Herbal-based Traditional Medicinal Knowledge of Local Inhabitants in Rudraprayag District of Uttarakhand, India

Kailash Chandra, Bhagwati P. Nautiyal and Mohan C. Nautiyal

Research

Abstract

Traditional medicinal knowledge has gained much attention recently due to rejuvenation of faith in traditional system of medicines. The Indian Himalaya is a source of plant based indigenous medicinal knowledge based on local plant diversity. Surveys were conducted in Rudraprayag district of Uttarakhand, India to collect indigenous information on primary health care. 29 formulations using 159 plant species were recorded treating 119 ailments in 13 broad therapeutic classes. Results have been compared with traditional knowledge from other parts of India.

Introduction

Traditional medicinal knowledge is defined as the sum of knowledge, skills and practices based on the ideas, beliefs and experiences indigenous to a culture, whether explicable or not, used in the maintenance of health as well as in the prevention, diagnosis, treatment and improvement of physical and mental illnesses (WHO 2000). About 60% of the Indian population depends on traditional systems of medicine (Timmermans 2003). India harbors about 17,000 plant species of which 7500 are known as medicinal plants (Nayar 2011). Uttarankhand state in the Indian Himalaya region is geographically and climatically diverse with the highest number of plant species known for medicinal properties among all the Indian Himalayan states (Kala 2004).

The inhabitants of Uttarakhand are still dependent on traditional **vaidyas** (practitioners of Ayurveda) and local healers for treating diseases (Kala 2000, 2005a). In the evolution of Ayurveda, the Himalaya region has played an important role with restricted habitats of many valuable medicinal plant species (Kala 2005b). However, recent years have witnessed fragmentation and outright loss of the traditional plant knowledge. There are many traditional **vaidyas** who claim to be able to treat chronic disorders such as chronic gastric problems, eczema and migraines that do not respond well to western medicines. Documentation of formulations prepared by traditional **vaidyas** is a step forward toward assessing claimed properties of medicinal plants and also for preparation of new formulations (Kala 2005c). Documentation initiatives have generated species lists, parts used, and distribution ranges (Chopra *et al*. 1986), and specific information on some species (Dhyani *et al*. 2010, Nautiyal *et al*. 2001, 2002, Pandey & Pandey 2010), however, there is no comprehensive record of plant based traditional knowledge in Rudraprayag district, Uttarakhand, India.

Methods

Study Area

The Rudraprayag district of Uttarakhand state of India covers an area of about 2439 km^2 and lies between latitudes 30°19'00'' and 30°49'N and longitudes 78°49' and

Correspondence

Kailash Chandra and Mohan C. Nautiyal, High Altitude Plant Physiology Research Centre, HNB Garhwal University, Srinagar, Uttarakhand, 246 174, INDIA.

Bhagwati P. Nautiyal, Department of Horticulture, Aromatic and Medicinal Plants, School of Earth Sciences and Natural Resources Management, Mizoram University, Aizawl 796 004, Mizoram, INDIA.
bhagwatinautiyal@gmail.com

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79°21'13" E (Figure 1). Altitudes range from 800-8000 masl with varied topography. The climate varies from subtropical monsoon to tropical upland. The northern and western parts of the district are perennially under snow cover with subalpine and alpine types of climate associated with lofty Himalayan peaks up to 8000 masl altitude, notably including Kedarnath (6,940 masl) and Chaukhamba (7,138 masl) with alpine ridges up to 3,800 masl (Tungnath). Therefore, severe winter and comparatively higher rainfall are the characteristic features of the northern and western part. The year may be divided into 5 seasons: cold winter (December–February) with temperature around below -12°C; spring (March-April); summer (May-June) with maximum temperatures to 32°C; southwest monsoon season (mid June-September); autumn or post monsoon season (mid November-last October). The average annual rainfall is around 1220mm at the district headquarter, Rudraprayag while average annual rainfall is 1995mm at Ukhimath town located at 1000 masl.

Traditional medicinal system and therapeutic classification

Information was collected through ethnobotanical inventories (Jain 1967, 1986). Preliminary surveys for the collection of plants were conducted for the entire Rudraprayag

