

# Medicinal Plant Diversity and their Pharmacological Aspects of Nepal Himalayas

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## ABSTRACT

**Background:** The Himalayan range of Nepal is affluent with vast diversity of medicinal plants. Due to insufficient supplement of modern allopathic medicine and the traditional believe of ethnomedicinal therapy, still vast majority of Nepalese people are dependent on indigenous use of medicinal plant. Use of Nepalese Himalayan medicinal plants is not only limited to erogenous use of Nepal Himalaya but also regarded as chief ingredients in Eastern medicinal system including Ayurveda of Indian subcontinent, Traditional Chinese Medicine, Korean Oriental Medicine, etc. But due to the lack of efficient pharmacological investigation, Himalayan plant diversity is still limited to their ethnomedicinal uses. Vigorous pharmacological investigation is mandatory to explore their therapeutic potential. **Conclusion:** Here in this review; based on latest published pharmacological research articles, we tried to explore pharmacological aspects of major Himalayan medicinal plant of Nepal for the first time. There is the current need to investigate further pharmacological potency of these medicinal plants in order to explore their therapeutic potential.

**Key words:** Ethnomedicine, indigenous use, Himalayas

## BACKGROUND

Nepal, the Kingdom of Himalaya, is small, landlocked country situated between India and China. Nepal lies on southern slope of central Himalaya and occupies a total area of 147181 sq. km between the latitude of 26° 22' and 30° 27' N and the longitude of 80° 40' and 88° 12' E. The average length of the country is 885 km from east to west and width varies 145 km to 241 km from north to south. About 86% of the total land area is covered by hills and high mountains and remaining 14% is covered by flat lands of Terai. Based on wild altitudal variation (60-8848 m), the climate is broadly classified into cold Arctic/Nival (above 3000 m), cold temperate (2000-3000 m), warm temperate (1500-2000 m), subtropical (1000-1500 m) and tropical (below 1000 m). According to the physiological region, Nepal is divided into 7 regions including Terai, Siwaliks, Mahabharat lekh, Midhills, Himalayas, Inner Himalayas and Tibetan marginal mountain range.<sup>[1,2]</sup>

Nepal is blessed with most varied and diverse soil and climate conditions suitable for the growth of veritable plant species. The indigenous people are well acquainted with the properties and uses of plants of their surroundings. Until the middle of the 19<sup>th</sup> century, plants were the main therapeutic agents used by humans. About 60% of the world population and 60-90% of the population of developing countries rely on traditional medicine<sup>[3]</sup> and about 85% of the traditional remedies for primary health care are derived from plants.<sup>[4]</sup>

In Nepal, at least 1,600 to 1,900 species of plants are commonly used in traditional medicinal practices.<sup>[5]</sup> Traditional medicine in Nepal is used extensively by majority of the population, and includes Ayurveda, Traditional Chinese medicine (TCM), Unani and various forms of indigenous medicine including Tibetan Amchi medicine.<sup>[6]</sup> Traditional medicine in Nepal comprises those practices based on beliefs that were in existence often for hundreds to thousands of years before the development and spread of modern medicine, and which are still in use today. In the past, many rural areas of Nepal, traditional medicinal knowledge and practice were passed down entirely via oral tradition based on a lineage mode of transmission and personal experience.<sup>[7]</sup> More recently, however, knowledge transfer has also occurred through formally recognized

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school level education. Medicinal plants play vital roles in the Nepalese livelihood and the use of medicinal plants is frequent in several Nepalese regions. The total population of Nepal is 23.1 million and about 90% of the Nepalese people reside in rural areas where access to government health care facilities is lacking. It is estimated that there is one physician for more than 30,000 people whereas there is one healer for fewer than 100 people in Nepal.<sup>[8]</sup> Nepal is a natural storehouse of medicinal plants. Each year thousands of tons of raw material are exported, mostly to India, but also to other Asian, European and American countries. The government of Nepal aims to promote medicinal plant use and conservation programmes for livelihood improvement and poverty alleviation through various policies.<sup>[9]</sup>

