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Medicinal Plants in Farwest Nepal: Indigenous Uses and Pharmacological Validity

Ripu M. Kunwar[1,2*] • Chundamani Burlakoti[2] • Chhote L. Chowdhary[2] • Rainer W. Bussmann[3]

[1] Ethnobotanical Society of Nepal, GPO Box 5220, Kathmandu, Nepal
[2] Center for Biological Conservation, GPO Box 19225, Kathmandu, Nepal
[3] William L. Brown Center, Missouri Botanical Garden, St. Louis, USA

Corresponding author: * **ripukunwar@gmail.com**

ABSTRACT

Medicinal plants have been used indigenously since ancient past as medicines for the treatment of various ailments. However, the knowledge of indigenous therapies have been distorting to these days due to changing perception, acculturation, commercialization and socio-economic transformations. The present study compares indigenous knowledge of therapies of 48 medicinal plants with the latest common pharmacological findings. Traditional indigenous plant knowledge and phytomedicine are consistently gaining acceptance in global society. The present study found that over two-thirds of traditionally used plants in the region show clear pharmacological efficacy. Total 23 species possessed strong resemblances and the species *Euphorbia royleana*, *Ricinus communis*, *Plantago major*, *Chenopodium album*, *Cordyceps sinensis*, etc. contributed the most. The complementarity of indigenous therapies and pharmacological uses is obvious and it is base of the modern therapeutic medicine. The increasing use of indigenous therapies demands more scientifically sound evidence, therefore further investigation and phytochemical screening of ethnopharmacologically used plants and assessment of the validity to the indigenous uses is worthwhile.

Keywords: Baitadi district, *Chenopodium album*, coumarin, pharmacology, traditional therapy

INTRODUCTION

Archaeological discoveries of 60,000 year-old Neanderthal burial grounds in Shanidar, Iraq, pointed to the use of several plants like Marshmallow, Yarrow and Groundsel that are still used in contemporary folk medicine (Lietava 1992). Evidence for the medicinal use of *Papaver somniferum*, the opium poppy, dates back to 8,000 years (Stockwell 1989; Lewington 1990). Concomitantly, the earliest written record of plants used as medicine in the Himalayas is found in the Rigveda in about 6,500 years ago (Malla and Shakya 1984), in the Atharvaveda in about 4,000 year ago (Nambier 2002) and in the Ayurveda in about 2,500 year ago (Kunwar *et al*. 2006). Hippocrates (460–377 B.C.) described the usage of leaves and bark of willow tree to treat fever and pain (Julkunen-Tuto and Tahvanainen 1989). According to Schmid and Heide (1995), there is a report of preparation of salicylate pain remedies for indigenous uses from Birch bark in North America in 200 B.C. Therefore, until the 19th century, plants were the main therapeutic agents used by humans, and even today their role in medicine is immense (Bhattarai *et al.* 2009; Uprety *et al.* 2010).

The first medically useful alkaloid was morphine isolated from Opium poppy *Papaver somniferum* (Solanaceae) in 1805 (Fessenden and Fessenden 1982); the name morphine comes from the Greek Morpheus, god of dreams. A drug used in indigenous culture transformed into a medication and research tool since 1864 after the first systematic studies of Claude Bernard (Bernard 1966) on physiologic-pharmacological effects.

Therefore, the essence of phytomedicine recounts prehistoric and isolation of useful plant constituents and researches are imminent. Scientific study of traditional medicines and research of drug discovery through traditional medicines is designated as ethnopharmacology (Bussmann 2002) was first used in 1967 by Efron *et al*. (1970) in a book, *Ethnopharmacological Search for Psyactive Drugs* (Heinrich and Gibbons 2001). Tubocurarine was the first ethnophar-

Fig. 1 Some Himalayan medicinal plants. (**Left**) *Rhus parviflora*. Fruits are indigenously used for diarrhea and dysentery. (**Center**) *Urtica dioica*. Stem juice is valued for sprain and fractures. (**Right**) *Euphorbia royleana*. Plant is kept in roof of house for protecting from evil.

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macological drug, derives from Menispermaceae (*Chondrodendron* spp.) and Loganiaceae (*Strychnos* spp.), researched and medicated extensively (Bisset 1991). There are many other examples (quinine from *Cinchona succirubra*, colchicine from *Colchicum autumnale*, etc.) of pharmaceutical relevant substances, which were developed based on observations of indigenous drugs during the last century (Heinrich 2001). Quinine, the cure for malaria, was originally the ritual medicine of Incas of Peru (Osujih 1993). The phytocompound used for medication and entered into the international market was ephedrine, an amphetamine like stimulant from *Ephedra sinica* (Patwardhan *et al*. 2005).

Numerous other traditional therapy base phyto-drugs artimisinin from *Artemisia annua* as a potent antimalarial drug, alkaloids of *Rauvolfia serpentina* as hypertension, phyllanthin of *Phyllanthus emblica* as antiviral, etc. deserve special interest. Some other plants and their compounds worth from traditional therapy to modern medicine are *Holarrhena* for amoebiasis, *Mucuna pruriens* for Parkinson's disease, *Commiphora* as hypolipidaemic, *Asclepias* as cardiotonic, psoralens for vitiligo, curcumines for inflammation, baccoside for mental retention, picrosides for hepatoprotective, indirubin for cancer, diosgenin for the synthesis of steroidal hormones, guggulsterons as hypolipidemic, piperidine as bioavailability enhancers, asarone as hallucinogenic, withanolides and many other steroidal lactones and their glycosides as immunomodulators, etc. (Jain 1994; Patwardhan 2000). Till 2002, 1141 different traditional plant drugs were registered for their therapeutic activities (Patwardhan *et al*. 2005) and it is estimated that about 25% of the prescription drugs contain active principles of higher plants (Farnsworth and Morris 1976; Tiwari and Joshi 1990; Cox 1994), and most are entrenched from traditional therapies. In some cases, about 60% of the antitumoral and antimicrobial medicines currently available in the markets are derived mainly from the higher plants (Cragg *et al*. 1997). Therefore, global demand of herbal medicine is accelerating and its worth was US $ 19.4 billion in 1999 (Laird and Pierce 2002). Herbal trade of over US $ 60 billion per year and its 7% annual increment was estimated (Nagpal and Karki 2004). Its market was valued for 2.3 and 2.1 billion in 1994 respectively in Asia and Japan (Grunwald 1995). The worth annual growth rate about 20% was reported in India (Srivastava 2000; Subrat 2002).

Interest of phytomedicine is gradually renewed (Bhattarai *et al.* 2010) or increased and numerous medicinal plant based drugs have spread into the international market through exploration of ethnopharmacology and indigenous therapies (Bussmann 2002). The search for pharmacological principles from existing indigenous therapies is encouraging and complemented the achievements of modern medicine. With increasing use of traditional therapies of plant resource base (Acharya and Acharya 2010), a verification of efficacy by western scientific means would be interesting, because the traditional health system adopt customized and multi-pronged strategies in treatment involving drug, diet and therapy (Patwardhan *et al*. 2005). Moreover, the indigenous therapies have been criticized due to inadequate research, critical evaluation, *in vivo* studies and validations (Houghton 1995; Fong 2002).

Despite growing interest in assessing phytochemical constituents of plants with pharmacological activities and modern medicine (Dalvi *et al.* 1994; Gupta 1994; Vaz *et al.* 1998; Dahanukar *et al*. 2000), to date only about 5% of the total plant species have been thoroughly investigated (Goswani *et al*. 2002; Patwardhan *et al*. 2005; Palombo 2006) to ascertain safety and efficacy of traditional remedies. Moreover, the current species extinction rate (the world is losing one major drug every two years) (Groombridge and Jenkins 2002) and distortion and percolation of indigenous knowledge, use and ethnopharmacology (Bussmann *et al*. 2007) aggravating the situation further. In this connection, present study aimed at surveying and assessing indigenous knowledge of uses and therapies of medicinal plants and their pharmacological validity.

MATERIALS AND METHODS

Field study for primary data collection was carried out in Baitadi, Dadeldhura and Darchula districts of West Nepal in May-June, December 2006 and Jan-Feb 2007, March-April 2008. Study sites Anarkholi, Dasharathchand, Jhulaghat, Khodpe, Kulau, Pancheswor, Patan, Salena, and Sera from Baitadi; Brikham, Jakh, Jogbudha, Patram and Rupal from Dadeldhura and Dumling, Gokule, Joljibi, Khalanga, Lali, and Uku from Darchula district were visited. All three districts are delineated as western borders to the country and adjacent to India. Dadeldhura district ranges with 29°–29°30′N latitude, 80°03′–80°50′E longitude and altitude 390-2950 m; Baitadi district with 29°22′–29°57′N latitude, 80°05′–80°57′E longitude and altitude 390-2950 m; and Darchula district lies within 29°26′-30°15′N latitude, 80°22′-81°9′E longitude and 357-7132 m altitude. Owing to varied topography, bioclimate and elevation, the districts harbor diversity of forest products (Devkota and Karmacharya 2003, Pant and Panta 2004), and the products have been collecting by local ethnic groups since time immemorial for both the subsistence and commercial purposes, however the subsistence use is profound particularly for home herbal healing (Burlakoti and Kunwar 2008; Kunwar *et al*. 2009).