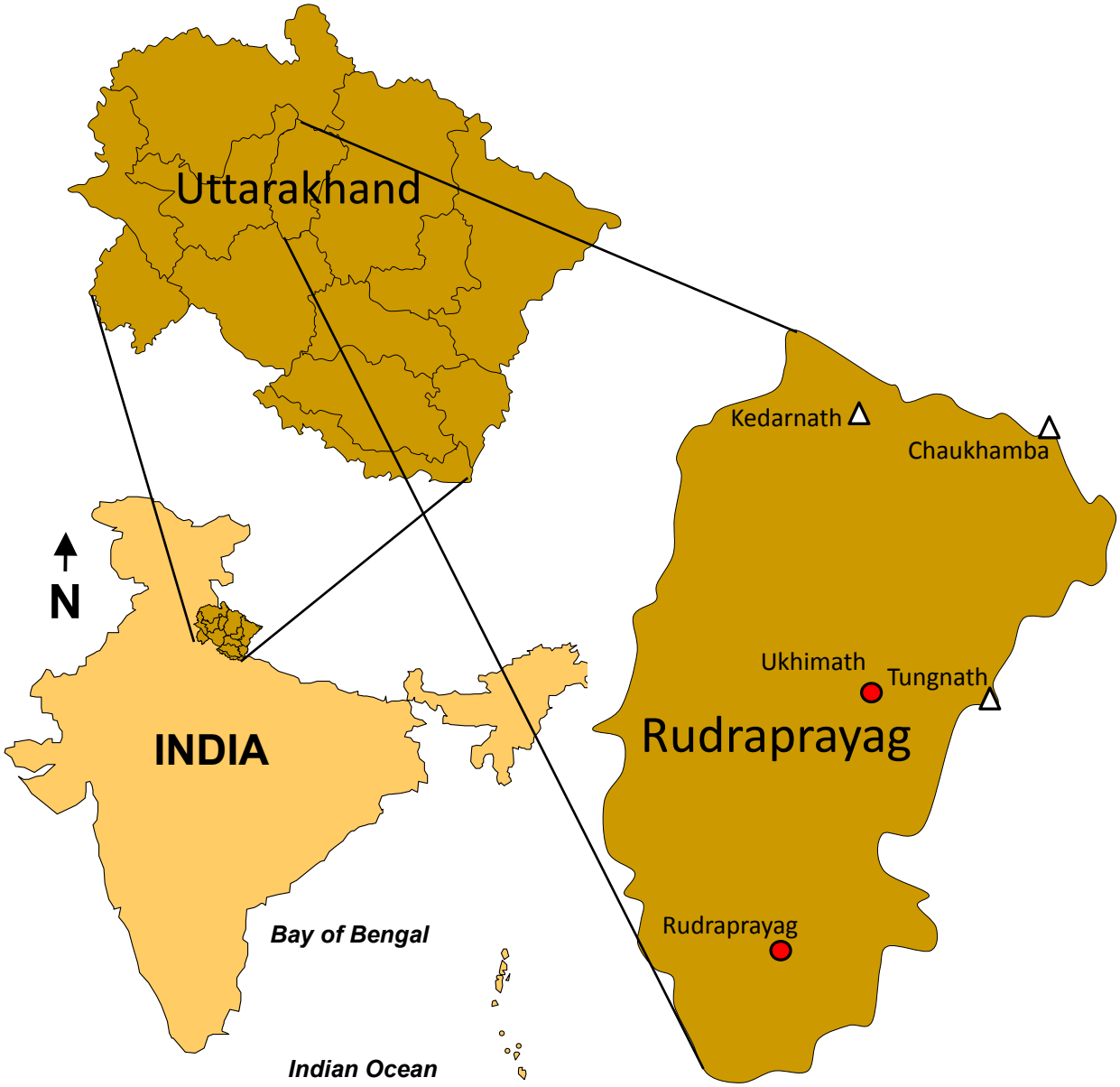

Figure 1. Rudraprayag district of Uttarakhand state, India.

district targeting different blocks and altitudes during the years 2007-2010. Thereafter, three sites between 800-2500 masl were selected for more intensive surveys. Plant samples were pressed, dried and preserved for deposition in the herbarium (Jain & Rao 1977). Dry specimens were poisoned using Kew mixture (115 gm $HgCl_3$ in 4.5 l ethyl alcohol). Identified plants (Gaur 1999, Naithani 1984-1985) were verified by comparison with prior collections from GUH, HNB Garhwal University, Srinagar and BSI, Northern circle Herbarium, Dehradun. All the specimens were then deposited in GUH.

The survey was conducted by sampling a wide range of users as suggested by Hamilton (2003). Background information was collected on the use, distribution, and status of plant resources in the area through a baseline survey. A household survey was conducted using open, individual and group interview was conducted during outdoor field surveys as per the methods described by Martinez (1995) and Cunningham (2001). For this purpose, a semi structured questionnaire was prepared preferably in local languages for direct communication. Information collected included plant identification criteria, parts used, time and collection methods, source of knowledge of traditional health cares/ specialization, formulations, dose determination of all the plants mentioned by the people/ traditional healers. Interviews were prepared following standard methods (Martinez 1995). For greater accuracy, a particular medicinal use of every species verified by at least five informants was considered as authentic information for this report. Species cited by fewer than five informants were not used in the final synthesis of the data.

Emphasis was given to specialist medicinal plant users of Rudraprayag district. Specialists are people for whom medicinal and aromatic plants are major components of their livelihood, such as trained practitioners (**vaidyas**, Ayurvedic doctors, pharmacists), folk knowledge based **vaidyas**, **dai** (woman practitioners), and other traditional health practitioners. Non-specialist users such as elder peoples who used medicinal plants for home consumption for the treatment of ailments were also surveyed. Data were analyzed for various therapeutic groups as described by Handa and Kapoor (2006) and Kala (2005a).

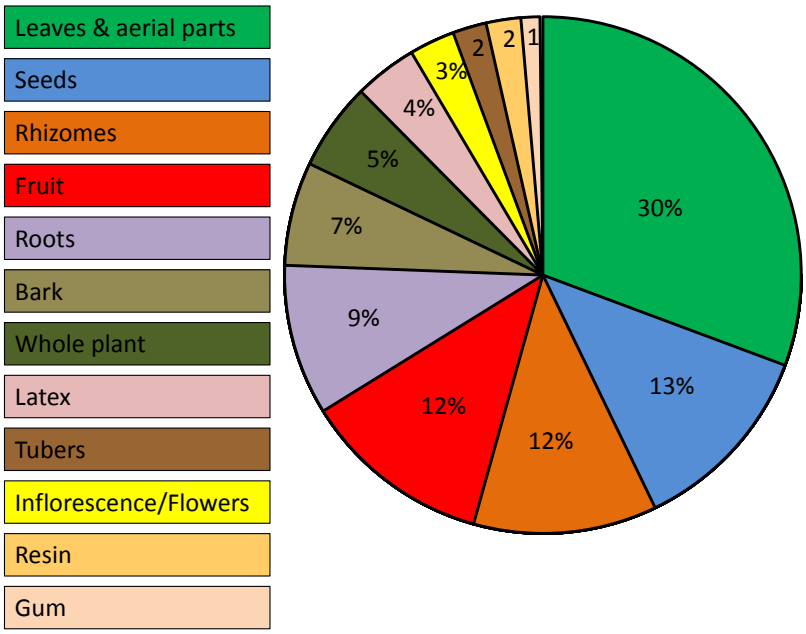

Figure 2. Plant parts used medicinally in Rudraprayag district of Uttarakhand state, India.

Results

During the study, 159 plant species were recorded to treat 123 ailments. Leaves and aerial parts were most commonly reported parts (Figure 2). Seventy species were used to treat gastrointestinal problems, followed by skin diseases (44) and uro-genital disorders (43).