The Himalayan plant diversity plays pivotal role to fulfill the medicinal demand of Nepalese society. The earliest record of medicinal plant use in the Himalayas is found in the Rigveda (4500 BC and 1600 BC), is supposed to be the oldest repository of human knowledge and describes 67 plants. After the Rigveda, *Ayurveda* (the foundation of science of life and the art of healing of Hindu culture) describes the medicinal importance of 1200 plants. The *Charak* or *Charaka Samhita* (900 BC) and *Susruta Samhita* (500 BC) enumerate the art of surgery, therapeutics and medicines in detail on the basis of *Atharvaveda*. The knowledge of

using these systems was accessed by Nepali *Vaidhyas* and *Kabirajs* as early as about 879 AD.<sup>[10]</sup> Therefore, the Ayurvedic physicians were incorporating medicinal plants in traditional Ayurvedic formulations from early on and the Ayurvedic system is reputed all over the Indian subcontinent since time immemorial.<sup>[11,12]</sup> Almost of the herbs of Nepal Himalayas are considered to contain medicinal properties. Kunwar and Bussmann 2008 reported that 56% of higher plants were ethno botanically important, and 54% were used as ethnomedicine in the Nepal Himalayas. The topographical characteristics of the Himalayas have resulted in a variety of ecological niches that host diverse medicinal plants. It has been estimated that the Himalayan region harbors over 10,000 species of medicinal and aromatic plants, supporting the livelihoods of about 600 million people living in the area.<sup>[13-15]</sup> This review was carried out by dividing Nepal Himalaya into 3 different region as West Nepal (80°E to 83°E), Central Nepal (83°E to 86°E) and East Nepal (86°E to 88°E), according to Kunwar and Bussmann, 2008.

So many researches are carried regarding to the indigenous use and ethnomedicinal potential of Nepalese medicinal plants till now. However, according to the knowledge of author, regarding the pharmacological aspects very few investigations have been carried out. Here, in this review article we tried to summarize the pharmacological aspects of major Nepalese Himalayan medicinal plants [Table].

**Table: List of Medicinal Plants of Nepal Himalayaas based on their latest pharmacological investigation and indigenous use (W = Western, C = Central, E = Eastern region)**

S. N.	Scientific Name (Family) <sup>[16,17]</sup>	Vernacular Name (English name) <sup>[16,17]</sup>	Indigenous/Local use	Phytochemical/ pharmacological properties (Literature review)	Distribution <sup>[16,18]</sup>
1.	<i>Abies spectabilis</i> (Pinaceae)	Gobre salla (Himalayan silver fir)	Leaves are sniffed for cough and cold	Pentene of <i>Abies</i> leaves is anti-inflammatory and antidepressant. <sup>[19]</sup>	W
2.	<i>Acacia catechu</i> (Mimosaceae)	Khair (Cutch tree)	Wood is used as local tea for cough and cold	Cyanidanol, an active ingredient of <i>Acacia catechu</i> , is claimed to be effective for treating liver diseases. <sup>[20]</sup> Catechu has Hypoglycemic, antipyretic and digestive properties. Catechuic acid is valued for expectoration for chest infection. <sup>[21]</sup>	W, C
3.	<i>Aconitum ferox</i> (Ranunculaceae)	Bikh (Himalayan monkshood)	Root paste is taken for joint pain.	Alkaloid extract possess anti-inflammatory properties. <sup>[22]</sup>	E, C, W
4.	<i>Aconitum heterophyllum</i> (Ranunculaceae)	Bish (Aconites)	Rhizome is dried up and taken to relieve body-ache, fever, cold, cough, nose discharge etc.	Ethanollic root extract of <i>Aconitum heterophyllum</i> has anti-inflammatory activity against cotton pellet-induced granuloma in rats. <sup>[23]</sup>	E, C, W
5.	<i>Aesculus indica</i> (Sapindaceae)	Karu (Indian horse chestnut)	Seed oil is valued for joint pain and skin problems	Plant is used for delaying Hypersensitivity. Aescin is cardiostimulant and anti-inflammatory. <sup>[24]</sup>	W