Primary data collection was facilitated by ten local assistants. Group discussions, informal meetings, questionnaire surveys and field observations were made for primary data collection. Group discussions, as informal interactions and meetings were held at the immediate spot and they were managed within the community forest user groups. Altogether 172 questionnaires were asked to the particular respondents representing ethnic groups: Badi, Bijale, Chanda, Chuhar, Dadal, Dhami, Hodke, Lawad, Lohar, Pali, Pariyar, Parki, Sitoli, Tamata, Uud, etc; age groups (25-74 year), sexes (both male and female), and occupations (collectors, cultivators, traders, herders, traditional healers). Information was validated by common responses (at least by three responses) and responses from less than three respondents were considered as insignificant. Species with common responses were preceded for crosschecking and key informant survey. Elders, traditional healers - Baidhyas, medicinal plant cultivators and collectors were individually asked for detail analysis. The species possessed highest common responses were considered for the present assessment. The assessment was made with comparing the present observations and latest and common phytochemical findings.

RESULTS

Observations (*significant and # partial affinities)

#Adiantum capillus-veneris L. Maidenhair fern (English), Gophale (Nepali), Hansapadi, Nilkanthasikha (Sanskrit), *Adiantaceae.*

Indigenous uses: Root juice is applied for snake bite, migraine, and scorpion sting.

Principal chemical compounds: Adiantone, carotenoid, filicene, flavonoides, kaemferol, leucopelarcogonidin, mollugogenol, quercetin, tannins (CSIR 1988).

Pharmacological uses: Whole plant extract possess hypoglycaemic activity (Jain and Sharma 1967). It showed potent antimicrobial activity against *Escherichia coli*, *Trichophyton rubrum* and *Aspergillus terreus* (Singh *et al*. 2008). Plant extract is potential elicitor of phytoalexins in sorghum and soybean (Meinerz *et al*. 2008).

****Rhus parviflora*** Roxb. (**Fig. 1**) Nepal Sumac (English), Bewoti (Local), Satibayer (Nepali), Tintideek (Sanskrit), *Anacardiaceae*.

Indigenous uses: Fruit decoction is taken for diarrhoea and dysentery.

Principal chemical compounds: Abinoside, biflavonoides, hetriocontane, kaemferol, lignoceric acid, myricetin, quercetin, rhamnoside, sitosterol (Husain *et al*. 1992).

Pharmacological uses: Methanolic extracts of the ripen fruits possess antidiarrhoeal effect (Thangpu and Yadav 2004). *Rhus* species have reactive oxygen (RO) which can damage DNA resulting in mutagenesis, aging, carcinogenesis, and antimicrobial effect (Lin *et al*. 2008). Plant ex-

tract is also antibacterial (Mahato 2006) in effect.

Angelica archangelica L. Angelica (English), Gannano (Nepali), *Apiaceae*.
Indigenous uses: Dried roots are anthelmintic and useful in gastric, and stomachache.
Principal chemical compounds: Angelicin, coumarin, furocoumarin, isoimperatorin, pinene, prangolarin, umbelliferene (Anonymous 1948; Kaul 1997).
Pharmacological uses: Ethanol extract of root of this plant shows anti-trypanosomal activity (Schinella *et al*. 2002).

#Pleumeria rubra L. Pagoda tree (English), Choya phool (Local), Galaincha phool (Nepali), Kshirchampaka, Swetachampa (Sanskrit), *Apocynaceae*.
Indigenous uses: Flowers are useful in indigestion and cholera.
Principal chemical compounds: Acetonine, amyrin, bornesitol, farnesol, fluroplumierin, kaemferol, lignan, lupeol, melilotic acid, oleanic acid, para-coumaric acid, plemeride, plumeric acid, plumerinine, quercetin, rubrinol, syringic acid, vanilic acid (Cambie and Ash 1994; Coppen and Cobb 1983).
Pharmacological uses: Plant extract is antibiotic, antitumour, antiviral, analgesic, antispasmodic, etc. and fluroplumierin inhibits mycobacteria (Sundarrao 1993; Cambie and Ash 1994).

Ageratum conyzoides L. Goat weed (English), Nilgandhe (Local), Kalo jhar (Nepali), Visamusti, Osari (Sanskrit), *Asteraceae*.
Indigenous uses: Stem juice is useful in bleeding control.
Principal chemical compounds: Ageratochromene derivatives, caffeic acid, chromenes, conyzorigun, coumarin, echinatine, eupalestin, friedelin, fumaric acid, kaemferol, lycopsamine, quercetin, rhamnoside, scutellarein, sitosterol, stigmasterol (Cambie and Ash 1994; Ayyanar and Ignacimuthu 2005).
Pharmacological uses: Embryotoxic, tannin is insecticidal, antidiarrhoeal, anti-inflammatory, anticoagulant, muscle relaxant, analgesic (Sharma *et al.* 1978; Cambie and Ash 1994). Fumaric acid shows hepatoprotective properties (Sharma *et al*. 1995). Caffeic acid is effective against viruses, bacteria and fungi (Brantner *et al*. 1996).

Ainslea latifolia (D.Don) Sch. Bippekuro (Local), *Asteraceae*.
Indigenous uses: Root juice is taken for stomach pain.
Principal chemical compounds: Plant contains flavonoids (Chandel *et al*. 1996).
Pharmacological uses: Ethanolic extract plant roots is diuretic (Chandel *et al*. 1996). Flavonoides are anti-inflammatory and anti-aggregant in properties (Mekhfi *et al*. 2004; Sharma 2004).

Artemisia indica Willd. Mug wort (English), Kurje pati (Local), Titepati (Nepali), Surparnaa, Nakuli, Nagadamni, Damanaka (Sanskrit), *Asteraceae*.
Indigenous uses: Plant is used in headache, fever and it is also used as insecticide. Leaves are used in skin itching and scabies.
Principal chemical compounds: Artemisin, exiguaflavonone, maackiain, sesquiterpene, thujone.
Pharmacological uses: Root extracts possessed insignificant hypoglycaemic effects (Villasenor and Lamadrid 2006). Plant infusion is used to reduce the post operative blood loss and relieve purulent inflammation (Davidov *et al*. 1995). Artemisin and its derivative α-arteether are used as antimalarial (Vishwakarma 1990).

****Cirsium verutum*** (D.Don) Spreng. Creeping thistle (English), Thakil, Dhande kanda (Local), Thakailo (Nepali), *Asteraceae*.
Indigenous uses: Root is used as refresher and for calmness. It is also applied for stomachache and abdominal pain.
Principal chemical compounds: Cicin, monogalactosyldiacyl glycerol, sterols, terpenes, etc. (Lee *et al*. 2002).
Pharmacological uses: Methanolic extract of whole plant juice is antimicrobial (Lee *et al*. 2002; Barbour *et al*. 2004).

#Inula racemosa Hook.f. Elecampane (English), Rithaula (Local), Puskarmul (Nepali), Puskaram (Sanskrit), *Asteraceae*.
Indigenous uses: Root extract is useful in severe stomacheache, dysentery and blood pressure.
Principal chemical compounds: Alantolactone, aplotaxene, curcumine, elemene, inunolide, ionone, tetraene (Husain *et al*. 1992).
Pharmacological uses: Methanol extract of root exhibited antimycobacterial activity (Cantrell *et al*. 1999) and its alcoholic extract enhanced liver glycogen and lowered blood glucose level (Tripathi and Chaturvedi 1995). Lung fibrosis (Thresiamma *et al*. 1996), blood pressure control (Dikshit *et al*. 1995) and anti-inflammatory properties (Kohli *et al*. 2005) are due to curcumine of the plant.

****Xanthium strumarium*** L. Sheep burr, Bur weed (English), Musekuro (Local), Bhede kuro (Nepali), Sankesvara, Arista (Sanskrit), *Asteraceae*.
Indigenous uses: Seed powder is useful in earache, dysentery and skin diseases.
Principal chemical compounds: Atractyloside, caffeyolquinic acid, carboxyatractyloside, caffeoylquinic acid, glycosides, hydroquinone, isoxanthanol, oxalic acid, strumaroside, thiazinedine, xanthanol, xanthin, xanthostrumarin, xanthanolide (Badam *et al*. 1988; Joshi 2004).
Pharmacological uses: Plant extract is antitussive, antibacterial, antifungal, antimalarial, hypoglycemic, stomachic, cytotoxic (Kupiecki *et al*. 1974; Gautam *et al*. 2007). Fruits are anti-inflammatory in effect (Han *et al*. 2007).

****Drymaria cordata*** (L.) Willd. ex Roem. & Schult. Lightening weed (English), Abijalo (Nepali), *Caryophyllaceae.*
Indigenous uses: Leaf is used as calmness, fresh and for cough.
Principal chemical compounds: Plant contains methoxycanthin, starch, etc.
Pharmacological uses: The methanolic extract of *Drymaria* was active against Gram-positive bacteria (Taylor *et al*. 1995). The extract of the plant has been reported to be useful in sinusitis, cold attack, burns and skin diseases (Mukherjee *et al*. 1995) which could suggest anti-inflammatory and antitussive activities (Mukherjee *et al*. 1997). The pounded leaf is applied to snake bites in China (Duke and Ayensu 1985). Uses of plant extract as emollient, febrifuge, laxative and stimulant have also been reported (Chopra *et al*. 1986).