Most of the time fresh material was used for medicinal formulations. Formulations (Figure 3) were **swarsa** (fresh juice), **lepa** (paste), **kwatha** (decoction with boiled

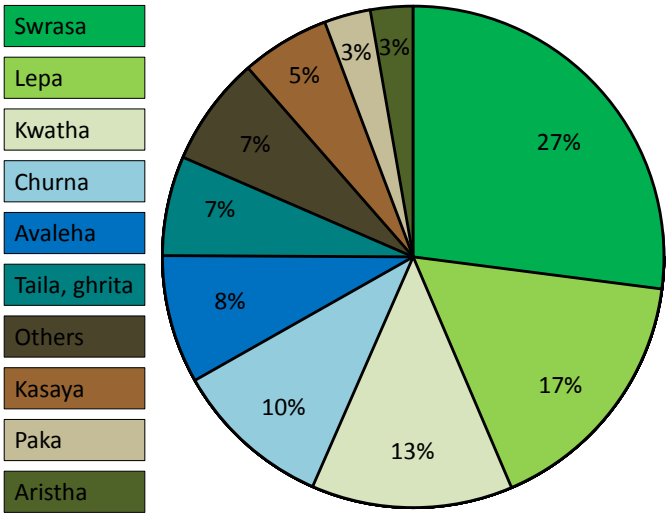

Figure 3. Medicinal formulations used in Rudraprayag district of Uttarakhand state, India.

water), **churna** (powder), **avaleha** (semi-solid), **taila** and **ghrita** (oil), **kasaya** (decoction), **aristha** (partially fermented) and **paka** (semisolid preparation with ghee or oil). **Swarsa** and **lepa** are mainly used as first hand remedies available to elderly people. Other formulations are used by **vaidyas**. Remedies based on use of single species were a predominant feature of this health care system (Table 1). However, formulations with many ingredients were also recorded and are present in Table 2.

Table 1. Medicinal properties and, formulation types [**aristha** (partially fermented), **avaleha** (semisolid), **churna** (powder), **kasaya** (decoction), **kwatha** (decoction with boiled water), **lepa/laipen** (paste), **netrabindu** (eye drop), **paka** (semisolid preparation with ghee or oil), **swarsa** (fresh juice), **taila** and **ghrita** (oil)] of medicinal plants recorded in Rudraprayag district, Uttarakhand, India.

Plant species	Vernacular	Formulation	Therapeutic uses	Local remedies
Acanthaceae				
Justicia adhatoda L.	**baisingu**	essential oil	Hepato-protective	**Churna** and oil is useful in cough, constipation and jaundice, oil and flowers are useful in respiratory disorders, hypertensive.
Acoraceae				
Acorus calamus L.	**bauj**	**churna, swarsa**	Vasodilator; Analgesic; Gastro-intestinal; Hepato-protective; Insecticidal; throat problems	**Churna** rhizome is useful in cough and throat infections, for treatment of livestock **khurpaka**. Oil is used in hysteria. Fresh rhizomes are crushed into **swarsa** and used in gastric troubles of infants, for relief of jaundice, and for removing lice. Used for clearing a heavy voice.
Amaranthaceae				
Achyranthes aspera L.	**latjira**	**lepa, swarsa**	Antidote; Demulcent; Oxytocic	**Panchang laipen** is used as an antidote for scorpion and snake bites. Root paste (1 part) along with water (8 parts) is taken orally by women to assist in child birth.
Alternanthera pungens Kunth	**-**	**swarsa**	Febrifuge	Leaf **swarsa** taken for fevers.
Deeringia amaranthoides (Lam.) Merr.	**kalalori**	**swarsa**	Anti-malarial; Tonic; Febrifuge Anti-cancerous; Anti-hemorrhoid	Root **swarsa** is used for toothache and infectious conjunctivitis. Seed **churna** is taken with **mand** (rice starch) for piles.
Anacardiaceae				
Buchanania cochinchinensis (Lour.) M.R.Almeida	**piyal**	**churna, lepa**	Anti-inflammatory; Topical	Seed **churna** or **laipen** are used externally for treating glandular swellings of the neck.
Semecarpus anacardium L.f.	**Bhilow**	**avaleha, swarsa**	Antiviral for skin warts; Vermifuge	Poisonous pericarp is mixed with sugar and water into **avaleha** and orally administered under the supervision of **vaidaya** in small quantities to remove or kill intestinal worms. Fresh juice is used topically to remove skin warts.
Apiaceae				
Centella asiatica (L.) Urb.	**brahmi/ mandukparnii**	**swarsa**	Febrifuge	Fresh or dried plant juice is fresh water is taken internally and kept on forehead externally for high fever.
Hydrocotyle sibthorpioides Lam.	**brahmi**	**netrabindu**	Conjunctivitis; Ophthalmatic	Entire plant **netrabindu** is used topically on mucus membranes for eye infections

Plant species	Vernacular	Formulation	Therapeutic uses	Local remedies
Apocynaceae				
Calotropis procera (Aiton) Dryand.	**aak**	**kwatha**	Dermatological problem; Anti-leprosy	Root bark decoction is used externally for skin diseases or leprosy.
Ichnocarpus frutescens (L.) W.T.Aiton	**kalidudhi**	**churna**	Nephrolithiasis,	Root **churna** and milk are administered twice daily for abdominal pains and also for removing kidney stones.
Asteraceae				
Ageratum conyzoides (L.) L.	**gundrya**	**kwatha kasaya, swarsa**	Anti-diarrheal; Antiseptic	Aerial parts **kwatha** or **kasaya** is used to treat diarrhea, dysentery and gasto-intestinal disorders. Leaf juice is applied on injuries. The plant is known as having antiseptic properties.
Anaphalis adnata Wall. ex DC.	**bugula**	**lepa**	Anti-hemorrhage; Shamanistic	Tomentum from the outer surface of the leaves is dried and used for stopping bleeding cuts or wounds.
Artemisia nilagirica (C.B.Clarke) Pamp.	**kunja**	**swarsa**	Anthelmintics; Shamanistic	Leaf **swarsa** is given orally to expel intestinal worms. The plant is regarded as sacred and offered in religious rituals.
Artemisia roxburghiana Wall. ex Besser	**kunja**	**kasaya**	Antiseptic; anti-hemorrhage	Fresh leaf **kasaya** is applied as a tourniquet with cloth on cuts or wound to stop bleeding, and as an antiseptic.
Bidens bipinnata L.	**kuru**	**lepa**	Galactagogue; Dermatological problems; Orthopedic; Vermicide	Used as milk promoter during breast feeding. Leaf past is applied on skin diseases.
Centipeda minima (L.) A.Br. & Asch.	**nakchini**	**churna**	Anti-hypersensitive; Respiratory disorders; Analgesic; Anti-allergic	Crushed or powdered leaves and inflorescences are used in snuffing colds, bronchitis and headaches.
Eclipta prostrata (L.) L.	**bhangra**	**swarsa**	Dermatological problems	Fresh juice **swarsa** is used externally in treating skin diseases.
Vernonia anthelmintica (L.) Willd.	**kalajira.**	**swarsa, lepa**	Anthelmintics; Dermatological problems	Seed extract is administered orally to expel threadworms. Seed **lepa** is used topically for skin infections.
Berberidaceae				
Berberis lycium Royle	**kirmor**	**kasaya**	Ophthalmatic	Root bark **kasaya**, after boiling with water is used topically on mucus membranes for eye ailments.
Bignoniaceae				
Oroxylum indicum (L.) Kurz	**tantya**	**lepa**	Dermatological problems; Wound healing	Bark and fruit **lepa** is used externally for cattle skin diseases or for wounds or cuts.