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Table: Continued

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6.	<i>Ageratum conyzoides</i> (Asteraceae)	Gnadhe jhar (Ageratum)	Leaf juice is applied externally to heal wounds. Decoction of herb is also given to cure stomach ailments such as diarrhea, dysentery and intestinal colic with flatulence	Hypoglycemic and antihyperglycemic activity on rat <sup>[25]</sup> also shows anticancer and antiadrenal activity. <sup>[26]</sup>	E, C, W
7.	<i>Allium cepa</i> (Alliaceae)	Pyaj/ Odal (Onion)	Eating raw bulbs reduces fever acting as cooling agent.	It prevents cadmium induced renal dysfunction <sup>[27]</sup> and has hypoglycaemic effect against type 1 and 2 diabetes mellitus. <sup>[28]</sup>	W, C, E
8.	<i>Amaranthus spinosus</i> (Amaranthaceae)	Bagani dhap (Prickly amaranth)	Root paste is applied on cuts and wounds.	Contains several chemical compounds, including tannins (coagulant), steroids (muscle building), flavonoids (antimicrobial), and volatile oils (antiseptic). <sup>[29]</sup>	E, C, W
9.	<i>Andrographis paniculata</i> (Acanthaceae)	Kalmegh (Kariyat)	Raw plant root juice is considered as antipyretic and effective in infections	Plant is immunostimulant, anti-inflammatory, antibacterial, analgesic and antiprotozoal. <sup>[30]</sup>	W, C
10.	<i>Anisomeles indica</i> (Lamiaceae)	Ratocharpate (Indian catmint)	Leaf extract is useful for urinary complaints	Ovatodiolide and pedallitin of <i>Anisomeles indica</i> is good anti-inflammatory. Pre-flowering plant water extract is analgesic. Ethanolic leaf extract is strong antiviral and anti HIV potential. <sup>[31]</sup>	W
11.	<i>Artemisia indica</i> (Asteraceae)	Titepati (Asian mugwort)	Leaf paste is applied on cuts and wounds.	Antimicrobial properties and in vitro antimalarial property. <sup>[32]</sup>	E, C, W
12.	<i>Artemisia vulgaris</i> (Asteraceae)	Tite pati (Fleabane)	Crushed leaves inserted in the nose stop bleeding. Water, mixed with crushed leaves, in taking bath prevents and cures allergy. Raw leaves chewed are good for mouth ulcer; also find uses in rituals.	Has antispasmodic and bronchodilator activity in guinea pigs. <sup>[33]</sup>	E, C, W
13.	<i>Asparagus racemosus</i> (Asparagaceae)	Kurilo (Shatavari)	Tuber paste is used for fever, stomach ache, and diarrhoea	Ethanol and aqueous extracts from the tubers exhibit significant antidiarrheic activity. <sup>[34]</sup>	E, C, W
14.	<i>Bauhinia variegata</i> (Caesalpinaceae)	Koiralo (Orchid tree)	Flower and floral buds are eaten regularly to cure leucorrhoea and mumps.	Methanol extract of <i>B. variegata</i> bark showed the most remarkable activity as antimicrobial and anticancer. <sup>[35]</sup>	W
15.	<i>Berberis asiatica</i> (Berberidaceae)	Chutro (Barberry)	Cambium paste is used for rheumatism and pith paste is used for eye problems.	Widespread use as an extract in eye drops for Conjunctivitis. Effective as an antipyretic, anesthetic, and antihypertensive. <sup>[36]</sup>	E, C
16.	<i>Bergenia ciliata</i> (Saxifragaceae)	Pakhanved (Frilly Bergenia)	Latex is effective in diarrhea, dysentery, stomachache	Aqueous and methanolic extract of <i>Bergenia ciliata</i> shows the cytoprotective activity. <sup>[37]</sup>	W
17.	<i>Bischofia javanica</i> (Euphorbiaceae)	Kainjalo (Java sedar)	Chewing raw leaves treat sore throat. Drinking bark juices cure diarrhea.	Betulinic acid derivatives from the bark has the DNA topoisomerase II inhibitory activity. <sup>[38]</sup>	E, C, W
18.	<i>Cannabis sativa</i> (Cannabaceae)	Ganja (Marijuana)	Plant paste is taken for stomach problems	Diuretic, anti-emetic, anti-epileptic, painkilling, anti-inflammatory, and antipyretic properties. <sup>[39]</sup>	E, C, W

