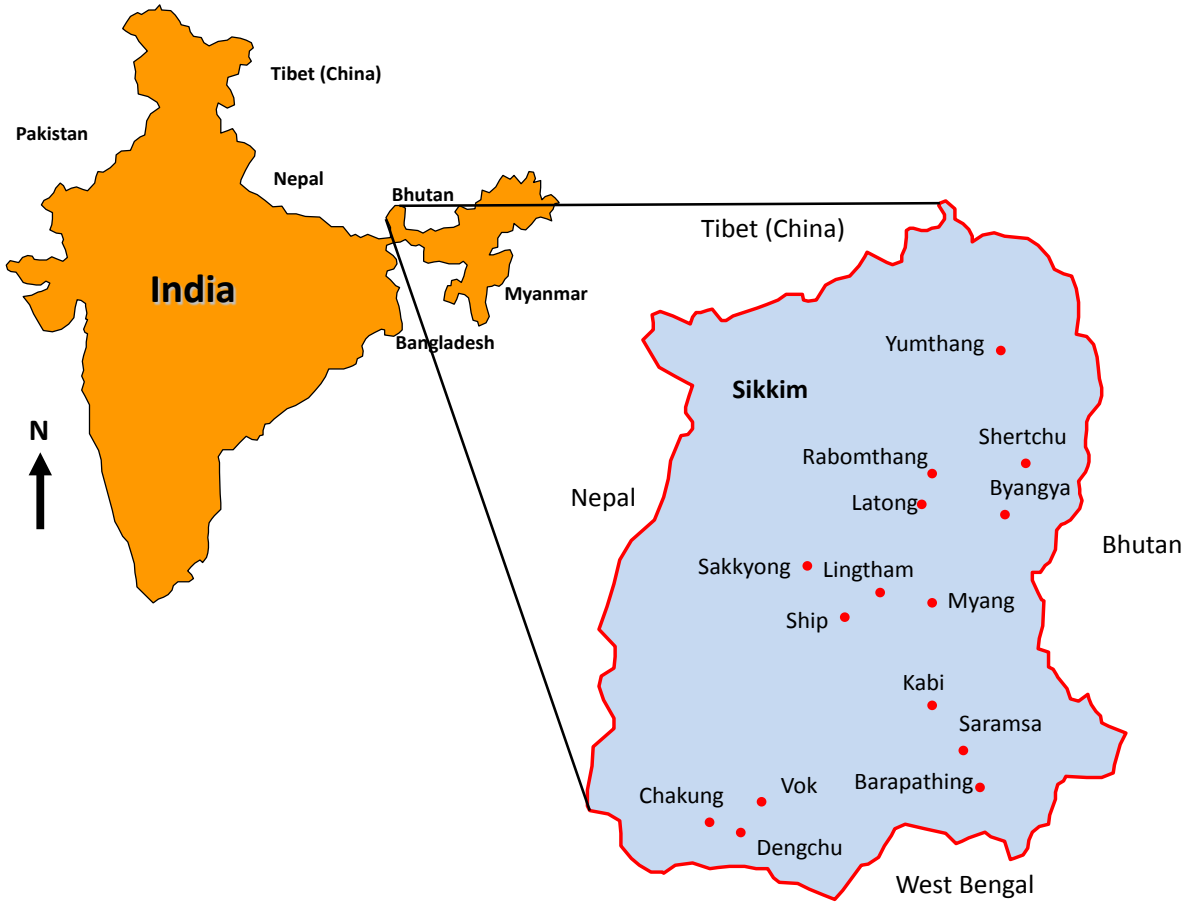

Figure 1. Sikkim, India, showing the villages surveyed for ethnoveterinary medicines.

Chauhan 1997). Sikkim's vegetation is divided into three altitudinal types, tropical (600-1500 m ASL), temperate (2700-3900 m ASL), and alpine (4000-5500 m ASL). Most of the areas of the state are very wet during June to September (Hajra & Verma 1996). On average, the eastern and southern portions get a heavier rainfall (3040-3810 mm) than the western portion of the state (2030-2540 mm) (Chaudhary 1951).

The native population of Sikkim is comprised mainly of three groups, Bhutias, Lepchas and Nepalese (Rai & Sharma 1994). The Lepchas are the earliest known inhabitants of the Sikkim. According to the 1891 census Lepchas accounted for 19% of the population. Recent census data shows they now only account for 8% (about 30,000) of the total population of Sikkim (Anonymous 2008). The Lepcha are mainly concentrated in the Dzongu reserve of the North district. The concept of health and illness among the Lepchas is guided by a belief in the supernatural. Before ethnoveternary treatments are begun, sacred hymns are chanted in front of the livestock by religious healers known as **Lama** (priest), **Mun** and **Bongthing**. These healers are considered by the Lepchas to be the mediums for communicating to the gods (**rum**) and devils or demons (**Mungs**). They also believe that the sacred chants ward off evil spirits and protect their livestock. Almost all Sikkimese, regardless of ethnic group, believe in the use of sacred chants to keep evil spirits at bay, and for successful treatments. They also use **Dacho** (prayer flags) for good luck and protection from demons (Burman 2003).

Bhutias make up about 14% of Sikkim's total population. They live primarily in some of the inner dry valleys of northern Sikkim. Their main sources of livelihood are animal husbandry and trade. Bhutias often reside in separate hamlets of villages. Although their culture shares many attributes with Tibetans, they have a distinct identity and language called Sikkimese. The religious doctors of Bhutias are known as **pau** (male), **neyjum** (female), and **lama**/priests, who treat patients with chants, tantras and herbs.

The eastern and southern parts of the state are largely inhabited by the Nepalese, the majority ethnic group (about 70% of population) of the state. Nepalese communities are chiefly agriculturalists (Chaudhary 1951). A majority of the Nepalese community are Hindus with a few Buddhists. Nepali is the primary language of this Nepal-

ese community. The native doctors in this community are known as **Jhankri**.