****Chenopodium album*** L. Goose foot, Pigweed (English), Bethe (Local, Nepali), Vastukah (Sanskrit), *Chenopodiaceae*.
Indigenous uses: Whole plant is useful in constipation and indigestion.
Principal chemical compounds: Ascariodes, beta-carotene, catechin, caffeic acid, ecdysteroides, ethereal oil, ferulic acid, furanocoumarins, linolenic acid, oxalic acid, oleanic acid, phenolic acid, polypodine, sitosterol, vitamin C (CSIR 1988; Joshi 2004).
Pharmacological uses: Oil, leaf infusion and whole plant parts possess anthelmintic activity against sheep gastrointestinal nematodes (MacDonald *et al*. 2004; Jabbar *et al*. 2007). The compounds like betain, oxalic acid, oleanolic acid and furanocoumarins (Nicholas *et al*. 1955; Hegnauer 1989) may be responsible for anthelmintic activity. The ethanolic extract reveals anti-inflammatory (Matsuda *et al*. 1997) and antipruritic effects (Dai *et al*. 2002).

****Cordyceps sinensis*** (Berk.) Sacc. Caterpillar fungus (English), Jara (Local), Yarsagumba (Nepali), Sanjiwani (Sanskrit), *Clavicipitaceae.*

Indigenous uses: Whole plant is tonic and aphrodisiac and useful to increase memory and immune system.
Principal chemical compounds: Adenosine, cadoverin, campesterol, cerevisterol, cordycepic acid, cordycepin, daucosterol, ergesterol, guanosine, mycosporin, quinic acid, spermidine, uracil, uridine (Halpern 1999; Watanabe *et al*. 2005).
Pharmacological uses: Cordyceps has been used as an anti-tumor herb and an adjuvant of chemo and radiotherapy for various cancers (Bok *et al*. 1999; Huang *et al*. 2000; Wu *et al*. 2007). It is also used as haemostatic, mycolytic, anti-asthmatic, expectorant and tonic (Wang and Shiao 2000; Kunwar 2002). Cordycepin and polysaccharides are most widely detected cytotoxic, antibiotic, antitumor (Chen *et al*. 1997; Kodama *et al*. 2000), anti-oxidation (Li *et al*. 2001), and potentiating the immune system (Liu *et al*. 1992).

Coriaria napalensis Wall. Musoorie berry (English), Dahikamlo, Bhojinsi (Local), Machhaino (Nepali), Masuri (Sanskrit), *Coriariaceae*.
Indigenous uses: Bark paste is applied on burns and scalds.
Principal chemical compounds: Coreolic acid, coriamyrtin, heptulose, naringenin, tannin, ursolic acid (Buckingham 1994).
Pharmacological uses: Methanolic extract of plants and fruits showed significant antimicrobial activity on *Escherichia* and *Staphylococcus* bacteria (Joshi and Bhatta 1999). Ursolic acid shows hepatoprotective (Saraswat *et al*. 1996) and antitumor properties (Bilia *et al*. 2004).

Dioscorea deltoidea Wall. Deltoid yam (English), Vyakur (Local), Gittha (Nepali), Brahmakanda, Varahi (Sanskrit), *Dioscoreaceae*.
Indigenous uses: Yam is used as pesticide and anthelmintic.
Principal chemical compounds: Diosgenin, epismilagenin, kryptogenin, nitrogenin, rhamnopyranoside, smilagenin, yamogenin (Husain *et al*. 1992; Sharma 2004).
Pharmacological uses: Diosgenin is used as anabolic, antiarthritic, antinflammatory, antiinfertility (Sharma 2004). Rhizome extract reveals cytotoxic activity against human cancer (Hu and Yao 2002).

Euphorbia royleana Bioss. (**Fig. 1**) Cactus spurge (English), Siudi (Local, Nepali), Snuhi (Sanskrit), *Euphorbiaceae*.
Indigenous uses: Stem latex is used in joint pain/leg pain.
Principal chemical compounds: Amyrin, campesterol, cycloroylenol, diterpene, ellagic acid, ingenol, luepol, octacosanol, phenolics, sitosterol, stigmasterol, succinic acid, taraxerol, terpenes, tetracosanol (Husain *et al*. 1992).
Pharmacological uses: Ethanolic plant extract shows anti-inflammatory (Amatya 1994) and latex reveals anti-arthritic activities (Bani *et al*. 1996).

Ricinus communis L. Castor bean (English), Indeya (Local), Arandi (Nepali), Eranda (Sanskrit), *Euphorbiaceae*.
Indigenous uses: Root juice is analgesic and seed is used in constipation.
Principal chemical compounds: Avenasterol, avercetin, β-amarin, brassicastrol, campesterol, carotene, casbene, chlorogenic acid, coumarin, ellagic acid, haemaglutinin, lupeol, lectin, linolenic, palmitic acid, phenolics, quinic acid, ricinin, ricin, ricinoleic acid, stearic acid, sitosterol, stigmasterol, tannins, terpene, vitamins B6, B1 (Cambie and Ash 1994; Singh 1986).
Pharmacological uses: Plant is diuretic, larvicidal, anticholestatic, antiamoebic, analgesic, estrogenic, laxative, cytotoxic, arbortifacient (Singh 1986; Desta 1993) and antimycotic (Rai 1996) and its seed is hepatoprotective (Reddy *et al*. 1993) and antidote for scorpion sting. Phenolics are antiseptic and anti-inflammatory when taken internally (Banerjee *et al*. 1991; Sharma 2004).

Bauhinia vahlii Wight & Arn. Camel's foot climber (English), Malu (Local), Bhorla (Nepali), Murva (Sanskrit), *Fabaceae*.
Indigenous uses: Bark is used in cuts, wounds, sprain and fracture. Root is tonic.
Principal chemical compounds: Agathisflavone, betulinic acid, campesterol, kaemferol, quercetin, sitosterol, stigmasterol (Husain *et al*. 1992).
Pharmacological uses: Methanolic extract of the plant possesses activity against herpes simplex virus (Taylor *et al*. 1996). Quercetin is effective in reducing infectivity (Cowan 1999). Betulinic acid is anti-inflammatory (Mukherjee *et al*. 1997).

Caesalpinia decapetala (Roth.) Alston. Black bonduc, Fever nut (English), Ulto Kanda (Nepali), Lata karanja (Sanskrit), *Fabaceae*.
Indigenous uses: Bark is poisonous and used in fish poisoning.
Principal chemical compounds: Braziline, caesalpine, heptocosan, sitosteroide, etc. (Datte *et al.* 2004)
Pharmacological uses: Fruit extract shows inhibitory effect against *Candida albicans* (Kumar *et al*. 2006) and anthelmintic effect (Datte *et al*. 2004), however failure reports on inhibition had also been noted (Rai 1996).

Cassia tora (L.) Roxb. Sickle pod (English), Tinkosi, Chakramandi (Local), Tapre (Nepali), Ayadham, Chakramardha (Sanskrit), *Fabaceae*.
Indigenous uses: Plant relieves bronchitis and its juice is anthelmintic and antiseptic.
Principal chemical compounds: Anthraquinones, cassiaside, chrysophanol, emodin, obtusifolin, rubrofusarin, toralactone, torachrysone, toralactone (Buckingham 1994).
Pharmacological uses: Plant seed extract is antibacterial, anticoagulant, antifungal, hepatoprotective (Mukherjee *et al*. 1995). Alcoholic extract of seeds exhibited hypoglycemic effect (Simon *et al*. 1987; Rao *et al*. 1994). Methanolic extract of seeds insignificantly inhibits leukotriene, which causes pain, inflammation and broncho-muscular constriction (Kumar and Muller 1999). Anthraquinones contracts intestinal walls and stimulate bowel movement and make stool loose (Sharma 2004).

Entada pursaetha DC. Mackay bean, Ladynut (English), Pangar (Local, Nepali), Kakavali, Gilagaccha (Sanskrit), *Fabaceae*.
Indigenous uses: Fruits are used in cuts and wounds, and body pain.
Principal chemical compounds: Entadamide, entanin, myristic acid, palmitic acid, phaseoloidin, phenylacetic acid, prosapognine, thionine, threonine, tryptophan (Buckingham 1994; Joshi 2004).
Pharmacological uses: Seed saponin is spasmolytic and central nervous system active (Chandel *et al*. 1996). Entanin is an antitumor saponin. Saponins have strong haemolytic action and depressant effect (Joshi 2004).

Milletia extensa (Benth.) Baker Milletia (English), Gaujo (Nepali), *Fabaceae*.
Indigenous uses: Root is useful as insecticide and piscicide.
Principal chemical compounds: Auriculatin, aurimillone, iso-flavones, miletin, sumatrol (Husain *et al*. 1992).
Pharmacological uses: Milletia have chemoprotective (Shirwaikar *et al*. 2003), antipyretic (Srinivasan *et al*. 2003), anti-inflammatory (Yankep *et al*. 2003) and cytotoxic properties (Ito *et al*. 2004). Leaf methanolic extract showed antimycobacterial activity (Taylor *et al*. 1996).