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19.	<i>Carum carvi</i> (Apiaceae)	Jangali jira (Caraway)	Fruit is stomachic and carminative. Seeds are used for their cooling effect.	Aqueous extract of <i>Carum carvi</i> (black zeera) seeds has the renal protective activity in streptozotocin induced diabetic nephropathy in rodents. <sup>[40]</sup>	W, C
20.	<i>Cedrela toona</i> (Meliaceae)	Tuni (Indian Mahogany)	Bark is crushed and the paste is applied to cure ulcers. Flower is chewed to promote menstrual discharge in females.	Has antiproliferative and antitumorogenic activity. <sup>[41]</sup>	E, C
21.	<i>Celastrus paniculatus</i> (Celastraceae)	Malkauna, kujur (Staff tree)	Seed paste is applied in case of skin irritation/allergy; good for gout.	Has potent relaxant activity in Human ileum. <sup>[42]</sup>	C, E
22.	<i>Cinnamomum tamala</i> (Lauraceae)	Dalchini, Tejpat (Malabathrum)	Leaves are rubbed on the body surface of the scabies affected person.	Has immunomodulatory activity on rat. <sup>[43]</sup>	C, E, W
23.	<i>Cissampelos pareira</i> (Menispermaceae)	Batulpate (Abuta)	Plant extract is given to treat diarrhea, dysentery, indigestion and urinary disorders. Root is used as antidote.	Roots are proven to have antineoplastic and antiarthritic activity. <sup>[44]</sup>	E, C, W
24.	<i>Citrus medica</i> (Rutaceae)	Bimiro (Citrus)	Chewing dried fruit peel prevents dysentery. Fruit is good for indigestion. Roots are tied together along with a copper coin and placed in women's naval during child birth, which is believed to expedite the expulsion of the placenta after child birth.	Shows good in-vitro inhibitory activity against diabetes mellitus and Alzheimer's disease. <sup>[45]</sup>	E, C, W
25.	<i>Clematis buchananiana</i> (Ranunculaceae)	Abijalo (Clematis)	Juice extracted by crushing fresh roots is inhaled to treat sinusitis and headache.	Aquous extracts of <i>Clematis buchananiana</i> leaf anti-inflammatory, antinociceptive and antipyretic properties in rats. <sup>[46]</sup>	E, C, W
26.	<i>Cordyceps sinensis</i> (Clavicipitaceae)	Yarsagumba (Cordyceps)	Whole plant juice is taken as tonic.	Largely recognized as inducing sexual power and validity. <sup>[47]</sup>	W, C
27.	<i>Costus speciosus</i> (Costaceae)	Betlauri (Wild ginger)	Rhizome mixed with sugar is used to treat venereal diseases. Juice taken before breakfast cures urinary tract infections.	Eremanthin from <i>Costus speciosus</i> shows antidiabetic and antilipidemic effect in STZ-induced diabetic rats. <sup>[48]</sup>	E, C
28.	<i>Curcuma aromatica</i> (Zingiberaceae)	Ban haledo (Aromatic turmeric)	Rhizome powder taken with water relieves nausea, stomachache and expels gas.	<i>Curcuma aromatica</i> oil has the antineoplastic activity. <sup>[49]</sup>	E
29.	<i>Curcuma longa</i> (Zingiberaceae)	Besar (Turmeric)	Drinking water boiled with root cures throat pain, cold, cough and fever.	More than thousands of researches have been carried out on <i>Curcuma longa</i> . Recent interests are on anticancer <sup>[50]</sup> anti-inflammatory <sup>[51]</sup> and antioxidant <sup>[52]</sup> activity	W, C, E
30.	<i>Cynodon dactylon</i> (Poaceae)	Dubo (Dog's tooth)	Crushed root juice is taken to relieve piles. Root paste applied heals cuts and wounds. Boiled leaf and root juice help in treating diarrhea and dysentery.	Hydrochloric extract of rhizome shows protective effect against heart failure in rat. <sup>[53]</sup>	E, C
31.	<i>Dioscorea alata</i> (Dioscoreaceae)	Ghar tarul (Winged yam)	Rhizome is eaten raw to relieve throat pain.	This has found to effectively reduced blood pressure of spontaneously hypertensive rat. <sup>[54]</sup>	E, C
32.	<i>Drymaria cordata</i> (Caryophyllaceae)	Chirbire jhar	The plant is warmed while wrapped in a cloth and emanating vapor inhaled in the case of sinusitis, nose blockade and headache. To relive sore throat pain and fever, the plant either eaten raw or cooked.	Hydroethanolic extract shows anxiolytic effect in animal model. <sup>[55]</sup>	E