Native peoples of Sikkim are highly dependent on animal husbandry, as it plays a major role in their livelihoods, especially at higher altitudes. A large number of livestock are still maintained using the traditional methods of the region (Balaraman & Golay 1991). The major livestock of the state are cattle (51%), goats (29%), pigs (9%), dogs (6%), sheep (3%), horses & ponies(1%), buffalos (1%), yaks (1%) and poultry (Anonymous 2006).

The area of Sikkim remained largely isolated due to its geographical impasses until the middle of the 19th Century when a series of visits by naturalists and explorers started towards the then mountain kingdom of Sikkim Himalaya (Chaudhary 1951, Clarke 1876, Hara 1966, Hooker 1849, King & Pantling 1889, Mehra & Bir 1964, Rao 1963, Smith 1913, Smith & Cave 1911). The ethnobotany of the area was first described by Atkinson (1882), followed by Biswas (1956), Puri & Pandey (1980), Hajra & Chakraborty (1981), Bennet (1983, 1985), Krishna & Singh (1987), Rai & Sharma (1994), Jana & Chauhan (1999, 2000), Maiti *et al.* (2003), Dash *et al.* (2003), Pradhan & Badola (2008). Despite all of this research, the ethnovetenary practices of the region remained unexplored. Modernization of Sikkim has increased cultural interaction with modern medicine, media and other cultural groups. This has resulted in a decrease in traditional knowledge and cultural practrices. Many areas of Sikkim remain isolated due to a lack of modern infrastructure there, and in these areas local tradtional knowledge persists. Keeping this in mind, we set out to document the prevalent knowledge being used by the local people of Sikkim. The aims of this project are the:

1. Investigation of traditional medicinal plant knowledge of Sikkim with special reference to livestock treatment.
2. Conservation of indigenous knowledge through documentation.

Methods

An ethnobotanical survey was conducted from March 2008 to June 2009 in 15 villages of Sikkim (Figure 1). After consultation with local people the sample villages, representing different geographical locations, climatic conditions, vegetation and major ethnic groups of the state were identified. Also included were Bhutia nomadic herdsmen, who were interviewed near Yumthang. A Transect Walk method of a Participatory Rural Appraisal (PRA) was adopted (Cunningham 2001). This method involves semi-structured interviews and discussion with key-research participants such as, community elders, traditional healers, livestock owners and herdsmen. The interviews were held in Nepali.

The prevalent animal diseases, 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 Hajra and Verma (1996). Additional identification was done by matching voucher specimens with previously identified specimens held in local herbaria (BSHC, DD). Voucher specimens from this research have been deposited at Raw Materials Herbarium & Museum Delhi (RHMD) and at the Department of Botany, N.R.E.C. College, Uttar Pradesh, India. A comparative assessment in the form of a literature review was also conducted to differentiate between new findings and similarities with past research (Tables 1, 2).

Results

A total of 46 people (30 men and 16 women), ranging from 30 to 70 years in age were interviewed. Key-research participants included members of the three main ethnic groups in Sikkim, Lepcha (9 men and 3 women), Bhutia (5 men and 5 women) and Nepali (16 men and 8 women).

Table 1. Plant species used in ethnoveterinary practices in Sikkim, India. Local names are given in the three main languages of the region, (B) = Bhutia, (L) = Lepcha, (N) = Nepali.

Species name and family	Specimen number	Local names	Distribution	Ethnoveterinary use (Present study)	Ethnoverinary use in other parts of India (Earlier studies)
Abies densa Griff. (Pinaceae)	KAB17	**Ailey** (N)	Temperate and subalpine climate from 2500 – 4000 m ASL	Fresh leaves are crushed and extract (≈40 ml) is given to cattle to treat fever, loss of appetite and uneasy feeling.	

Species name and family	Specimen number	Local names	Distribution	Ethnoveterinary use (Present study)	Ethnoverinary use in other parts of India (Earlier studies)
Acorus calamus L. (Acoraceae)	KAB24	**Bojo**, **Bojho** (N)	Marshy or semi-aquatic land in between 1700 - 2300 m ASL	Paste of root and rhizome is administered twice daily to treat indigestion in livestock. Rhizome paste is used as ointment on wounds.	Roots are used as anthelmintic and in edema (Anjaria 2002); hoof disease (Tiwari & Pande 2006; Pande *et al*. 2007); removal of external and internal parasites, mouth blisters, snake bite, hematuria, wound (Pande *et al*. 2007); dyspepsia (Borthakur & Sarma 1996); appetizer (Jain & Srivastava 1999); against flea (poultry), snake bite, lice (Ghotage & Ramdas 2008).
Amomum subulatum Roxb. (Zingiberaceae)	KAB155	**Alaichi** (N)	Cultivated in between 600 -1800m ASL	Oil extracted from dry seeds is applied on eye-lids to allay inflammation of the eye. Paste of seeds is applied externally as antidote for scorpion-sting and insect bites.	
Artemisia vulgaris L. (Asteraceae)	KAB128	**Tetaypati**, **Teil** (N)	Abundant between 1500 - 2500 m ASL	Leaves are crushed and extract is applied externally on skin to treat itching. Fresh leaves are cleaned, ground and the sap extracted. It is used as nasal drop to stop nose bleeding.	
Arundinaria maling Gamble (Poaceae)	KAB140	**Malingo** (N)	Abundant from 1800- 2700 m ASL	Ash of the root is mixed with a few drops of mustard oil and the paste is applied externally on ringworm. Leaves of plant (≈ 20 gm) is mixed with black pepper (≈ 5 gm) and feed with little salt to cattle to treat diarrhea and dysentery.	