Mimosa pudica L. Sensitive plant (English), Lajjabati (Nepali), Lajja, Saptaparni (Sanskrit), *Fabaceae*.
Indigenous uses: Leaves are used in skin diseases.
Principal chemical compounds: Amino acid, amyrin, crocetin, β-sitosterol, friedelin, gentisic acid, jasmenic acid, mimosine, nor-epinephrine, pinitol, sitosterol (Husain *et al*. 1992; Cambie and Ash 1994; Joshi 2004).
Pharmacological uses: Plant juice is used as antiviral, anti-

bacterial, anti-inflammatory, antispasmodic, diuretic (Singh 1986).

#Sophora mollis (Grah. ex Royle) Himalayan laburnum (English), Chunnjado (Nepali), *Fabaceae*.
Indigenous uses: Roots are taken for rheumatism, and cold.
Principal chemical compounds: Cystine, matrine, rutin, etc.
Pharmacological uses: Matrine is anti-inflammatory, anti-diarrhoeal, analgesic and antotumorous, and it inhibits liver fibrosis (Tan and Zhang 1985; Zhang *et al*. 2001) and reduces body weight (Cheng *et al.* 2006). Rutin, a flavonoid protects heart (Chopra and Singh 1994), relieves acute and chronic inflammations (Lee *et al*. 2000) and strengthens capillary walls (Sharma 2004).

#Didymocarpus villosa D.Don. Kumkum dhup (Nepali), *Gesneriaceae*.
Indigenous uses: Leaf infusion and dust are useful in respiratory problem of children and chronic asthma.
Principal chemical compounds: Anthraquinone, chalcone, didymocalyxin, isoflavone, onyselin, pedicinin (Segaw *et al*. 1999).
Pharmacological uses: Plant oil is weak antimicrobial (Chandel *et al*. 1996). Plant is also affirmative in body weight reduction (Rao *et al.* 1999).

****Morchella esculenta*** (L.) Pers. Morel mushroom (English), Mathyaura (Local), Guchhi chyau (Nepali), *Helvellaceae*.
Indigenous uses: Plant stalk and cap are aphrodisiac in properties and used as tonic and immunostimulant.
Principal chemical compounds: Amino acid, carotene, protein, saponins (Zheng *et al*. 1998).
Pharmacological uses: Methanolic extract of plants inhibits leukotriene, which causes pain, inflammation and broncho-muscular constriction (Kumar *et al*. 2000).

Colebrookea oppositifolia Sm. Bedmauri (Local), Dhursool (Nepali), *Lamiaceae*.
Indigenous uses: Leaf juice is taken for skin disease.
Principal chemical compounds: Chrysin, flavonene, ladanein, negletein, sitosterol, triacontane, triacontalol (Husain *et al*. 1992; Yang *et al*. 1996).
Pharmacological uses: Ethanolic root extract is central nervous system active (Chandel *et al*. 1996).

#Leea indica (Burm. f.) Merr. Galeno (Nepali), Kakanasika (Sanskrit), *Leeaceae*.
Indigenous uses: Leaf is useful in spleen problems. Young leaves are digestive.
Principal chemical compounds: Eicosanol, farnesol, gallic acid, leeaoside, lupeol, palmitic acid, phthalic acid, sitosterol, solanesol, ursolic acid (Srinivasan *et al*. 2008).
Pharmacological uses: The methanolic extract of L. indica was reported to possess strong antioxidant and nitric oxide inhibitory activities (Saha *et al*. 2004) and it was due to gallic acid, a well known antioxidant compound (Srinivasan *et al.* 2008). Plant extract is antiviral and anticancer in properties (Jain *et al*. 1991).

#Melia azedarach L. Bead tree, Persean lilac (English), Bakaino (Local, Nepali), Mahanimba (Sanskrit), *Meliaceae*.
Indigenous uses: Bark and leaf juice is useful in spleen disorders.
Principal chemical compounds: Azaridin, azadirachtin, bakalactone, bakayanin, benzoic acid, deacetylsalanin, dihydronimocinol, fraxinellone, quercetin, meliacarpinin, meliacine, meliotannic acid, melazolide, nimbolinin, rutin, salanin, salannal, vilasinin (Husasain *et al*. 1992; Watanabe *et al*. 2005).
Pharmacological uses: The extract of leaf suppresses nitric oxide (NO) synthesis, since increased NO production is associated with acute and chronic inflammation (Lee *et al*. 2000) and it is antioxidant (Virgili *et al*. 1998). Methanol extract of root, stem bark and leaves showed a broad spectrum of antibacterial activity (Khan *et al*. 2001). Meliacine can be used as a therapeutic agent against HSV-1 ocular infection (Petrera and Coto 2003).

****Psidium guajava*** L. Guava (English), Ambak (Local), Amba, Belauti (Nepali), Amratphala, Peruk, Mamsala (Sanskrit), *Myrtaceae*.
Indigenous uses: Fruit is laxative, colic, astringent to bowls and beneficial to constipation.
Principal chemical compounds: Amritoside, arjunolic acid, asiatic acid, brahmic acid, daucosterol, ellagic acid, eugenol, gallic acid, guavin, isostrictin, latechin, lupol, maslinic acid, pedunculagin, procyanidin, quaverin, quercetin, oleanolic acid, strictinin trans-cinnamic acid, ursolic acid, zeatin (Buckingham 1994; Cambie and Ash 1994).
Pharmacological uses: Leaves are antidiabetic due to pedunculagin, and are antibacterial, antimycobacterial, antifungal, antimalarial, analgesic, anti-inflammatory (Suksamrarn *et al*. 2002), antidiarrhoeal, anticough, antiamoebic, muscle relaxant, hypoglycaemic (Cambie and Ash 1994; Lozoya *et al*. 1994; Tona *et al*. 1999; Antoun *et al*. 2001).

#Dactylorhiza hatagirea (D.Don) Soo. Marsh orchid, Salep (English), Hathajadi (Local), Panchaunle (Nepali), Salammisri, Munjatak (Sanskrit), *Orchidaceae*.
Indigenous uses: Root juice is taken in cuts and wounds.
Principal chemical compounds: Albumin, butanedic acid, dactylorhizin, hydroquinone, lesoglossin, militarrin, pyranoside, pyrocatechol, volatile oil (Kizu *et al*. 1999).
Pharmacological uses: The decoction and plant extract with sugar are useful in pierce, cuttings, wounds, and the plant is tonic and aphrodisiac (Thakur and Dixit 2007).

****Oxalis corniculata*** L. Creeping sorrel (English), Chalmaro (Local), Chari amilo (Nepali), Changeri, Amla patrika (Sanskrit), *Oxalidaceae*.
Indigenous uses: Leaves are stomachic and useful for throat pain.
Principal chemical compounds: Carotene, citric acid, eugenol, glycoxylic acid, malic acid, pentylfuran, pyruvic acid, tartaric acid, tocopherols, votexin, etc. (Ayyanar and Ignacimuthu 2005).
Pharmacological uses: The plant is antihypertensive, hypoglycemic, uterine relaxant, muscle relaxant and rich source of Vitamin B (Cambie and Ash 1994). Eugenol is considered a bacteriostatic and fungistatic (Duke 1985). Alcoholic leaf extract is antibacterial (Joshi 2004).

****Plantago major*** L. Blond psyllium (English), Ishabgol (Nepali), Ashvagola, Snigdhabija (Sanskrit), *Plantaginaceae*.
Indigenous uses: Plant seeds are useful in diarrhea, dysentery and indigestion.
Principal chemical compounds: Apigenin, ascorbic acid, aucubin, baicalein, benzoic acid, caffeic acid, catalpol, chlorogenic acid, cinnamic acid, papa-coumaric acid, ferulic acid, hispidulin, loliolide, luteolin, majoroside, nepetin, plantagonine, planteose, scutellarein, syringic acid, vannillic acid, vitamin A (McCutcheon *et al*. 1992).
Pharmacological uses: Root and seed extract is antibacterial, anti-inflammatory, antiviral, antitumor, hypotensive, oestrogenic, wound healer, kidney stone disintegration, diuretic (McCutcheon *et al*. 1992). Ethanolic root extract show little inhibitory effect of human tumor cell growth (Whelan and Ryan 2003). Caffeic acid is effective against viruses, bacteria and fungi (Brantner *et al*. 1996). Seeds are useful in diarrhea and amoebic dysentery (Sharma 2004).

Cynodon dactylon (L.) Pers. Bermuda, Dog's teeth grass (English), Dubi (Local), Dubo (Nepali), Durva (Sanskrit), *Poaceae*.
Indigenous uses: Plant paste is effective on sprain. Inflorescence is grinded with water and applied for earache.
Principal chemical compounds: Coumarin, ferulic acid, phytol, stigmasterol, syringic acid, tricin, vanilic acid

(Husain *et al*. 1992).
Pharmacological uses: Rhizome juice possesses antiviral property (Foster and Duke 2000). The aqueous extract of Cynodon dactylon has high antidiabetic potential along with significant hypoglycemic and hypolipidemic effects (Singh *et al*. 2007). The aqueous plant extract is used as anti-inflammatory, diuretic, anti-emetic and purifying agent (Ahmed *et al*. 1994) and used in treating dysentery, dropsy and secondary syphilis (Chopra and Handa 1982). The ethanolic extracts of the plant showed antioxidant activity (Auddy *et al*. 2003).