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33.	<i>Drynaria propinqua</i> (Drynariaceae)	Kammari (Dryndria)	Plant is effective in fever and headache.	Propinqualin, 4-O-beta-D-glucopyranosyl caffeic acid, beta-sitosterol-3-O-beta-D-glucopyranoside has been isolated from this plant. <sup>[56]</sup>	C, E
34.	<i>Engelhardia spicata</i> (Juglandaceae)	Mahuwa (Engelhardia)	Flower juice is drunk for abdominal pain.	Engelhardtione possesses antitubercular activities. <sup>[57]</sup>	W, C, E
35.	<i>Entada rheedii</i> (Fabaceae)	Prami (African dream herb)	Body pain, musculo-skeletal problems.	Triterpenes isolated from seed of <i>Entada rheedii</i> has antiproliferative and antioxidant activity. <sup>[58]</sup>	C
36.	<i>Ephedra gerardiana</i> (Ephedraceae)	Somlata (Ephedra)	Whole plant is used for respiratory problems.	Ephedrine from <i>Ephedra gerardiana</i> stimulates the respiratory centers, uterus, dilates the bronchi and pupils, contracts the intestines and raises blood sugar. <sup>[59]</sup>	C, E, W
37.	<i>Equisetum diffusum</i> (Equisetaceae)	Ankhle Jhar (Horsetail)	Plant stem juice is given for gonorrhoea.	Methanolic plant extract shows good free radical scavenging activity. <sup>[60]</sup>	W, C, E
38.	<i>Eupatorium adenophorum</i> (Asteraceae)	Banmara (Sticky snakeroot)	Leaf juice is applied on cuts and wounds.	Methanolic leaf extracts shows the analgesic effect. <sup>[61]</sup>	E, C, W
39.	<i>Ficus auriculata</i> (Moraceae)	Timila (Roxburgh fig)	Stem juice is considered effective against diarrhea and fruits are used in dysentery.	Tannins of the bark extract may reveal anti-inflammatory And analgesic activities. <sup>[62]</sup> Bark extract shows potential antioxidant activity. <sup>[63]</sup>	W, C, E
40.	<i>Ficus hirta</i> (Moraceae)	Khasreto (Ficus)	Root decoction treats food poisoning.	Aqueous extracts from <i>Ficus hirta</i> have hepatoprotective activity against N, N-dimethylformamide induced acute liver injury in mice. <sup>[64]</sup>	E
41.	<i>Fraxinus floribunda</i> (Oleaceae)	Lankuree (Himalayan ash)	Bark infusion is used for body pain.	Anti-inflammatory, anti-oxidative and skin regenerating activities. <sup>[65]</sup>	C
42.	<i>Fritillaria cirrhosa</i> (Liliaceae)	Kakoli (Fertillaria)	Plant juice is taken for stomach disorders	Plant contains steroidal alkaloids effective against stomach disorders. <sup>[66]</sup>	E, C
43.	<i>Helianthus annus</i> (Asteraceae)	Suryamukhi (Sunflower)	Root decoction as a gargle relieves toothache; dried flower chewed cures ulcers, fever, cough and cold. Leaves crushed and mixed with water and taken bath cures allergy and skin diseases.	Terpenoids in methanolic and aqueous extract of <i>Helianthus annus</i> shows anti-inflammatory activity in rat. <sup>[67]</sup>	E, C
44.	<i>Hibiscus esculentus</i> (Malvaceae)	Ramtoria (Okra)	Fruit mucilage acts as soothing agent on cuts.	Methanol extract of <i>Hibiscus esculentus</i> seeds shows antihypoxic and antioxidant activity in male mice. <sup>[68]</sup>	E
45.	<i>Hippophae salicifolia</i> (Elaeagnaceae)	Dale chuk (Sea buckthorn)	Fruit juice is taken for cough, diarrhea, and menstrual disorder.	Contains high levels of flavonoids (with antimicrobial properties and effectiveness against menopausal symptoms), carotenoids and vitamin C. <sup>[69]</sup>	W, C
46.	<i>Hippophae tibetana</i> (Elaeagnaceae)	Bhui chuk, (Tibetan Sea buckthorn)	Fruit juice is taken for stomach disorders.	Contains high levels of flavonoids (antimicrobial), carotenoids and vitamin C. <sup>[69]</sup>	C, W
47.	<i>Hordeum vulgare</i> (Poaceae)	Jau (Barley)	Gruel is made by the powdered grains and given in case of painful indigestion. Barley water with honey is prescribed in bronchial coughs.	Aqueous methanolic extract of this plant shows hepatoprotective activity against acetaminophen induced liver damage in rats. <sup>[70]</sup>	E, C