Species name and family	Specimen number	Local names	Distribution	Ethnoveterinary use (Present study)	Ethnoverinary use in other parts of India (Earlier studies)
Asparagus racemosus Willd. (Asparagaceae)	KAB122	**Satamuli** (N)	From 600 - 1800 m ASL	About 100 gm of root is mixed with hay or grain to feed the cattle for fortnight to increase milk-yield.	Galactagogue, fatigue (Anjaria 2002); Lactation problems (Tiwari & Pande 2006; Kiruba *et al*. 2006; Reddy & Raju 2000; Pande *et al*. 2007); painful out-growth below tongue, hematuria, tympany, flatulence, cuts, wounds, demulcent, indigestion, gastric trouble, skin disease (Pande *et al*. 2007); insect bite (Jain & Srivastava 1999); galactagogue (Ghotage & Ramdas 2008); arthritis (Harsha *et al*. 2005).
Bauhinia variegata L. (Fabaceae)	KAB142	**Taki** (N)	Lower hills forest of Terai region up to 1700 m ASL	Fresh flowers (about 200 gm) are orally administered thrice daily to cattle to cure diarrhea and dysentery.	Internal injury (Pande *et al*. 2007); foot and mouth disease & injury (Pandey et al. 1999).
Bergenia ciliata Sternb. (Saxifragaceae)	KAB125	**Pakhanbh-ed**, **Bet** (N)	Between 1500-3000 m ASL	The root is crushed and extract is administered (≈ 40 ml) thrice daily to cattle to treat diarrhea and dysentery.	Mastitis (Tiwari & Pande 2006); weakness and sickness (Singh & Kumar 2000).
Cannabis sativa L. (Cannabaceae)	KAB146	**Ganja**, **Bhang** (N)	Abundant on lower hill forest in Terai region	Stem is cut into small pieces and fed to livestock to treat inflammation. Small pieces of stem are mixed with fodder to feed cattle as a tonic.	Stomachache (Tiwari & Pande 2006; Samal *et al*. 2003); stomachache, mouth disease, dysentery, rheumatism, piles, retention of placenta, eczema, internal injury, sprain, flatulence, indigestion, bone fracture, wound, bleeding, expel leeches (Pande *et al*. 2007); dysentery (Mishra *et al*. 1996); diarrhea, dysentery, increase strength and vigour (Ghotage & Ramdas 2008).

Species name and family	Specimen number	Local names	Distribution	Ethnoveterinary use (Present study)	Ethnoverinary use in other parts of India (Earlier studies)
Celastrus paniculatus Willd. (Celastraceae)	KAB158	**Ruglin** (L)	Tropical and subtropical climate up to 1800 m ASL	About 50 gm of leaves are given twice daily to cattle to treat loss of appetite.	Restlessness, hyperactivity, morbidity (Anjaria 2002).
Centella asiatica (L.) Urb. (Apiaceae)	KAB104	**Ghod Tapre**, **Bhram Jhar** (N)	Moist places in between 1300-2000 m ASL	About 20 gm of plant is crushed and administered thrice daily to livestock to cure urinary disorders such as little and frequent urine pass.	Restlessness, hyperactive, morbility (Anjaria 2002); sunstroke (Tiwari & Pande 2006); dyspepsia (Borthakur & Sarma 1996); ulcer, pneumonia, dyspepsia, urinary disorder, galactagogue (Jain & Srivastava 1999); galactagogue, gives strength (Ghotage & Ramdas 2008).
Cissampelos pareira L. (Menispermaceae)	KAB106	**Tamshaprip** (L), **Batul Pati** (N)	Temperate climatic condition from 1600-2500 m ASL	Paste of root is applied externally as antidote on insect bite and scorpion sting. The root is crushed and extract is given twice daily to cattle to treat blood in urine.	Swelling of abdomen due to flatulence (Bandyopadhyay & Mukherjee 2005); fever (Jain & Srivastava 1999); jaundice (Jain & Srivastava 2003).
Costus speciosus (J. König) Sm. (Costaceae)	KAB135	**Bet Lauree** (N)	Tropical and subtropical climate up to 1700 m ASL	Rhizome powder (≈ 20 gm) is given twice daily to cattle to treat fever and inflammation.	Wound (Bandyopadhyay & Mukherjee 2005); Injuries and bruises (Ghotage & Ramdas 2008); jaundice (Jain & Srivastava 2003).
Drymaria cordata (L.) Willd. ex Roem. & Schult. (Caryophyllaceae)	KAB19	**Abhijal** (N)	Up to 2100 m ASL	Plant paste is applied externally on fractured bone and bandaged with the help of cotton cloth. After 20-25 days bandage is removed. About 100 gm of plant is boiled in water to prepare decoction. This decoction is administered thrice daily to animal to treat mouth ulcer.	