Plant species	Vernacular	Formulation	Therapeutic uses	Local remedies
Boraginaceae				
Cordia dichotoma G.Forst.	**lasura**	**swarsa**	Diuretic; Respiratory disorders; Splenomegaly	Fruit swarsa is believed to be useful in urinary ailments, lung and spleen troubles.
Caprifoliaceae				
Valeriana jatamansi Jones	**tagar**	essential oil	CNS depressant; Local anesthetic; Shamanistic	Rhizome oil is said to be useful in **pagalpan** (extreme mental disorders) and in **pooja** as **dhoop** (essence).
Colchicaceae				
Gloriosa superba L.	**kalhari, langlai**	**lepa, churna**	Dermatological problems; Anti-emetic; Abortifacient	Tuber is said to be useful in the treatment of skin diseases, infections and treating lice. It is also used to stop vomiting and said to be useful as an abortifacient.
Combretaceae				
Terminalia bellirica (Gaertn.) Roxb.	**baheda**	**churna**	Constipation; Colic pain; Respiratory disorders	Used along with **haida**, **saunth** (dry ginger), or **jiggery** to treat asthma. Also used as a **rasāyana** (rejuvenating drug).
Terminalia chebula Retz.	**haida**	**paka, swarsa**	Anti-hypersensitivity; Respiratory disorders; Gastrointestinal disorders	Fresh or boiled fruit pulp with honey is administered for the treatment of asthma, cough, and bronchitis. It is a very good purgative, useful for piles and strengthen the body.
Dioscoreaceae				
Dioscorea bulbifera L.	**genthi**	**paka, avaleha**	Anti-ulcer; Anti-hemorrhoid	Cooked tubers are used for treating ulcers and piles.
Euphorbiaceae				
Baliospermum solanifolium (Burm.) Suresh	**ban-jamalghota**	**swarsa**	Hepatoprotective	Fresh root **swarsa** is taken with water twice a day to treat jaundice.
Euphorbia hirta L.	**dudhali**	**kwatha, churna**	Anti-dysuric; Respiratory disorders	**Panchang** is used by **vaidyas** for treating cough, asthma, and urinary problems.
Fabaceae				
Abrus precatorius L.	**rathadani**	**lepa**	Gout; Rheumatism	Root is used in joint pain and believed to treat ulcerous wounds. Seeds are used as an eye cleaner.
Butea monosperma (Lam.) Taub.	**dhak**	**kwatha**, dye	Menstrual disorders; Antiseptic	Root bark **kasaya** is taken internally for menstrual disorders. A yellow dye from the flowers is said to be antiseptic.
Millettia extensa (Benth.) Baker	**gauj**	**lepa**	Pesticide; Insecticide	Root powder **lepa** is rubbed on cattle to remove lice and flies.
Mucuna pruriens (L.) DC.	**kaunch**	**swarsa, paka**	Anti-ulcer; Anthelmintic; Blood purifier; Anti-diarrheal	Leaves are boiled and administered for ulcers. Leaf **swarasa** with **kalimirch** (*Piper nigrum* L.) is used as an anthelimintic.
Saraca asoca (Roxb.) Willd.	**ashok**	**ghrita, aristha**	Menorrhagia; Uterus disorders	Fresh shoots / flowering buds are reported to be very useful to regulate menstrual cycles and related concerns. For this, 6-8 buds are eaten daily. Bark is used for anemia, leucorrhoea, and menorrhea.

Plant species	Vernacular	Formulation	Therapeutic uses	Local remedies
Senna occidentalis (L.) Link	**chakunda**	**kwatha**	Anti-hypersensitive; Respiratory disorders; Dermatological problems; Anti-hemorrhoid	Seed **churna** is boiled with water and taken for asthma and bronchitis. Seed **lepa** is applied externally twice daily for piles or skin diseases.
Senna tora (L.) Roxb.	**chakunda**	**kwatha, asava**	Vermifuge; Anthelmintic; Anti-leprosy	Fresh leaf **kasaya** with curds is taken with water at bed time for treating worms, and is taken internally for leprosy or leucoderma.
Lamiaceae				
Ajuga brachystemon Maxim.	**neelkanthi**	**swarsa, kwatha**	Ant malarial; Febrifuge	Leaf **swarsa** is used for malarial fever. Leaf **kasaya** is useful for general fevers.
Callicarpa macrophylla Vahl.	**daiya, priyangu**	raw, topical	Anti-Inflammatory; Anti-rheumatic; Demulcent	Leaves are warmed and applied to treat rheumatic joints.
Colebrookea oppositifolia Sm.	**bindap**	**lepa**	Anti-septic; Wound healing	Tomentose leaf **lepa** is applied to wounds and cuts.
Mentha spicata L.	**odina**	**kasaya**	Carminative; Laxative	An infusion of leaves with onion is used as a digestive medicine.
Mosla dianthera (Buch.-Ham. ex Roxb.) Maxim.	**malcharu**	**swarsa, lepa**	Dermatological problems; Wound healing	Fresh leaf juice is used externally for skin diseases during rains, and for wounds or cuts.
Ocimum americanum L.	**morya**	**swarsa**	Carminative; Cold beverage	Fresh leaves are used in the preparation of a cooling drink and as a digestive agent.
Lauraceae				
Litsea monopetala (Roxb.) Pers.	**kathmaru**	**lepa**	Orthopedic purposes	Fresh bark paste is used as a plaster for cattle fractures.
Linaceae				
Reinwardtia indica Dumort.	**phionly**	**lepa**	Wound healings	**Panchang lepa** is used topically for cattle diseases with wounds.
Lythraceae				
Woodfordia fruticosa (L.) Kurz	**dhaula**	**swarsa, avaleha**	Febrifuge	Fresh flower **swarsa** with sugar is believed to have a cooling effect and therefore used as a drink in high fevers.
Malvaceae				
Abelmoschus crinitus Wall.	**van bhindi**	**swarsa, kwatha**	Dermatological problems; Aphrodisiac	Root **kwatha** is believed to be aphrodisiac. **Swarsa** is applied in cuts and wounds.
Abutilon indicum (L.) Sweet	**kanghe**	**Kwatha**	Febrifuge; Anti-diarrheal	Leaf **kwatha** is given as a febrifuge. Bark decoction is given for diarrhea.
Menispermaceae				
Cissampelos pareira L.	**pahare**	**kwatha**	Diuretic; Anti-dysuric	Root **kasaya** is boiled with water and taken for urinary troubles.
Tinospora cordifolia (Willd.) Miers	**gilae**	**swarsa, kwatha**	Anti-leprosy; Diuretic, Febrifuge	Arial roots are extracted and applied topically for leprosy. A stem decoction is used by the local **vaidya** for treatment of fevers and urinary problems.