Imperata cylindrica (L.) Beauvois. Cogon grass (English), Siru (Local, Nepali), Sarba (Sanskrit). *Poaceae*.
Indigenous uses: Rhizome paste is applied for urinary problems.
Principal chemical compounds: Arundoin, chromone, cylindrene, cylindol, fernenol, flidersiachromone, graminone, imperanene (Matsunaga *et al*. 1995; Yoon *et al*. 2006).
Pharmacological uses: Rhizome extracts possessed insignificant hypoglycaemic effect (Villasenor and Lamadrid 2006), weak antibacterial activity (Risal 1994) and decreased the urine volume (Kanchanapee 1966; Sripanidkulchai *et al*. 2001). Imperanene showed inhibitory activity on platelet aggregation (Matsunaga *et al*. 1995) and chromone is neuroprotective (Yoon *et al*. 2006).

Rumex nepalensis Spreng. Sheep sorrel (English), Ban haldi (Local), Halhale (Nepali), Amlavetasa (Sanskrit), *Polygonaceae*.
Indigenous uses: Root extract is applied in joint pain and paralysis.
Principal chemical compounds: Anthraquinones, chrysophanol, emodin, lupeol, musizin (nepodin), orientalone, physcion, sitosterol, tannins (Husain *et al*. 1992).
Pharmacological uses: Methanol extract significantly possesses the hypotensive effect and shows the property of muscle relaxant and tranquilizer (Murugesan *et al*. 1999; Ghosh *et al*. 2002). Tannins draw the tissues closer and improve the resistance to infection (Sharma 2004).

Thalictrum cultratum Wall. Meadow rue (English), Peljadi (Local), Dampate (Nepali), Peet ranga (Sanskrit), *Ranunculaceae*.
Indigenous uses: Root juice is commonly used in stomacheache and dysentery.
Principal chemical compounds: Berberine, diterpene, jatrorhijine, magnoflorine, palmatine, thalictrine (Husain *et al*. 1992).
Pharmacological uses: Root extract is antiperiodic, diuretic, purgative (Chauhan 1999) and antimicrobial (Omulokoli *et al*. 1997; Schmeller *et al*. 1997; Iwasa *et al*. 1998). Berberine is antibacterial and antimalarial (Yamamoto *et al*. 1993) and Thalictrine has inhibitory effect on lymphoma, sarcolymphoma and hepatoma (Jain *et al*. 1991).

Agrimonia pilosa (D.Don) Nakai. Hairy agrimony, Couch grass (English), Kathlange (Nepali), *Rosaceae*.
Indigenous uses: Plant is used to cure dysentery and root juice is used as antidote for snake bite.
Principal chemical compounds: Agrimonolides, agrimophol, apigenin, coumarins, ellagic acid, flavonoides, luteolin, phenylpropanoides, quercetin, pilosanol, pyranoside, triterpenes, tormentic acid (Kimura *et al*. 1995).
Pharmacological uses: Antitumor, bacteriostatic, antiyeast, antidysenteric (Kimura *et al*. 1996, Peter 1969). Triterpenes show antitumor and expectorant properties (Sharma 2004). Ellagic acid is antimutagenic (Kaur *et al.* 1997) and antimicrobial (Gyamfi and Aniya 2002). Luteolin has better antiviral activity against Respiratory syncytial virus (RSV) (Ma *et al*. 2002). RSV is a major cause of pneumonia and bronchiolitis in infants, in young children, and even in adults. Luteolin demonstrates anti-inflammatory effect (Park *et al*. 2001; Panthong *et al*. 2007). Luteolin and quercetin inhibit proliferation of cancer cells (Elangovan *et al.* 1994).

Rubus ellipticus Sm. Golden raspberry (English), Ainselu (Nepali), Gauriphala (Sanskrit), *Rosaceae*.
Indigenous uses: Root juice is given for relieving fever and diarrhoea and dysentery.
Principal chemical compounds: Amyrin, arjunetin, rosamultin (Bilia *et al*. 1994)
Pharmacological uses: Antiimplantation and early abortifacient activities of *Rubus ellipticus* were denoted (Dhanabal *et al*. 2000).

Anthocephalus chinensis (Lam.) A. Rich. ex Walp. Wild cinchona (English), Kadam (Nepali), Kadamba (Sanskrit), *Rubiaceae*.
Indigenous uses: Fruits are used in urinary problems.
Principal chemical compounds: Cadambine, dihydrocadambine, geraniol, linalool, linalylacetate, nonanol, phellandrene, saponins, sitosterol, selinine (Husain *et al*. 1992).
Pharmacological uses: Bark extract is astringent and useful in snake bite poison (Yusuf *et al*. 1994). Linalool exhibits significant antimutagenic and antioxidative properties (Deans *et al.* 1993; Stevic *et al.* 2004).

Citrus medica L. Adam's apple, Citron (English), Bimiro (Nepali), Mahulunga (Sanskrit), *Rutaceae*.
Indigenous uses: Leaf is antipyretic and used as insect or pest repellant.
Principal chemical compounds: Aureusilin, bergamotene, caffeine, grandmarin, hesperidine, kinocoumarin, limonene, lumbelliferone, nomilinic acid, resveratrol, rutaevin, theophylline, xanthyletin (Buckingham 1994; Kretschmar and Baumann 1999; Govindachari *et al*. 2000).
Pharmacological uses: Leaf extract is useful in fever and febrile illnesses (Ajaiyeoba *et al*. 2003). Peel is aromatic and tonic (Font Quer 1992). Seeds, leaves and fruit pulp have anticancer property due to their limonin content (Tian *et al*. 2001; Arias and Laca 2005). Oil from leaves possesses antibacterial property (Limyati and Juniar 1998).

Osyris wightiana Wall. Wild tea (English), Nundhikya (Local), Jhuri, Nundhiki (Nepali), *Santalaceae*.
Indigenous uses: Bark infusion is given to stop bleeding. Leaf and bark decoction is used in sprains and fractures.
Principal chemical compounds: Lanceol, proline, tannins, etc. (Chandel *et al.* 1996)
Pharmacological uses: Leaf extracts possess antiviral activity (Chandel *et al*. 1996). Tea made from the leaves of *O. wightiana* stimulated the flow of breast milk and also acted as a labor-inducing agent (Osujih 1993).

Aesandra butyracea (Roxb.) Baehni. Butter tree (English), Chiura (Local), Chiuri (Nepali), *Sapotaceae*.
Indigenous uses: Oil cake is used to escape out snake, and it can be used as fish poisoning. Oil or ghee is taken to cure cracked heels and lips. Root juice is useful in dysentery.
Principal chemical compounds: Betulinic acid, friedelin, hentriacontane, linoleic acid, oleanic acid, palmitine, protobasic acid, quercetin, rhamnoside, stearic acid, sitosterol (Husain *et al*. 1992; Bhattacharjee *et al*. 2002).
Pharmacological uses: Betulin and quercetin of Butter tree are anti-infectivity (Cowan 1999) and anti-inflammatory in properties (Mukherjee *et al*. 1997).

Astilbe rivularis Buch.-Ham. ex D.Don. Astilbe (English), Sutkeribelo (Local), Thulo okhati, Budho okhato (Nepali), *Saxifragaceae*.
Indigenous uses: Root juice is used for easy delivery and control bleeding during child birth. It is valued for diarrhoea, dysentery and hemorrhage.
Principal chemical compounds: Aesculatin, astilbic acid, astilbin, aticoside, bergenin, dimethylaesculatin, daucosterol, eucryphin, palmitine, peltoboykinoleic acid, scopoletin, sitosterol, stilbene (Jain *et al*. 1991; Buckingham 1994).
Pharmacological uses: Pharmacological experiments indi-

cated the extracts from Astilbe chinensis had antineoplastic and immunopotentiating activities (Chen *et al*. 1996). Dried rhizome is used as substitute drug for Shengma (Han *et al*. 1998). Astilbic acid is beneficial in regulating various inflammatory processes (Moon *et al*. 2005).

Urtica dioica L. (**Fig. 1**) Stinging nettle (English), Sisnu (Local, Nepali), Agni damani (Sanskrit), *Urticaceae*.
Indigenous uses: Stem is valued for sprain and fractures. Root juice is given for gastric problems and maintaining blood pressure.
Principal chemical compounds: Acetylcholine, betaine, choline, flavonoides, histamine, linoleic acid, oleic acid, palmitic acid, plastoquinone (Husain *et al*. 1992).
Pharmacological uses: The aqueous extract has antihyperglycaemic effect (Bnouham *et al*. 2003; Farzami *et al*. 2003), and it is also a good antioxidant (Pieroni *et al*. 2002), hepatoprotective (Lebedev *et al*. 2001), analgesic (Gulcin *et al*. 2004), antiviral (Manganelli *et al*. 2005), diuretic and hypotensive in properties (Tahri *et al*. 2000; Testai *et al*. 2002). Flavonoides shows the anti-aggregant property (Mekhfi *et al*. 2004).