Species name and family	Specimen number	Local names	Distribution	Ethnoveterinary use (Present study)	Ethnoverinary use in other parts of India (Earlier studies)
Elatostema ficoides Wedd. (Urticaceae)	KAB64	**Chiplu**, **Chiplay** (N)	Between 1200 -2500 m ASL	About 20-50 gm of plant is crushed and given twice daily to livestock to treat fever.	
Embelia ribes Burm. f. (Primulaceae)	KAB98	**Buibidans**, **Pierlahara** (N), **Sangrik Asumbu** (L)	Tropical climate on lower hill forest in Terai region	About 200 gm of fruits are crushed and given to pigs for two days to kill tapeworm. Fruits are also used as appetizer for cattle, about 50 gm of fruit is crushed and administered daily until complete cure of the disease.	Fever, stomach worms (Jain & Srivastava 1999); sprains, worms in calves (Ghotage & Ramdas 2008).
Equisetum debile Roxb. ex Vaucher (Equisetaceae)	KAB70	**Kurkure Ghans** (N)	Common, in shaded or open water logged areas, or along streams from 1000 - 2500 m ASL	Paste of stem shoot is applied externally on injury to stop bleeding. About 20 gm of plant is crushed and given twice daily with jaggery to livestock to treat blood in urine and blood secretion from vagina.	
Fragaria nubicola (Hook. f.) Lindl. ex Lacaita (Rosaceae)	KAB134	**Bhui Ainselu** (N)	Temperate climatic condition from 1800-4000 m ASL	About 50 gm of pounded leaves and fruits are administered with lukewarm water to cattle to treat diarrhea and dysentery. Leaves and fruits are also used as diuretic for cattle, about 50 gm is administered twice daily until cure.	External parasite (Pande *et al*. 2007).
Holarrhena antidysenterica (L.) Wall. ex A. DC. (Apocynaceae)	KAB48	**Indrajow**, **Kurchi**, **Aulay Khirrn** (N)	Lower hills forest of Terai region up to 500 m ASL	About 20 gm stem bark powder or decoction is given thrice daily to livestock to treat constipation, problems during stool passing and dysentery.	Constipation, diarrhea, cold and cough, anthelmintic (Anjaria 2002); Anthrax (Sikarwar 1996); Appetizer (Jain & Srivastava 1999).

Species name and family	Specimen number	Local names	Distribution	Ethnoveterinary use (Present study)	Ethnoverinary use in other parts of India (Earlier studies)
Lecanthus peduncularis (Wall. Ex Royle) Wedd. (Urticaceae)	KAB50	**Kala Jhar** (N)	In between 1500-3500 m ASL	The leaf paste is applied as ointment on cuts and wounds.	Galactogogue (Jain & Srivastava 1999).
Lycopodium clavatum L. (Lycopodiaceae)	KAB71	**Nagebeli** (N)	Very common; forming mat over grasses, found from 1800-2400 m ASL	About 20 gm of plant is administered orally for treatment of muscle contraction in cattle.	
Mallotus philippinensis Muell.-Arg. (Euphorbiaceae)	KAB73	**Numboong-kor**, **Purva**, **Tukla** (L); **Sinduri** (N)	Lower hill forest in Terai region.	About 50 gm seeds are administered to pigs along-with food to kill intestinal worms. Seeds are crushed and applied externally to cure wound, injuries and skin infection.	Anthelmintics, anorexia, fatigue (Anjaria 2002); diarrhea and dysentery (Singh & Kumar 2000).
Mentha viridis (L.) L. (Lamiaceae)	KAB138	**Mentha**, **Babri** (N)	Cultivated in subtropical climatic condition	About 200 gm leaves are crushed with water and boiled to prepare decoction. Two cups of decoction is given thrice daily to treat mild fever.	
Picrorhiza kurroa Royle ex Benth. (Scrophulariaceae)	KAB109	**Kutki** (N)	Subalpine and alpine climatic condition from 2100 - 4200 m ASL	About 100 gm dried root is mixed with stem bark of *Azadirachta indica* A. Juss. in a ratio of 4:1. These are boiled in water to prepare decoction. The decoction is given thrice daily to treat cold and fever. Root is ground, boiled in water to prepare decoction. About 100 ml of root decoction is given to animal as appetizer.	Tonsil (Tiwari & Pande 2006); loss of appetite, fever (Tiwari & Pande 2004); digestive troubles, dysentery, alimentary disorders, intestinal worm, diarrhea (Pande *et al*. 2007); wound, hypocaemia (Jain & Srivastava 1999).
Plantago major L. (Plantaginaceae)	KAB29	**Nasha Jhar** (N)	Frequently grow along roadsides from 1200-2600 m ASL	Paste made from root is applied externally on cuts and wounds for quick healing.	

Species name and family	Specimen number	Local names	Distribution	Ethnoveterinary use (Present study)	Ethnoverinary use in other parts of India (Earlier studies)
Rauvolfia serpentina (L.) Benth. ex Kurz. (Apocynaceae)	KAB26	**Sarpgandha** (N)	Lower hills forest of Terai region up to 600 m ASL	About 20 gm powder of root bark is administered orally as antidote to snake-bite.	The root is used as nervine tonic, eye problem, diarrhea (Jain & Srivastava 1999).
Rhododendron arboreum Sm. (Ericaceae)	KAB119	**Etok** (L); **Ghonas**, **Gurangs**, **Guras**, **Lal-Gurans**, **Lalli-Gurans** (N)	Temperate and upper hill forest from 1500-3300 m ASL	About 20 - 50gm flowers are crushed with water and administered twice a day to livestock to treat diarrhea and dysentery.	Leaves are used in removal of external parasites (Tiwari & Pande 2006; Pande *et al.* 2007).
Rhododendron campanulatum D.Don (Ericaceae) Note: However, it is reported that young buds and leaves of the plant are poisonous to cattle (Anonymous 2004).	KAB120	**Bargi** (B); **Nilo Chimal**, **Cheriala**, **Teotosa**, **Gurans** (N)	Usually in gregarious patches in upper hill forest from 2700-4400 m ASL	Leaves and twigs are mixed with leaves of tobacco (*Nicotiana tabacum* L.) in ratio of 3:1. They are crushed together and about 10-15 gm of paste is administered orally twice a day with lukewarm water to cattle to treat chronic fever.	Leaves are used as goat poison at Uttranchal (Pande *et al.* 2007).
Rubia cordifolia L. (Rubiaceae)	KAB95	**Vhyem, Vhyeni** (L); **Soth** (B); **Manjito** (N)	Climber on shrubs From 1200-2500 m ASL	Root paste is used as ointment to treat skin infection. About 100 gm of roots are cut into small pieces and boiled to prepare a decoction. The decoction is administered (≈ 100 ml) to cattle after delivery for quick recovery.	Lactation, swelling, sunstroke, skin disease (Pande *et al.* 2007).
Rubus ellipticus Sm. (Rosaceae)	KAB78	**Ainselu**, **Asayloo** (N); **Kashyem** (L)	Abundantly in subtropical and temperate areas from 600-2100 m ASL	About 50 gm of new tender leaves and/or young stem shoots are pounded and administered to livestock to treat cold and fever. Root paste is applied externally on wound for quick recovery.	Hematuria (Pande *et al.* 2007).