Plant species	Vernacular	Formulation	Therapeutic uses	Local remedies
Moraceae				
Artocarpus lakoocha Roxb.	**dhau.**	**netrabindu**	Ophthalmatic; Eye ointments	Seed paste is applied topically to conjunctivitis.
Ficus benghalensis L.	**bargad**	**kasaya**	Hypoglycemic; Anti-diarrheal; Opthalmatic	Soft bark kasaya is used for dysentery and diabetes. Fresh latex is used for eye infections.
Ficus palmata subsp. *virgata* Browicz	**anjir**	**kasaya,** latex	Diuretic; Dermatological problems; Vermifuge	**Vaidyas** use fruit for promoting urine discharge and also for skin diseases. Fresh latex is used internally to extricate intestinal worms.
Ficus subincisa Buch.-Ham. ex Sm.	**umaru**	**kwatha,** latex	Anti-diarrheal; Hypoglycemic	Root and stem latex is taken with boiled water for diarrhea, piles, and diabetes.
Moringaceae				
Moringa oleifera Lam.	**sunjuna**	**avaleha,** crude gum/ **lepa**	Dermatological problems; Gastrointestinal disorders	White gum is used topically as a lotion for skin diseases, and also taken internally with sweets or milk for stomach pains.
Nyctaginaceae				
Boerhavia diffusa L.	**punar-nawa**	**churna, swarsa**	Anti-hypersensitive; respiratory disorders; Dyspepsia; Dysuria; Diuretic	Root **churna** or **swarsa** is used for asthma, stomach problems, and dysuria.
Oxalidaceae				
Oxalis corniculata L.	**bhilmoru**	**swarsa**	Antiviral; Dermatological problems	Juice is used for removing skin warts or small thorns from the skin.
Papaveraceae				
Argemone mexicana L.	**satyanashi**	**kwatha**	Abortifacient; Anti-hypersensitive; Respiratory disorders; Hepatoprotective	Yellow latex is used for eye diseases. Root **kwatha** is administered orally for the treatment of asthma and bronchitis. **Vaidayas** with spiritual power used seeds for the treatment of jaundice. Seeds are used as abortifacient.
Pinaceae				
Pinus roxburghii Sarg.	**kulai**	fresh resin	Wound healings	Resin is used topically for healing cuts and wounds.
Ranunculaceae				
Anemone tetrasepala Royle	**-**	**lepa**	Antiseptic	Leaf paste is believed to have good healing properties.
Rutaceae				
Zanthoxylum armatum DC.	**timbru**	**churna, taila**	Anti-pyrea	Seed **churna** or seeds macerated into oil are applied to treat pyrea. A stem has great religious importance as a symbol of “Lord Narsinhga.”

Plant species	Vernacular	Formulation	Therapeutic uses	Local remedies
Saxifragaceae				
Bergenia pacumbis (Buch.-Ham. ex D.Don) C.Y.Wu & J.T.Pan	**slipari**	**churna, swarsa**	Gastro-intestinal disorders; Nephrolithiasis	Dried rhizome **churna** is believed to relieve gastritis and is also used for kidney stones.
Scrophulariaceae				
Verbascum thapsus L.	**gidar-tambakhu**	**churna, taila**	Dermatological disorder	Dried inforescence **churna** mixed with mustard oil is used externally for skin diseases.
Solanaceae				
Datura inoxia Mill.	**dhatura**	**ghrita, kasaya,** emulsion	Anti-hypersensitive; Respiratory disorders; Analgesic; Anti-diarrheal	Leaf **kasaya** made into **ghrita** butter / ghee is administered orally for body pains and is believed to be useful for asthma and bronchitis. Leaf **swarsa** along with ointment is used topically to treat skin spots.
Solanum americanum Mill.	**ginway**	**swarsa**	Febrifuge; Conjunctivitis	Fruit juice is used internally for fevers and topically for eye infections.
Solanum rudepannum Dunal	**ban-bhatta**	**paka**	Hepatoprotective	Unripe fruit are cooked like vegetables and eaten for the treatment of liver troubles.
Urticaceae				
Boehmeria rugulosa Wedd.	**ganthi**	**lepa, avaleha**	Orthopediatric	Fresh bark paste is used as a plaster for animals/cattle fractures.
Urtica ardens Link	**kandali**	**paka**	Menorrhagia disorder; Oxytocic; Abortifacient	Young shoots are cooked as vegetable and eaten for smooth menstruation, delivery and also used as an Abortifacient .
Vitaceae				
Ampelocissus rugosa (Wall.) Planch.	**chhipari**	**kwatha**	Pitta vicar; Intestinal disorder	Leaf powder converted into **kwatha** with **gomutra** (cow urine) is believed good for all types of **pitta** ailments.
Xanthorrhoeaceae				
Aloe vera (L.) Burmf.	**ghee-kunwar**	**kwatha, laipen**	Hepatoprotective; Cardiac stimulant; Dermatological problems	Fresh leaf *kwatha* is administered orally for liver disorders and heart problems. Leaf paste is applied topically to treat skin diseases.
Zingiberaceae				
Curcuma angustifolia Roxb.	**ban-haldi**	**avaleha, churna**	Demulcent; Confectionary purpose	Rhizome paste or powder is applied externally to burns.