#Callicarpa arborea Roxb. Urn fruit, Beauty berry (English), Gotmelo (Local), Dahikamlo (Nepali), Gandhaphali (Sanskrit), *Verbenaceae*.
Indigenous uses: Fruits are edible and help in indigestion.
Principal chemical compounds: Amyrin, apigenin, astilbin, beta sitosterol, calliterpenone, cartegolic acid, luteolin, maslinic acid, oleanoic acid, oleanolic acid, sitosterol, ursoleic acid (Husain *et al*. 1992).
Pharmacological uses: Luteolin has antiviral (Cheng Ma *et al*. 2002) and anti-inflammatory effects (Park *et al*. 2001; Panthong *et al*. 2007). Along with quercetin, luteolin inhibits cancer cell proliferation (Elangovan *et al.* 1994).

Viscum album L. Mistletoe, Devil's fuge (English), Hadchur (Local), Ainjeru (Nepali), *Viscaceae*.
Indigenous uses: Plant is used in fractures and sprains.
Principal chemical compounds: β-sitosterol, caffeic acid, dimethoxyflavone, eleutheroside, flavonoides, glycoproteins, kaemferol, lectin, oleanic acid, pectin, quercetin, syringin, triterpene, ursolic acid (Husain *et al*. 1992; Ergun and Deliorman 1995; Lyu *et al*. 2000; Deliorman *et al*. 2005).
Pharmacological uses: Immuno-regulatory, diuretic, antibacterial, antiviral, inhibits cell proliferation (Yoon *et al*. 1999), diuretic, anti-inflammatory as well as immunostimulant effects (Yesilada *et al*. 1998). The extract produces antihypertensive (Ofem *et al*. 2007) and antioxidant effect (Ucar *et al*. 2006).

Cissus repens Lam. Wild grape (English), Pureni (Nepali), Asthisamharaka (Sanskrit), *Vitaceae*.
Indigenous uses: Stem juice is useful in eye redness.
Principal chemical compounds: β-sitosterol, luteolin, piceatannol, pallidol perthenocissin, resveratrol (Adesanya *et al*. 1999; Gupta and Verma 1991).
Pharmacological uses: Pharmacological studies revealed the bone fracture healing property (Chopra *et al*. 1976; Deka *et al*. 1994) and antiosteoporotic effect (Shirwaikar *et al*. 2003). Murthy *et al*. (2003) reported the antibacterial and antioxidant activities of the extract. Plant demonstrates anti-inflammatory effect (Singh *et al*. 1984) due to β-sitosterol and luteolin of the plant (Park *et al*. 2001; Panthong *et al*. 2007).

DISCUSSION

Traditional medical systems

Prehistoric uses of medicinal plants as therapy for illness in farwest Nepal has been investigated in present study. Traditional therapies abound in nearby medicinal plants (Bhattarai *et al.* 2010), and the tribal people/ethnic groups, wherever they exist, chiefly rely on herbal medicines. Traditional medicines are conferred in ancient, natural health care practices such as folk/tribal practices, home herbal remedy, Baidhya, Ayurveda and Amchi healing systems. Folk-lore medicine, home herbal remedy and Baidhya practices are indigenous to farwest Nepal and are partly influenced by the Ayurveda (Kunwar and Bussmann 2008). Baidhyas are traditional herbalists of far western Nepal (Bhattarai 1992) and adjoining areas of India (Kala 2005) and they pursue their remedies to cure diseases and aliments, taking advantage of the abundance of nearby medicinal plants. Amchi healing system is widely accepted and practiced throughout high altitude areas (Kunwar *et al*. 2006) and the Darchula district is particularly influenced, albeit with varying degrees of modifications (Lama *et al*. 2001). All these traditional medicinal systems are popular with a long tradition in the use of medicinal plants (Uprety *et al.* 2010) and they are due to easy and open access, availability and cheaper in use (Shale *et al*. 1999; Kunwar and Bussmann 2008). Ayurveda is most important in bio-prospecting of new medicines (Patwardhan *et al*. 2005) in among. Consequently, acceptance of the Ayurveda is gearing up (Kunwar *et al*. 2009).

The traditional therapies have played vital roles in health care delivery systems especially in high hills and remote areas of study districts where clinics and hospitals are absent or sparsely located. Moreover the extensive usage of traditional therapies is due to high cost of western pharmaceuticals and healthcare. Inadequate modern medical facilities (Sherpa 2001) and government subsidies, and intensive uses of plants (Bussmann and Sharon 2006) also made home herbal remedies pertinent in the Himalayas. Modern medicines are also difficult to find (Manandhar 2002) when needed particularly in the Himalayas due to complex geomorphology. Such situation consents to the data where there is one traditional healer for less than 100 people (Gillam 1989) and one physician for 6,000-20,000 people (WRI 2005, Pradhan 2007).

Since the apposite of traditional therapies, the role of natural products and herbal medicine is being increasingly appreciated (Cragg *et al*. 1997) in recent years. The therapies mostly using plants and plant products of western Nepal incorporate ancient beliefs and are passed down from generations to generations by oral tradition and/or guarded literatures (Bhattarai 1997; Kunwar and Bussmann 2008). This study shows that information obtained from traditional healers and local herbal medicine practitioners can support to renew and increase in use of herbal medicines and discovery of therapeutically useful agents and *vice versa*. However, changing perception of local people, acculturation, commercialization and socio-economic transformations have jeopardized the indigenous knowledge of phytotherapies. Furthermore, some tribal therapies were not supported by systematic ethnopharmacological findings. Therefore validity assessment of indigenous therapies of plant resources base received greater attention.

Validity analysis

We compared the traditional and modern pharmacological uses of 48 medicinal plant species commonly used in folklore of farwest Nepal. The species represented from 34 families and 34 genera. Families Fabaceae and Asteraceae contributed the most and provided 7 and 6 species respectively. Euphorbiaceae and Rutaceae families possessed the most contribution in earlier study (Kunwar *et al*. 2009) and moderate contribution in present study, rendered two and one species respectively. Among the surveyed 48 species in the present study, 15 species possessed weak analogy or their indigenous uses were differed to the pharmacological findings. It was may be due to knowledge distortion. Changing perception of local people, commercialization and socio-economic transformations are prevalent in study area (Kunwar *et al.* 2010) and they contributed misleading situations to the traditional therapies. Moreover, younger generations were uninterested on traditional thera-

pies. The situation was also provoked due to research limitations and diverse resource users. As a result, essence of ethnopharmacological surveys and cross-referencing approaches on those species revealing trivial affinities is warranted. Misled of indigenous knowledge and use of ethnomedicine out of the experience or ignorance and willful deception may deviate knowledge out of standard and ultimate cause illness and even fatal (Zhao *et al*. 2006; Kumar 2007).

Approximately 68% (33) species used in indigenous medicine of the present study demonstrated some analogous effects and the 23 species (48%) bestowed the strong supports. This fair corroboration of pharmacological activity gives the claims by traditional healers a significantly high credibility and such similar conceivable remarks were also observed in abroad by Marles and Farnsworth (1995), Chandel *et al*. (1996), Hamza *et al*. (2006) and Gautam *et al*. (2007). These results substantiated the importance of surveys of indigenous knowledge of utilization plant resources for screening plants as a potential source for bioactive compounds. Hence ethnomedicine and ethnopharmacology could result in discovery of novel constituents because they are developed through long trial and error operations (Rijal 2008).

Strong affinities between indigenous and pharmacological findings

There were two species: *Euphorbia royleana* and *Ricinus communis* from Euphorbiaceae exhibited strong ethnopharmacological properties in present study. Ethnopharmacological usage of latex of *Euphorbia royleana* for joint/leg pain is supported by phytochemical investigations: ethanolic extracts of plant latex has anti-arthritic activities (Bani *et al*. 1996). Root juice of *Ricinus communis* is indigenously taken as analgesic and antidiarrhoeic in study area resembled to the findings of pharmacology where plant possessed anticholestatic, antiamoebic, analgesic, arbortifacient, estrogenic (Singh 1986; Desta 1993), antiseptic and anti-inflammatory effects when taken internally; are due to phenolics (Sharma 2004). The phenolic acid of the plant acts as cholagogues, stomach refresher, and immuno-stimulants, as well as anti-tumor, antioxidant, antibacterial, and antifungal agents (Hamauzu *et al*. 2005; Mishima *et al*. 2005). Ricinoleic acid, an active component of castor oil causes irritation and inflammation to the intestinal mucosa, results an increase in the net secretion of water and electrolytes into the small intestine (Pierce *et al*. 1971; Luderer *et al*. 1980) and induces diarrhea (Gaginella *et al*. 1975). Euphorbiaceae that is rich in active compounds including terpenoids, alkaloids, phenolics and fatty acids, having various ethnopharmaceutical uses (Rizk 1987). Terpenenes are active against bacteria (Kubo *et al*. 1992; Habtemarium *et al*. 1993), fungi (Taylor *et al*. 1996; Rana *et al*. 1997), viruses (Fujioka and Kashiwada 1994), and protozoa (Vishawakarma 1990).