Species name and family	Specimen number	Local names	Distribution	Ethnoveterinary use (Present study)	Ethnoverinary use in other parts of India (Earlier studies)
Sinopodophyllum hexandrum (Royle) T.S. Ying (Berberidaceae)	KAB116	**Papari**, **Panchpatey** (N)	Interior range of the Himalayas at altitude of 2700 – 4200 m ASL	The root is crushed and applied externally on hoof to treat infection. Rhizome is crushed and boiled in water to prepare decoction. One bamboo cup of decoction is administered twice a day to cattle to treat indigestion.	
Swertia chirata (Wall.) C.B. Clarke (Gentianaceae)	KAB49	**Chirowto** (N)	Usually found at shady places from 1600 - 2600 m ASL	Fresh plant (≈ 100 gm) is cut into small pieces and decoction is prepared. This is later filtered through a cotton cloth and administered orally to cattle to treat fever.	Tonic (Anjaria 2002); hoof disease, eye disease (Pande *et al.* 2007); fever (Pandey *et al.* 1999).
Terminalia bellirica (Gaertn.) Rox. (Combretaceae)	KAB54	**Barra** (N)	Lower hill forests of Terai region up to 1000 m ASL	About 100 gm of fruit are crushed with water and boiled to prepare decoction. It is administered thrice daily to livestock for treatment of diarrhea and dysentery.	Constipation, naval swelling, cold and cough (Anjaria 2002); diarrhea (Pande *et al.* 2007); wound (Harsha *et al.* 2005).
Terminalia chebula Retz. (Combretaceae)	KAB59	**Harra** (N); **Selim Pot** (L)	Lower hills forest of Terai region up to 1000 m ASL	About 100 gm of fruit and/or bark are crushed and boiled in water to prepare decoction. The decoction is administered thrice daily with small amounts of rock salt to cattle to treat diarrhea and dysentery.	Constipation, diarrhea, indigestion, anorexia, flatulence, naval swelling, cold and cough, epistaxis, wound, restlessness (Anjaria 2002); rickets (Samal *et al*. 2003; Pande *et al.* 2007); constipation (Singh & Kumar 2000); skin infection, diarrhea (Pande *et al*. 2007).
Urtica dioica L. (Utricaceae)	KAB93	**Sisnu** (N); **Surang** (L)	Abundant in temperate zone between 1000 - 2200 m ASL on middle hills along roadsides	Paste of roots is applied externally to bone fractures with a cotton cloth. About 30 gm young leaves are mixed with ripened	Galactagogue, increase egg production in poultry (Deshpande 2006); Bone fracture (Tiwari & Pande 2004); galactagogue (Borthakur & Sarma 1996).

Species name and family	Specimen number	Local names	Distribution	Ethnoveterinary use (Present study)	Ethnoverinary use in other parts of India (Earlier studies)
Urtica dioica L. (Utricaceae) con't			and edges of cultivation.	tamarind fruit (*Tamarindus indica* L.) in a ratio of 2:1 and crushed together. The preparation is administered (≈ 50 gm) to cattle to increase milk yield.	
Zingiber officinale Roscoe (Zingiberaceae)	KAB66	**Aduwa** (N)	Cultivated up to 1200 m ASL	About 20gm of rhizome of plant is mixed with fruits of long pepper (*Piper longum* L.) in a ratio of 4:1. These are crushed together and given with Jaggery to cattle for treatment of cold. About 20 gm rhizomes are ground and the extract is fed to animal in the morning and evening with lukewarm rice wash to treat cough.	Indigestion, anorexia, flatulence, naval swelling, cold and cough, restlessness (Anjaria 2002); constipation, food poisoning (Tiwari & Pande 2006); swelling (Tiwari & Pande 2004); cough, fever, indigestion, loss of hunger (Mishra *et al*. 1996); conjunctivitis, ephemeral fever, pneumonia, bloat, fever, hemorrhagic septicaemia, poisoning, skin allergy (Ghotage & Ramdas 2008).

Table 2. Comparative study of plant species used in ethnoveterinary and human medicine in Sikkim, India.

Species	Veterinary medicine (Present study)		Human medicine (Earlier studies)	
	Part	Use	Part	Use
Abies densa Griff.	Leaves	Fever and anorexia	Leaves	Stomach ache, fever (Pradhan & Badola 2008)
Acorus calamus L.	Roots, rhizomes	Indigestion, wound	Roots/rhizome	Dysentery, skin disease (Dash et al. 2003); fever, skin disease (Rai & Sharma 1994); Itching (Jana & Chauhan 2000); skin disease, fever, cough, speech clarity (Pradhan & Badola 2008)
Artemisia vulgaris L.	Leaves	Itching, nose bleeding	Leaves	Nose bleeding, allergy, mouth ulcer (Pradhan & Badola 2008)
Bauhinia variegata L.	Flowers	Diarrhea, dysentery	Dried buds	Ulcer, piles (Pradhan & Badola 2008)
			Bark	Tonic (Pradhan & Badola 2008)