Table 2. Some traditional health care system formulations recorded in Rudraprayag district, Uttarakhand, India.

	Remedies	Administration
Cough & respiratory disorders:		
	A combination of **trifala** (*Terminalia chebula* Retz., *Terminalia bellirica* (Gaertn.) Roxb. and *Phyllanthus emblica* L.) and *Piper longum* L. (10-15 gm each) in equal amounts is ground into fine **churna**.	3 gm of **churna** is administered orally with honey twice a daily for 7 days.
	Bark of *Myrica esculenta* Buch.-Ham. ex D. Don, *Digitalis purpurea* L., *Pistacia chinensis* subsp. *integerrima* (J.L. Stewart ex Brandis) Rech. f., *Cyperus scariosus* R.Br., dry ginger, *Piper nigrum* L., *P. longum* and *Parthenocissus semicordata* (Wall.) Planch. is taken in equal quantity and ground into fine **churna**.	Taken orally twice a daily with ginger **swrasa** and honey for 7 days.
	Piper longum is ground into **churna** and added to **sainda namak** (pink rock salt) in equal proportion.	Taken with warm water for all types of cough.
	Acacia catechu (L.f.) Willd., *Cordia dichotoma* G.Forst., *Acacia nilotica* (L.) Delile bark and *Glycyrrhiza glabra* L. in equal quantity is ground into **churna**, filtered with muslin cloth, then mixed with ginger **swrasa** and converted into **vatika** (tablets).	**Vatika** are taken orally for severe cough.
	1 kg fresh ginger is boiled over fire in a bronze pan until it is converted into paste. The same volume of cow **ghee** is heated in the bronze pan until it started boiling. Paste of ginger is then mixed with **ghee** and boiled until it become almost brownish in color. It is cooled down and stored.	A teaspoonful of the formulation is taken orally after dinner every day followed by a cup of cow milk for three months. This treats chronic asthma.
Treatment of leucorrhea (swet pradar) & painfull menorrhazia (stri roga):		
	Roots of *Withania somnifera* (L.) Dunal, *Asparagus racemosus* Willd., *Mucuna pruriens* (L.) DC. seeds along with **trifala** (see above) are mixed in equal proportion into **churna**.	Around 3 gm of **churna** is administered with milk twice a daily for the treatment of **swet pradar** (Leucorrhea).
	Churna is prepared with equal quantities of **silajeet** (asphaltum), *Convolvulus arvensis* L., *P. longum* and **misri** (crystallized sugar lumps).	Taken orally twice a day with warm water.
	25 g *Asparagus racemosus*, 10 g **satwa** of *Tinospora cordifolia* (Willd.) Miers, 20 g *Saussurea gossypiphora* D.Don, 25 g *G. glabra* and 120 g *Abelmoschus moschatus* Medik. is mixed and ground then filtered with muslin cloth, then mixed with 20 g *Crocus sativus* L. and 10 g **godanti bhasma** (a natural form of calcium derived from plants).	3 g of formulation is taken orally with cow milk in mornings and evenings after meals for 15 days for **rakta pradar** (menorrhagia). During the treatment, spices and oily foods are prohibited.
	Surma (white), bark of *Saraca asoca* (Roxb.) Willd. and **mishri** (see above) are mixed and ground into **churna**.	Taken with cow milk in mornings and evenings after meals for 10-15 days for **swet pradar**.
	Mesua ferrea L. and **mishri** (see above) are ground and filtered with muslin cloth into **churna**.	About 6 mg of **churna** is taken orally daily as a single dose for 30-45 days for painful menorrhagia.
	Woodfordia fruticosa (L.) Kurz leaves, *Cocculus hirsutus* (L.) W.Theob. and *Pterocarpus santalinus* L.f. (all dried) are mixed in equal proportion, ground, filtered and formulated as **churna**.	One teaspoonful is taken orally for 15 days for **swet pradar**.
Fever including pneumonia		
	Bark of *Cinnamomum tamala* (Buch.-Ham.) T.Nees & Eberm. (20 g), *Myristica fragrans* Houtt. (5 g) and **saunth** (dried ginger) (50 g) are ground into **churna** after filtering with muslin cloth. Thereafter, it is added with **loha bhasma** (iron ash) (10 g), **swrna bhasma** (gold ash) (600 mg) and *A. moschatus* (400 mg).	About 2 g **churna** is taken orally 3 times a day with warm water for pneumonia. Rice and cold food is prohibited.
	A combination of *Ocimum tenuiflorum* L., *P. longum*, *P. nigrum* and **mishri** (6:4:1:10) is ground in water.	1 teaspoonful is administered twice a day for one week for periodic fever.