Root juice of *Cirsium verutum* (Asteraceae) is ethnopharmacologically applied for stomachache and abdominal pain, and the use is coincided to biological activity of terpenes. Plant is rich in cicin, glycerol, sterols and terpenes (Lee *et al*. 2002) and its uses as antimicrobial (Lee *et al*. 2002; Barbour *et al*. 2004) supports the folklore. Topical anti-inflammatory properties of *Xanthium strumarium* (Asteraceae) fruits (Han *et al.* 2007) supports the use of plants' seeds and fruits for treatment of inflammatory diseases in folk medicine. The natural xanthones showed good inhibitory activity against pathogenic fungi (Gopalakrishnan 1997). Juice from the plant *Drymaria diandra* is used to treat coughs, fever and eye disease (conjunctivitis) (Manandhar 1990), which could all possibly be caused by bacteriostatic properties (Mukherjee *et al*. 1997). The methanolic extract of *Drymaria diandra* was active against Gram-positive bacteria. Various researches have already shown that Gram positive bacteria are more susceptible towards plant extracts as compared to Gram negative bacteria (Lin *et al*. 1999; Parekh and Chanda 2006). Gram-negative bacteria are multilayered in structure and more resistant (Yao and Moellering 1995).

Diterpenoid alkaloids, commonly isolated from the plants of Ranunculaceae family, are commonly found to have antimicrobial properties (Omulokoli *et al*. 1997). Root juice of *Thalictrum cultratum* (Ranunculaceae) commonly used in stomachache and dysentery in study area is affirmative to the *in vitro* antimicrobial properties. Berberine, a benzylisoquinoline alkaloid, acted as an antibacterial and antimalarial drug (Yamamoto *et al*. 1993), is a principal chemical constituent of *T. cultratum*. Berberine shows strong antimicrobial activity to both Gram-positive and -negative bacteria as well as to other microorganisms (Schmeller *et al*. 1997; Iwasa *et al*. 1998). It is potentially effective against trypanosomes (Frieburghaus *et al*. 1996) and plasmodia (Omulokoli *et al*. 1997). Ethanol extract of root of *Angelica archangelica* (Apiaceae) also shows resistant to the trypanosomes (Schinella *et al*. 2002). Dried roots of *Angelica* are anthelminthic and useful in gastritis and stomacheache in the study area.

Root juice or raw roots of *Astilbe rivularis* (Rosaceae) are consumed for easy delivery and control bleeding during child birth. Because of its effects, it is called as *sutkeribelo* in local dialect i.e. plant is useful in parturition for easy delivery and controlling bleed. Because of its astilbic acid, it is beneficial in regulating various inflammatory processes (Moon *et al*. 2005). Stilbene and asiaticoside from *Astilbe* rhizomes have wound healing properties (Gomathi *et al*. 2003; Kapoor *et al*. 2004) and accentuate burn and wound healing. Furthermore, astilbin and bergenin are effective in treatment of obesity (Han *et al*. 1998). Astilbin has anti-arthritic and antiallergy effects (Cai *et al*. 2003) and Bergenin, an isocoumarin prevents arrhythmia, liver injury (Pu *et al*. 2002), and gastric troubles (Goel *et al*. 1997). Scopolamine (hyosine) of *Astilbe* rhizomes is used as analgesic (Yamamoto *et al*. 1993; Iwasa *et al*. 1998) and is tranquilizer in property (Duke 1992).

We observed anti-arthritic and anti-paralytic effects of plant juice of *Rumex nepalensis* (Polygonaceae). Tannin from *Rumex nepalensis* (Polygonaceae) draws tissues together and improves their resistance to infections (Sharma 2004). Polygonaceae is also widely used as anthelmintic due to its anthraquinones (Midiwo *et al.* 1994). *R. nepalensis* is also persuaded as antipyretic (Suresh *et al*. 1994) and its lupeol and its derivatives regulate genito-urinary systems (Anand *et al*. 1995). *Coriaria nepalensis* (Coriariaceae) contains tannins and ursolic acid as main constituents. Tannin is antinflammatory, muscle relaxant, analgesic, etc. (Sharma *et al.* 1978; Cambie and Ash 1994) and ursolic acid shows hepatoprotective (Saraswat *et al*. 1996) and anti-tumor properties (Bilia *et al*. 2004). Tannin cures and prevents variety of illness (Scortichini and Rossi 1991; Haslam 1996). In folklore, *Coriaria* bark is applied on burns and scalds and it is coincided to its anti-inflammatory, analgesic, antibacterial, muscle relaxant and antimicrobial properties (Joshi and Bhatta 1999).

It is well known that *Plantago major* (Plantaginaceae) has demonstrated antineoplastic activity against cancer of the breast, anus, stomach, eye, foot, intestine and liver, and against neuroblastoma cancer (Duke 1985). *P. major* contains caffeic acid which is effective against viruses, bacteria and fungi (Brantner *et al*. 1996). Plant seeds are used in indigestion and dysentery as ethnomedicine. Ethnomedicinal use was beneficial due to its antibacterial and antiviral properties of caffeic acid. *Ageratum conyzoides* and *Viscum album* also contain caffeic acid. Caffeic acid, coumarins and tannins of *A. conyzoides* (Asteraceae) possess antibacterial (Mahato and Chaudhary 2005), anthelmintic, anti-inflammatory, analgesic (Hedberg *et al*. 1983; Namba *et al*. 1988; Tandon *et al.* 1994) and anticoagulant and muscle relaxant (Cambie and Ash 1994) effects. Anti-inflammatory activity was also shown by sterols, especially stigmasterol (Garcia *et al.* 1999). Coumarin of *A. conyzoides* is a potential insecticide (Kamboj and Saluja 2008). Folk use of stem juice of *A. conyzoides* as bleeding control was supported by haemo-

static (Akah 1988) and antibacterial (Mahato and Chaudhary 2005) effects. Plants' use as bleeding control could be a part of further research because the juice of plant is extensively used in cuts, wounds and bleeding control in western Nepal (Bhattarai 1993; Manandhar 1998; Joshi and Joshi 2000).

Agrimonia pilosa (Rosaceae) is indigenously used to cure dysentery and its root juice is taken as antidote for snake bite. The purport of indigenous uses was substantiated by pharmacological findings, *A. pilosa* plant extract and its active constituent the coumarin act as bacteriostatic, antiyeast and antidysenteric, etc. (Peter 1969; Kimura *et al*. 1996). Coumarin also act as antithrombotic (Thastrup *et al*. 1985), anti-inflammatory (Piller 1975), and vasodilatory (Namba *et al*. 1988). Ellagic acid of the plant is antimicrobial (Gyamfi and Aniya 2002) and supports ethnopharmacology.

Antibacterial and antiviral properties of caffeic acid of *Viscum album* (Viscaceae) (Yoon *et al*. 1999) support its indigenous use for sprain and fracture. Leaf and fruit extracts of *V. album* possesses immunostimulant effects (Yesilada *et al*. 1998). *Viscum album*, *Psidium guajava* and *Coriaria nepalensis* species of present survey contains ursolic acid. Ursolic acid and its derivatives have shown a significant activity against P-388 and L-12 10 lymphocytic leukemia cells as well as human lung carcinoma (Bilia *et al*. 2004). These biological studies indicate that the antitumor activity of the plant could be due to presence of triterpenes. Eugenol, available in plant extract of *Psidium guajava* (Myrtaceae) and *Oxalis corniculata* (Oxalidaceae), was found as bacteriostatic and fungicidal (Thomson 1978) corroborates ethnopharmacological uses of *Psidium* fruits for constipation and colic. Gallic acid derivatives from *Psidium* fruits are more effective against both types of *Staphylococcus aureus* (Sato *et al*. 1997) and they show potent antimicrobial properties (Gyamfi and Aniya 2002). Pedunculagin of *P. guajava* is anti-inflammatory (Suksamrarn *et al*. 2002) in effects. In our observation, *O. corniculata* has been used to cure throat pain and mouth problems. The cure of aphthae might be due to eugenol and supplement of Vitamin B complex to quick healing and there by relieving of pain. The mechanism of action of these plants on aphthae is worth for further investigation.

The compounds like betalain alkaloids, phenolic acids, betain, oxalic acid, oleanolic acid, sitosterol, furanocoumarins and saponins may be responsible for anthelmintic activity of *Chenopodium album* (Chenopodiaceae) (Nicholas *et al*. 1955; Hegnauer 1989). The oil and infusion of plant leaves possess worth anthelmintic activity against gastrointestinal nematodes (MacDonald *et al*. 2004; Jabbar *et al*. 2007). Catechin, a flavonoid of *C. album* also exhibited antibacterial, antiviral and antimicrobial properties (Sakanaka *et al*. 1992; Vijaya *et al*. 1995; Borris 1996). The indigenous use of *C. album* species for constipation and indigestion is rational to its antibacterial, antiviral and antimicrobial properties.