Species	Veterinary medicine (Present study)		Human medicine (Earlier studies)	
	Part	Use	Part	Use
Bergenia ciliate Sternb.	Roots	Diarrhea, dysentery	Rhizomes	Diarrhea, vomiting, fever, cough, pulmonary affections (Rai & Sharma, 1994)
Cannabis sativa L.	Stem	Inflammation , tonic	Seeds	Body pain (Pradhan & Badola 2008)
Costus speciosus (J. König) Sm.	Rhizomes	Fever, inflammation	Rhizomes	Urinary tract infection, veneral disease (Pradhan & Badola 2008); urinary tract infection or inflammation (Rai & Sharma 1994)
Drymaria cordata (L.) Willd. ex Roem. & Schult.	Whole plant	Bone fracture, mouth ulcer	Whole plant	Sinusitis, nasal blockage, headache, sore throat pain, fever (Pradhan & Badola 2008); sinusitis and nasal blockage (Rai & Sharma 1994)
Equisetum debile Roxb. ex Vaucher	Stem shoots	Stop bleeding after injury, blood in urine & blood secretion from vagina	Aerial parts	Fresh wound, nose bleeding, etc. to clot blood (Pradhan & Badola 2008)
Holarrhena antidysenterica (L.) Wall. ex A. DC.	Bark	Constipation, dysentery	Bark, leaves, latex	Acute dysentery (Jana & Chauhan 2000); amoebic dysentery (Rai & Sharma 1994)
Picrorhiza kurroa Royle ex Benth.	Roots	Cold and fever, anorexia	Roots/rhizomes	Cough, fever (Pradhan & Badola 2008); malarial fever, catharitic, purgative and dyspsiac (Rai & Sharma 1994)
Rhododendron arboreum Sm.	Flowers	Diarrhea and dysentery	Flowers, buds and petals	Blood dysentery (Dash *et al.* 2003); dysentery and diarrhea (Jana & Chauhan 2000)
Rhododendron campanulatum D. Don	Leaves	Chronic fever	Leaves	Chronic rheumatism, syphilis, sciatica (Jana & Chauhan 2000); cough (Pradhan & Badola 2008)
Rubia cordifolia L.	Roots	Skin infection, postpartum recovery	Roots	Urinary infection, skin disease (Pradhan & Badola 2008)
Rubus ellipticus Sm.	New tender leaves, young stem shoots	Cold and fever	Young stem	Dysentery (Dash *et al.* 2003)
	Roots	Wound	Dried roots	Jaundice (Dash *et al*. 2003)
Sinopodophyllum hexandrum (Royle) T.S. Ying	Roots/rhizomes	Hoof infection, indigestion	Roots	Blood purifier, vermifuge, purgative, emetic, cholagogue, cardiac tonic, skin inflammation (Rai & Sharma 1994)
Swertia chirata (Wall.) C.B. Clarke	Whole plant	Fever	Whole plant	Fever (Rai & Sharma 1994)

Species	Veterinary medicine (Present study)		Human medicine (Earlier studies)	
	Part	Use	Part	Use
Terminalia belerica (Gaertn.) Roxb.	Fruit	Diarrhea, dysentery	Fruit	Indigestion, diarrhea (Rai & Sharma 1994)
Terminalia chebula Retz.	Fruit/bark	Diarrhea, dysentery	Fruit	Tonsillitis, pharyngitis and other throat complications (Rai & Sharma 1994)
Urtica dioica L.	Roots	Bone fracture	Roots	Minor fracture (Rai & Sharma 1994)
	Young leaves	Galactagogue	Whole plant	Bone fracture and dislocation, diarrhea, cough, child delivery (Pradhan & Badola 2008)
Zingiber officinale Roscoe	Rhizomes	Cold and cough	Rhizomes	Cough, fever, throat pain (Pradhan & Badola 2008)

Ethnoveterinary information on 37 plant species of Sikkim Himalayas was recorded. These plants are being used in 15 broad categories of livestock ailments: diarrhea and dysentery, digestive disorder, injury and wound, fever, maternity ailments, skin disease, urinary ailment, cough and cold, skeleto-muscular problems, inflammation, scorpion sting, snake and insect bite, weakness, worm, ulcer and bleeding.

Out of these 37 species, roots/rhizomes of 16 species were being harvested for 25 remedies, followed by leaves of 10 species for 13 remedies, whole plants of four species used to treat six remedies, fruits of three species for six remedies, stem & stem bark of five species for five remedies, seed of three species for four remedies and flower of two species for two remedies (Figure 2). Herbs