	Remedies	Administration
	Panchang of *Swertia chirayita* (Roxb.) Buch.-Ham. ex C.B.Clarke is converted into **churna** and boiled in water with leaves of *Lamium amplexicaule* L. until only half of the volume remains. The product is filtered with muslin cloth and the **kwatha** (decoction) is stored in an air tight container.	One teaspoonful of **kwatha** is taken orally for 3 days for fever.
	M. esculenta bark, *D. purpurea*, *P. nigrum* and *P. chinensis* subsp. *integerrima* in equal amounts is ground into **churna**.	**Churna** is taken with honey for 7 days for treatment of fever.
	Phyllanthus emblica, *Plumbago zeylanica* L., *T. chebula*, *P. nigrum* along with **saindha namak** are taken in equal amounts and ground into **churna**.	Taken twice a daily for 1 week with warm water for all types of fever, gastric troubles and respiratory problems.
Ear, nose, and throat		
	A paste is made of a mixture of *Solanum aviculare* G. Forst. and *Spilanthes acmella* (L.) L. in equal proportions.	The **lepa** is used as toothpaste to treat sensitive teeth as well as toothaches.
	Fitkari (alum) (5 g) is ground and added to rose water (250 ml).	About 2-3 drops of this is poured into the eyes at short intervals (2-3 hours) for pain relief and infections.
	Saussurea gossypiphora flowers are ground into **churna**.	A pinch of **churna** along with **swrasa** of lemon is used for earaches.
Gastro-intestinal disorders		
	Saunth (dry ginger) (10 g), *T. chebula* bark (20 g), *P. emblica* (10 g) *T. bellirica* (15 g), **khurasani ajwain** (*Hyoscyamus niger* L.) (25 g), **boja** (*Acorus calamus* L.) (15 g) and **gilai** (*T. cordifolia*) (25 g) are mixed and ground into **churna**.	Administered orally (5 g) 3 times a daily for dysentery.
	Piper longum (5 g), **shyaha jeera** (*Bunium persicum* (Boiss.) B.Fedtsch.) (10 g), **saindha namak** (15 gm) and **naushadar** (ammonium chloride) (20 g) are mixed and ground into **churna**.	**Churna** used for indigestion and constipation.
	Dry *P. emblica* (10 g) and *T. chebula* (5 g) are mixed and ground into **churna**.	Taken orally 2 times daily for 3 days for dysentery.
Rheumatism / joint pain		
	Arandi (*Ricinus communis* L.) (100 g) and *Vitex negundo* L. (200 g) are boiled in mustard oil (500 ml) until it turns black. This is then filtered and stored as **taila**.	Massage of this **taila** on joints is useful for rheumatic pain.
	Pipali (*P. longum*) fruit (1 g), **pipali** roots (15 g), *Phaseolus vulgaris* L. (15 g), **saunth** (10 g) and P*. zeylanicum* (10 g) are boiled and filtered. A pinch of black salt and *D. purpurea* are also added.	Administered frequently (4-5 times a day) for rheumatic pain.
	Yograj guggulu (an Ayurvedic formulation) is mixed with mustard oil.	One teaspoonful is taken orally and topically 2 times daily for 15 days for rheumatic pain.
Hepatoprotective		
	Dry ginger, *P. nigrum*, *P. longum*, *D. purpurea* and dry **heeng** (asafoetida) in equal proportions are ground into **churna**.	**Churna** is administered orally with warm water (2-4 g) for 15-20 days for liver disorders.
	Triphala churna	One half teaspoonful is taken frequently for one week for jaundice.
Anti-hemorrhoid (piles treatment)		
	Young bud of guava (100 g) and *M. esculenta* bark (200 g) are ground and filtered with muslin cloth to make fine **churna**.	Two teaspoonfuls are taken twice daily for 30 days for piles.
	Young and fresh leaves of *Senna tora* (L.) Roxb. are ground and mixed well with water.	The mixture is chewn raw on an empty stomach early in the morning for 15 days.

Therapeutic Categorization of Indigenous Medicinal Knowledge:

123 different ailments were reported to be treated with indigenous medicinal practices in the Rudraprayag district. These ailments were further categorized into 13 major therapeutic groups. The largest category was dermatological (skin) problems with 24 ailments followed by ear, nose and throat (ENT) with 20, gastrointestinal disorders (18), uro-genital problems (16), mental disorders/nervous disorders/shamanistic (10), orthopediatric purposes (7), cardiovascular, respiratory and fever (5 each), cancer and hepato-protective categories (2 each), and only 1 ailment under hemorrhoid and hypoglycemic.

Under different therapeutic groups, nearly 70 species were reported for the treatment of gastrointestinal ailments out of which 51 species were also used for the treatment of ailments under different therapeutic groups. This was followed by dermatological group comprising of 44 species, uro-genetial by 43 species, respiratory disorders 34 species, mental disorders 31 species, fever 29 species, cardiovascular 24 species, ENT 18 species, for bone related and liver ailments 12 species each, 6 species for the treatments of piles, 4 species for cancer and only 2 species were reported for the treatments of diabetes. Besides 51 species of gastrointestinal group, 36 species of uro-genital, 31 of respiratory, 30 species of mental disorders, 26 of fever, 24 species of cardiovascular, 22 species of dermatological and many other species also reported to have other therapeutic uses.

Gastrointestinal disorders:

Ailments treated are constipation, colic pain, cholera, indigestion, vomiting, diarrhea, dysentery, gastritis and ulcer. Most of the time plants are used as carminatives and laxatives. Few plants have been previously reported for this purpose (Kala 2004). Most of the time, species were used as a single remedy with occasional combination with water, salt, sugar and honey. Out of 70 species, 40 were mainly used to treat diarrhea and dysentery, 20 for gastritis and acidity, 5 for ulcer and 10 for constipation. One of the practitioners suggested the decoction of root of *Berberis aristata DC.* as a very good treatment for chronic gastritis.

Dermatological problems:

Cuts and wounds were the most frequent maladies of this group followed by itching, scabies, eczema, pimples, blisters, burns, boils and swellings. Most of the remedies were used as demulcents and antiseptics applied topically in the form of **lepa** and **swarsa**. Kala (2004) reported 134 species for treating skin diseases and *A. conyzoides* was the most common species also reported during this work.

Uro-genital problems:

Many of the plants used for uro-genital problems that are covered in Table 1 are reported for the first time. Most were used as diuretics. Additional formulations from **vaidayas** related to this category are presented in Table 2.

Respiratory disorders:

Ailments treated are cough, cold, bronchitis, asthma, tuberculosis and as a vasodilator. The formulations are predominantly **churna** administered orally and preferably with honey.

Mental disorders:

Ten ailments were treated by traditional health care professionals, while 23 species are used for shamanistic purposes.

Fever:

Ailments treated include normal fever, pneumonia and typhoid.

Cardiovascular:

Ailments treated include hypertension and low blood pressure. Several plants are used as cardio-stimulants.

Ear, nose, and throat:

Ailments treated are nose bleeds, conjunctivitis, cataracts, night blindness, and tooth or ear aches. Most of the time, fresh juice of plants is used as and when required.