Indigenous use of *Rhus* fruits decoction for diarrhea and dysentery concurred its antidiarrhoeal properties (Galvez *et al*. 1993; Su *et al*. 2000). Because, most naturally occurring flavonoids of plant show an antioxidant and antidiarrhoeal effects (Galvez *et al*. 1993; Thangpu and Yadav 2004), but some flavonoids are mutagenic in bacterial and mammalian systems (Mdee *et al*. 2003) and have antiviral and anti-inflammatory activities (Farnsworth 1966; Sharma 2004). Flavonoides, essential constituents of the cells of all higher plants (Brouillard and Cheminat 1988), play a major role in successful medical treatment of ancient times and their use has preserved till date (Dixon *et al.* 1998). *Rhus* species, widely distributed in the subtropical regions of the world and used medicinally in various ways, are rich in biflavonoids. Flavonoides along with sterols work as bioactive for diabetes (Rhemann and Zaman 1989; Patil *et al*. 2005). Plant extract of *Urtica dioica* (Urticaceae) also contains active flavonoides. Flavonoides pose anti-inflammatory, antibacterial and wound healing properties (Afolayan *et al*. 2008) and have shown to increase mucus secretion, prostaglandin synthesis and blood flow (Singh *et al.* 1998). *Urtica* stem is indigenously valued for sprain and fractures and its root juice is valued for gastric and blood pressure problems. Aqueous *U. dioica* plant extract control blood sugar level (Bnouham *et al*. 2003; Farzami *et al*. 2003), and it is a good antioxidant (Pieroni *et al*. 2002) and hypotensive (Tahri *et al*. 2000; Testai *et al*. 2002) due to flavonoids (Galvez *et al*. 1993). Antiviral, anti-inflammatory and anti-aggregant properties of flavonoides (Farnsworth 1966; Su *et al*. 2000; Mekhfi *et al*. 2004; Sharma 2004) of *U. dioica* are consistent to the folk uses.

Polysaccharide is one of the active components in *Cordyceps sinensis* (Clavicipitaceae) that has multiple pharmacological activities. It has high concentrations of adenosine, guanosine and uridine (Li *et al*. 2001) among these; adenosine is most worth in pharmacology. Adenosine has widespread effects on circulation of blood, cerebral and coronary (Berne 1980; Toda *et al*. 1982), prevention of cardiac arrhythmias (Pelleg and Porter 1990), inhibition of neurotransmitter release and the modulation of adenylate cyclase activity (Ribeiro 1995), potentiating immune system (Liu *et al*. 1992; Xu *et al*. 1992) and antitumor activity (Chen *et al*. 1997). The indigenous uses of plants as tonic, aphrodisiac, immuo-stimulative and useful in memory longetivity throughout Nepal (Uprety *et al.* 2010) are justifiable to the pharmacological observations. Inhibition of LTB4 biosynthesis and lipoxygenase activity by the *Morchella esculenta* (Helvellaceae) extracts supports their indigenous uses in various diseases known to be mediated by 5-lipoxygenase products, i.e. leukotrienes. Plant stalk and cap are considered as aphrodisiac (Kunwar 2006) and are used as tonic and immunostimulant in folklore. Methanolic extract of plants facilitates healing and soothing (Kumar *et al*. 2000). Lipoxygenase induces inflammation and the activity of lipoxygenase can also be inhibited by the rhizome extract of *Imperata cylindrica* (Matsunga *et al*. 1995). Rhizome extracts of *I. cylindrica* (Poaceae) decreased the urine volume (Kanchanapee 1966). Alike to pharmacological findings, ethnomedicinal use of the plant rhizome paste was for urinary complaints.

Pharmacological literatures reveal antipyretic, digestive and tonic properties of *Citrus* fruits and leaves (Font Quer 1992; Ajaiyeoba *et al*. 2003) since the antipyretic effect of *Citrus* (Rutaceae) is recognized by folklore in Nepal Western Himalaya. Anticancer properties have been associated with the components of various natural products including polyphenols, resveratrol, and limonene (Kaegi 1998). Resveratrol and limonene of *Citrus* fruits have multiple biological activities including vasodilatory (Duarte *et al*. 1993), anticarcinogenic, anti-inflammatory, antibacterial, antiviral effects, etc. (Brown 1980; Middleton and Kandaswami 1992). *Cassia tora* (Fabaceae) is used for bronchitis and its juice is applied as anthelmintic and antiseptic in study area argued with the antibacterial, antifungal (Mukherjee *et al*. 1995), anti-inflammatory and broncho-dilator efficacies of the plant (Kumar and Muller 1999). Seed extracts is anticoagulant (Mukherjee *et al*. 1995) and hypoglycaemic (Simon *et al*. 1987; Rao *et al*. 1994). Plant anthraquinones placate intestinal walls and stimulate bowel movement and make stool loose (Sharma 2004).

Moderate affinities between indigenous and pharmacological findings

Alcoholic extract of *Inula racemosa* (Asteraceae) enhanced liver glycogen and lowered blood glucose level (Tripathi and Chaturvedi 1995). Lung fibrosis (Thresiamma *et al*. 1996), blood pressure control (Dikshit *et al*. 1995) and anti-inflammatory properties (Kohli *et al*. 2005) are due to curcumine of the plant. Root extract of the plant is useful in stomachache, dysentery and blood pressure in study area. Indigenous use of plant for stomachache and dysentery infers connotation of antibacterial and antiviral properties. Antibacterial (Negi *et al*. 1999) and antiviral (Bourne *et al*.

1999) properties of curcumin are suggested. Curcumin, a yellow colored phenolic pigment, is found to inhibit arachidonic acid metabolism, cytokines, and release of steroidal hormones. It has strong oxygen radical scavenging activity which is responsible for anti-inflammatory property (Kohli *et al*. 2005; Singh *et al*. 2008).

Rutin, a flavonoid from *Melia azedarach* (Meliaceae) strengthens capillary walls (Sharma 2004), relieves acute and chronic inflammations (Lee *et al*. 2000) and protects heart (Chopra and Singh 1994). Methanol extract of plant root, stem bark and leaves showed a broad spectrum of antibacterial activity (Khan *et al*. 2001) and it is partially consented to the indigenous usage as bark and leaf juice is therapeutically used for spleen disorders. Rutin from *Sophora mollis* (Fabaceae) protects heart (Chopra and Singh 1994), and relieves acute and chronic inflammations (Lee *et al*. 2000) and capillary wall infections (Sharma 2004). The cardioprotective action of the plant is traditional therapy base where the plant roots are taken for rheumatism, and cold. Antiviral property of *Leea indica* (Leeaceae) (Jain *et al*. 1991) and indigenous use of plant leaves as digestive are partially justified. Leaves of *Artemisia* are used in skin itching and scabies in ethnopharmacology, and in phytochemical studies plant leaf extract possessed activities against bacteria (Bhattarai *et al.* 2009) which produce malodors in skin surface (Moulari *et al*. 2004).

Pleumeria rubra (Apocynaceae) is antibiotic, antiviral, etc. and fluroplumierin of the plant inhibits mycobacteria (Sundarrao 1993; Cambie and Ash 1994) which consented to the indigenous uses as digestive and anticholeric. Fruit of *Callicarpa arborea* (Verbenaceae), considered as edible and digestive in study area, has antiviral property because of its luteolin (Cheng Ma *et al*. 2002). Bark of *Bauhinia vahlii* (Fabaceae) is used in cuts, wounds, and fractures and this is substantiated by quercetin and betulin of the plant which are respectively anti-infectivity (Cowan 1999) and anti-inflammatory in properties (Mukherjee *et al*. 1997).

Discrepancies between indigenous and pharmacological uses

Antiimplantation and early abortifacient activities of *Rubus* species were denoted (Dhanabal *et al*. 2000). The results are in agreement with the traditional use of this plant as abortifacient by the tribal of Nilgiri, India but such folklore was not observed in study area. *Rubus* root juice was given for relieving fever, diarrhea and dysentery in far-western Nepal. *Caesalpinia bonduc* has been cited as a cure for cutaneous eruptions and stomachache (Kerharo and Adams 1974) but we observed only its usage as fish stupefying. Rhizome juice of *Cynodon dactylon* (Poaceae) possesses antiviral pro-perty (Foster and Duke 2000) and its aqueous extract has anti-inflammatory, diuretic, anti-emetic effects (Ahmed *et al*. 1994) and is useful in treating dysentery, dropsy and secondary syphilis (Chopra and Handa 1982). The ethanolic extracts of the plant showed antioxidant activity (Auddy *et al*. 2003). However, the plant rhizome paste was recognized only for sprain and its grinded inflorescence was applied for earache by local people in farwest Nepal. Several instances were rational behind a certain function of a chemical constituents of a species therefore further research is imperative to delve the actual medicinal effect of a species against particular diseases.

CONCLUSION

Plant resources have been used as immediate and ultimate ingredients for therapies and the indigenous therapies have been employed and appreciated by local populace for centuries. Because of prolong existence and uses, the therapies have become an integral part of the culture. Knowledge base for therapies were also stemmed from customs, livelihood strategies and available nearby resources. The ethnomedicinal and ethnopharmacological information gleaned from the present research provided the potential to identify which plants are most likely to be useful in treatment of diseases. Despite the high potential plants have as sources of new antimicrobial agents, they may soon disappear because of over-population, indiscriminate exploitation and irrational managements (Fabry *et al*. 1998). The environment where people learnt and experienced folklore is imperiled on account of deforestation and overexploitation (Bhattarai 1997) and acculturation and social transformation of aboriginal life (Kunwar and Bussmann 2008). It is therefore important that the age-old plant based indigenous therapy to be explored and documented properly for future uses before it is lost. Significant corroboration of pharmacological activity gives the claims by traditional healers a significantly high credibility albeit with varying degrees of modifications. Some plants that were thought to be effective in ethnopharmacology were ineffective while pursuing their comparative assessment with phytochemical findings, as a result. Several instances are rational behind a certain function of a phytomolecule. Such species can be reevaluated in the fields for their effect therefore further research is imperative.

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