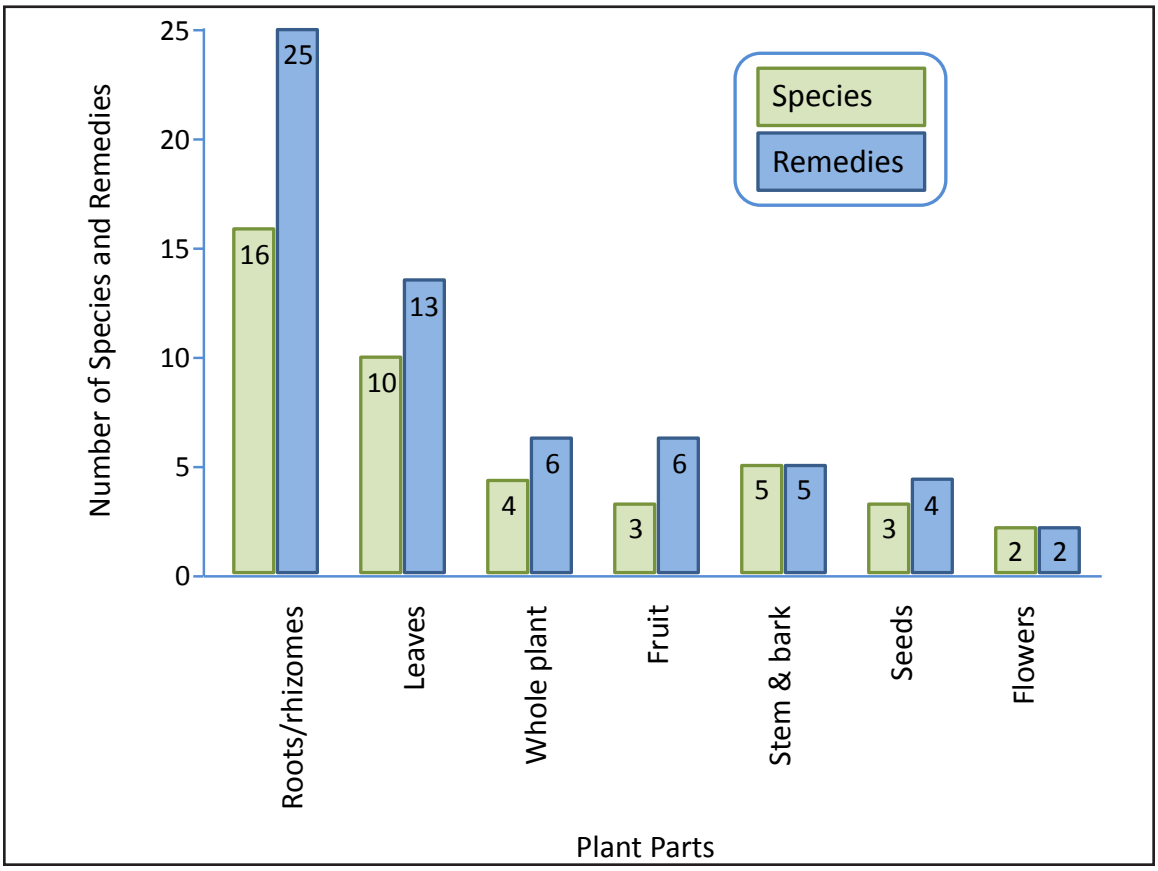

Figure 2. Comparison of plant part(s) used between remedies and plant species, in ethnoveterinary medicine in Sikkim, Himilayas, India.

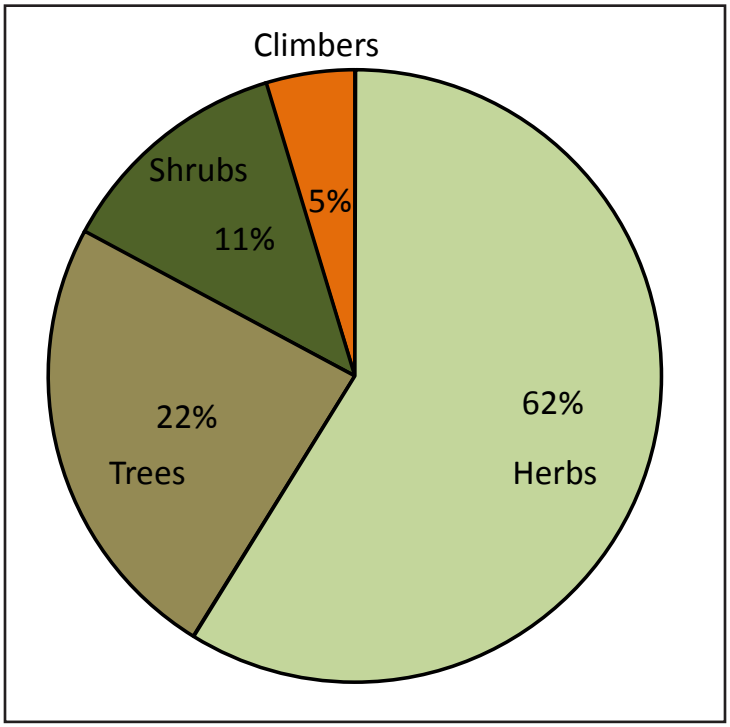

Figure 3. Medicinal plants used in ethnoveterinary medicine in Sikkim Himalayas, India arranged according to their life forms.

are the primary source of medicinal plants in terms of number of species (62.16 %) followed by trees (Figure 3).

In the present study, nine species are used to treat diarrhea & dysentery, followed by injury & wounds by seven species, fever by seven species, digestive disorders by six species, maternity ailments by five species, skin disease by four species, urinary ailments by four species, cough & cold by three species, skeleto-muscular problems by three species, inflammation by three species, scorpion sting, snake & insect bite by three species, weakness by two species, worm by two species, ulcer by two species and bleeding by one species (Figure 2).

Discussion

Comparative assessment

This research recorded 13 species being used as ethnoveterinary medicine in Sikkim as being used to treat similar ailments in other parts of India (Table 1). With 37 species being reported during this research, this indicates moderate affinity (37%) between ethnoveterinary medicinal system of Sikkim and rest of the India. However, 12 species (32.43%) have common medicinal use in both human and livestock. This suggests that the relationship between human and veterinary medicine has been parallel (Table 2).

New findings

Twelve plant 12 species (32.43% of those recorded) were reported for the first time as being used as ethnoveterinary medicine (Table 1). Further, this study reports new remedies which were not mentioned in previous studies. For example, participants reported use of *Acorus calamus* L. for indigestion and wound-healing, which is a use not previously documented. Similarly, use of *Bauhinia variegata* L. for diarrhea, use of *Rhododendron campanulatum* D. Don for fever, *Cannabis sativa* L. for inflammation, and use of *Rauvolfia serpentina* (L.) Benth. ex Kurz for snake-bite have not been reported in earlier studies on ethnoveterinary medicines of the region (Table 1).

Status of traditional knowledge

It has been observed that older persons (age group 55-70 years) and traditional healers have greater knowledge about traditional medicines than younger persons (age group 30-40 years). This may be due to increased awareness of allopathic treatment and modern medicines in younger people, however the traditional medicinal system is still prevalent in remote villages of Sikkim. The primary ailments of livestock are diarrhea, injury, fever, digestive disorders and maternity complications, which are commonly treated with medicinal plants.