Bone diseases:

Ailments treated are rheumatism, arthritis, bone fracture, dislocated joints and sprains. Some formulations used especially for rheumatism and joint pains are described in Table 2.

Miscellaneous problems:

In addition, twelve species were reportedly used to treat liver ailments and as a tonic, six for the treatment of piles, four for cancer, and two for diabetes.

Discussion

Globally, treatments of various gastrointestinal disorders are predominant, and a sizeable number of plants have been reported as part of treatment for such illness across different ethnic communities (Kala 2004). However, Kala (2004) reported that more medicinal plants in Uttarakhand were used to treat general body ache and colic pain.

Traditional medicinal systems are diverse in their historical background, logic, practices, contemporary social realities and dynamics (Bhasin 2007). Medicinal knowledge of the local inhabitants of Rudraprayag district can be categorized into three groups: 1) Traditional medicinal knowledge (folk medicines) that is intrinsic knowledge inherited by oral communications across generations within the indigenous communities (Hazarika *et al*. 2012). 2) Traditional systems of medicine, mainly Ayurveda, practiced by trained practitioners and **vaidayas**. and 3) Shamanistic medicine practiced by performing religious rituals including **tantra**-**mantra** and using plants either as a symbols of gods or evil spirits. Out of 150 people surveyed, only 25 were trained. The remaining 125 practitioners were using experiences they learned from elders and supporting primary health care of family members and village inhabitants.

This study reveals some new used besides common medicinal uses of the plants recorded

Abrus precatorius L. and *Litsea monopetala* (Roxb.) Pers. are used for bone related diseases in Rudraprayag district. Kala (2004) also reported *A. precatorius* along with *Cuscuta reflexa* Roxb. and *Rhododendron campanulatum* D. Don for treating bone diseases. In Kumaun Himalaya, the Bhotiya apply this for treatment of gastric problems, digestive system, dysentery and diarrhea, liver malfunctioning, kidney stone, fever, blood purifier, common cold and cough, skin diseases and for vigor and vitality of the body (Farooquee *et al*. 2004).

Crushed juice of *Achyranthes aspera* L. is used for dysentery, piles, skin eruptions and ulcer in Sonitpur, Assam (Kumar *et al.* 2009). However, this plant is used as an antidote, demulcent and as oxytocic and for the treatment of tooth aches in Rudraprayag district. In high altitude areas it is used for the treatment of ringworm (Phondani *et al.* 2010).

Acorus calamus L. was reported in this study for gastrointestinal problems and as a hepatoprotective. Similarly, Rawat *et al*. (2010) reported that it is used for the treatment of dyspepsia, bronchitis, dysentery, snake bite, insectifuge and asthma in traditional medicinal systems of Tones valley of Garhwal Himalaya. In Meghalaya, a root decoction of *A. calamus* is taken orally for the treatment of malaria (Bora *et al*. 2007). Similarly, in other parts of Uttarankhand, Kala (2004) reported that *A. calamus* was used to treat nine ailments including fever, stomachache, and headache, abdominal pain, in respiratory problems and also in malaria.

In Rudraprayag, *Argemone mexicana* L. is used as an abortifacient, anti-hypersensitive, and its yellow latex is used for eye diseases. **Kwatha** of roots is administered orally for the treatment of asthma and bronchitis. Vaidyas with spiritual power used seeds for the treatment of jaundice. However, Nath people in Assam (Sikdar & Dutta 2008), reported *A. mexicana* as useful in leprosy, scabies, syphilis, and gonorrhea, toothache, as a purgative, for dropsy, jaundice, healing of ulcers, herpes, and skin diseases. It is also used as an antidote for snakebites.

Callicarpa macrophylla Vahl. is used in dermatological problems and for the treatment of leprosy in Rudraprayag whereas in Arunachal Pradesh it is used for headaches and indigestion (Kala 2005c).

Sati and Joshi (2011) reported anti-fungal activity in root bark of *Calotropis procera* (Aiton) Dryand. It is also used in skin diseases in Rudraprayag district.

In Assam (Sikdar & Dutta 2008), *Eclipta prostrata* (L.) L. is taken internally and applied externally to blacken hair. Fresh leaves are used for elephantiasis, liver ailments, and dropsy. Juice is also used for jaundice and fever. However, in Rudraprayag, fresh juice is used externally to treat skin diseases.

Euphorbia hirta L. is used for cough and asthma, whooping cough, chronic bronchitis, as a sedative, hemostatic, soporific, and for urinary problems in Rudraprayag district. In Assam, the milky juice was considered useful for warts (Sikdar & Dutta 2008).

In Arunachal Pradesh, *Oxalis corniculata* L. is used to relieve intoxication from wine as well as for diarrhea (Kala 2005c). By contrast in this study the juice of the plant is used for removing skin warts, and to take out small thorns from the skin.

Senna occidentalis (L.) Link is used as a remedy for hysteria, dyspepsia, nervous disorder skin diseases, bronchitis, asthma, and as an antidote for snakebite (Bhardwaj & Gakhar 2005, Dutta & Dutta 2005, Sikdar & Dutta 2008). In the Rudraprayag district it is used to treat asthma, bronchitis, piles, skin diseases, and hypersensitivity.

Solanum rudepannum Dunal is used for treatment of liver troubles in Rudraprayag district. However, in Assam and Arunachal Pradesh it is used for treatment of malaria (Bora *et al*. 2007).

Urtica ardens Link was reported in this research as useful in menorrhagia disorder, as an oxytocic and as an abortifacient. However, Phondani *et al.* (2010) reported it as useful for anemia.

In Apatani, Arunachal Pradesh, *Zanthoxylum armatum* DC. is used to treat colds, cough, fever and as an appetizer (Kala 2005c). In Rudraprayag district, *Z. armatum* was used mainly for the treatment of tooth ache and pyorrhea. Similar uses were reported by Rawat *et al*. (2010) in Tones valley.

Conclusion

The traditional medicinal system of Rudraprayag includes diverse knowledge of useful plants. Many species already described by earlier workers had different medicinal uses. Some formulations are also reported for the first time during the course of this study. Moreover, information regarding various formulations may help local people to fulfill primary health care demands.

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