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48.	<i>Hydrocotyle asiatica</i> (Mackinlayaceae)	Ghortapre (Pennywort)	Fresh plant parts crushed and ingested orally cure sores of throat and lungs. Leaf juice is used as eye drops to cure eye infection. Dressing with leaf paste reduces swelling or and applied in wounds. Juice of shoots treats gastritis and constipation.	It has neuroprotective, anti-allergic, Anti-pruritic, and anti-inflammatory activities in animal models. <sup>[71]</sup>	E, C, W
49.	<i>Lantana camara</i> (Verbenaceae)	Masino kada, Sitaji phul (Spanish flag)	The juice of crushed leaves is applied to the fresh cut and wounds to heal. Crushed leaves are tied over the sprain to relieve pain.	Ethanol extract of leaves and roots shows the antibacterial activity against both gram positive and gram negative bacteria. <sup>[72]</sup>	E
50.	Lichen species (Parmeliaceae)	Jhau (Lichen)	Lichen extract and decoction is applied to treat moles.	Parmelia species are antimicrobial <sup>[73]</sup> and also used to treat warts and cranial diseases. <sup>[74]</sup>	W, C, E
51.	<i>Lindera neesiana</i> (Lauraceae)	Pahenlo khapate (Spicewood)	Fruit juice taken for diarrhea.	Essential oil extracted from fruits possess significant antimicrobial activity. <sup>[75]</sup>	E, C
52.	<i>Lobelia pyramidalis</i> (Campanulaceae)	Aklebir (Lobelia)	Juice of leaves and flowers is rubbed on body parts during body ache.	Lobeline, the active constituent, may cause nausea, vomiting and diarrhea. <sup>[76]</sup>	W
53.	<i>Lycopersicon esculentum</i> (Solanaceae)	Rambheda (Tomato)	Raw fruit is taken during indigestion and to prevent bleeding from the gums.	It has 5-alpha-Reductase enzymatic activity which enhances the formation of testosterone. <sup>[77]</sup>	C, E, W
54.	<i>Lycopodium clavatum</i> (Lycopodiaceae)	Supari jhar (Groundpine)	Pollen paste is used on cuts and wounds.	Contains anti-inflammatory alkaloids types of compounds. <sup>[78]</sup>	C, E
55.	<i>Mentha arvensis</i> (Lamiaceae)	Pudina (Mint)	Raw leaves chewed help to check stomach related disorders: gastritis, acidity, indigestion etc., also used to flavor chutney.	Various extracts of <i>Mentha arvensis</i> clearly shows a protective effect against acid secretion and gastric ulcers in ibuprofen plus pyloric ligation, 0.6 mol/L HCl induced and 90% ethanol-induced ulcer models. <sup>[79]</sup>	W, C, E
56.	<i>Mucuna macrocarpa</i> (Fabaceae)	Baldengra (Mucuna)	Seed powder taken with water helps remove round worm from stomach.	Crude methanolic extract of stem have in vitro and in vivo apoptosis-inducing antileukemic effects. <sup>[80]</sup>	E
57.	<i>Musa paradisiacal</i> (Musaceae)	Kera (Banana)	Person suffering from fever is advised to drink sap released from the plant directly.	Crude aqueous methanolic extract of leaves shows in vitro anthelmintic effect. <sup>[81]</sup>	E, C, W
58.	<i>Mussaenda frondosa</i> (Rubiaceae)	Asari (Mussaenda)	Whole plant is boiled and decoction is given to treat fever, asthma and cough.	Alcoholic and aqueous extract of this plant shows in vitro antioxidant activity. <sup>[82]</sup>	E
59.	<i>Myrica esculenta</i> (Myricaceae)	Kafal (Box myrtle Bay Berry)	Fruits are eaten for dysentery and bark decoction is given for bronchitis.	Crude extract of stem bark shows anti-allergic activity on mice. <sup>[83]</sup>	W, C, E
60.	<i>Nardostachys grandiflora</i> (Valerinaceae)	Jatamansi (Jatamansi)	Whole plant juice is taken to treat headache and high altitude sickness.	Ethanol extract from roots showed anticonvulsant activity and are a nervous system stimulant. <sup>[84]</sup>	C, E
61.	<i>Oroxylum indicum</i> (Bignoniaceae)	Tatelo (Indian trumpet)	Bark and seeds are powdered and mixed with water, and strained; the mixture is fed to patients suffering from high fever or pneumonia, which believed to restore health or brings down fever. Unbroken pod is also used in rituals.	Methanolic extract of root, bark, stem and leaves have the antioxidant activity. <sup>[85]</sup>	E, C