Although hematuria is the most common livestock disease reported by the government veterinary hospital in Gangtok, villagers in the study area mentioned digestive disorders, such as anorexia, diarrhea, dysentery and indigestion as the most common ailments in Sikkim. The probable reason behind such contradictions is use of home remedies to cure digestive disorders, hence they are not reported to veterinary hospitals.

Conservation of species

Several locally uncommon species, such as *Bergenia ciliata* Sternb. (Figure 5, Figure 6), *Cissampelos pareira* L. and *Swertia chirata* (Wall.) C. B. Clarke were reported as being destructively harvested for livestock medicines by using whole plant or roots/rhizomes, which may be related to their possible vulnerability of deplition. During the interview process, about 60% of participants mentioned *S. chirata* as being the most frequently used ethnoveterinary species. This supports the the observations of Nayar and Sastry (1987-1990) that *S. chirata* is considered as vulnerable for north-east India.

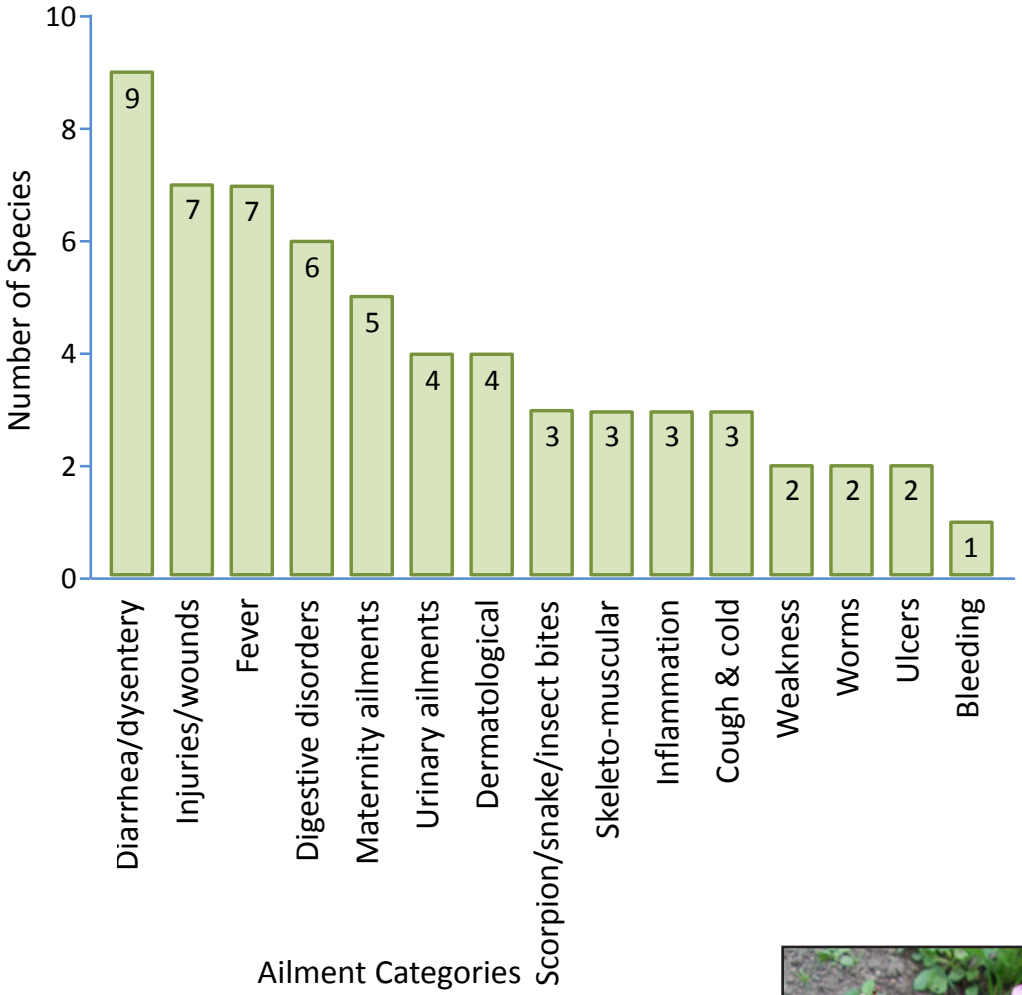

Figure 4. Major ailment categories and number of associated plant species used in ethnoveterinary medicine in Sikkim Himalayas, India.

Figure 5. *Bergenia ciliata* Sternb. showing hairy and rounded leaves. *B. ciliata* is used in ethnoveterinary medicine in Sikkim Himalayas, India.

Figure 6. White-pink inflorescence of *Bergenia ciliata* Sternb. in Sikkim Himalayas, India.

Other species, such as *Acorus calamus* L., *Centella asiatica* (L.) Urb. and *Picrorhiza kurrooa* Royle ex Benth. are also widely used medicinaly plants for humans and subjected to destructive harvesting through digging/uprooting the plant or roots/rhizomes. Hence, such medicinal plants need conservation protection in natural habitats, and large scale cultivation to take pressure off of these plants.

Conclusion

Traditional health care practices have been developed through generations of practical experience without external input. This study provides identifies ethnoveterinary plant species, potentially for economic development. Further study and promotion of ethnoveterinary medicine is bound to help the communities conserve information and integrate select practices into rural animal healthcare services. This may create opportunities for phytochemists and pharmacologists to conduct future studies. Two points are worth underlining: first, local knowledge can be converted into medicinal or other commercial products. Local people and the keepers of this knowledge should be recognized and appropriately compensated. Second, over-exploitation of medicinal plants is bound to put their survival at risk and measures need to be implemented to conserve them. The situation is made more urgent since in many regions both traditional knowledge and plant diversity are disappearing rapidly (Mathias 2007).

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