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62.	<i>Oxalis corniculata</i> (Oxalidaceae)	Chari amilo (Creeping woodsorrell)	Whole plant is chewed raw and the juice acts as an appetizer; also checks boil. Fresh plant decoction taken treats dysentery. Fruit is consumed to lessen throat pain.	Methanol extract of <i>Oxalis corniculata</i> shows in-vitro antioxidant and anti-inflammatory activity. <sup>[86]</sup>	E, C, W,
63.	<i>Paederia scandens</i> (Rubiaceae)	Pat biree (Sewer vines)	Dried fruit is powdered and applied over teeth to relieve tooth ache and prevent tooth decay.	Several pharmacological activities are reported. Most recent are xanthine oxidase inhibitory and uricosuric activity. <sup>[87]</sup>	E, C
64.	<i>Paris polyphylla</i> (Trilliaceae)	Satuwa (Himalayan Paris)	Root paste is taken for fever, vomiting and worms	A methanolic extract is gastro protective. Also possesses anthelmintic properties. <sup>[88]</sup>	W, C
65.	<i>Phyllanthus emblica</i> (Phyllanthaceae)	Amala (Indian gooseberry)	as a tonic to build up lost vitality and vigor and rassayana in Ayurveda. Also considered as a source of vitamin and amino acid.	It has so many action reported included antiviral, antioxidant, etc. recent research shows the antiplasmodic and cytotoxic effect of water extract. <sup>[89]</sup>	C, E, W
66.	<i>Picrorhiza kurroa</i> (Scrophulariaceae)	Kutki (Picrorhiza)	Dried rhizome is boiled in water and taken to cure fever, cough, etc	Methanolic and aqueous extract of rhizome has potent antioxidant and antineoplastic activity. <sup>[90]</sup>	E
67.	<i>Piper longum</i> (Piperaceae)	Pippali (Long pepper)	Dried seed powder paste is applied to reduce sprains; the powdered roots are given to treat cold and cough.	It has insecticidal and acaricidal, antifungal, antiameobic, antimicrobial, antiasthmatic, antidiabetic, analgesic, anti-inflammatory, hypocholesteromic, antioxidant, anticancer, immunomodulatory, antidepressant, antiulcer, hepatoprotective effect. <sup>[91]</sup>	E
68.	<i>Plantago erosa</i> (Plantaginaceae)	Isabgol jhar (Greater plantain)	Leaf paste is applied to heal wounds, cuts, bruises, insect bites, poison-ivy rashes, minor sores and snakebite. Seed powder is with water treats diarrhea and dysentery.	Methanolic extract shows anti inflammatory activity against carageenan induced paw edema in rat and mice. <sup>[92]</sup>	E, C, W
69.	<i>Podophyllum hexandrum</i> (Berberidaceae)	Laghupatra (Himalayan May Apple)	Root juice is taken for liver complaints	Ethyl acetate extract of <i>Podophyllum hexandrum</i> rhizome has antioxidant and protective effect on carbon tetrachloride induced rat liver injury. <sup>[93]</sup>	W, C, E
70.	<i>Psidium guajava</i> (Myrtaceae)	Amba (Guava)	Young leaves and tender shoots taken raw cure mouth ulcers, sore throat, cough, toothache. Drinking bark powder mixed in hot water is best local remedy for dysentery with blood in stool; fruits are edible.	Ethyl acetate fraction of <i>Psidium guajava</i> leaf extract shows antioxidant and antiglycative potential in streptozotocin-induced diabetic rats. <sup>[94]</sup>	E, C, W
71.	<i>Pteris biaurita</i> (Pteridaceae)	Gulmohar (Fern)	Mashed petiole extract applied on the cuts and wounds stop bleeding and infections	Alcoholic extracts has the antimicrobial activity. <sup>[95]</sup>	E, C
72.	<i>Rhododendron arboreum</i> (Ericaceae)	Lali guras (Tree rhododendron)	Dried flowers crushed and mixed with water stop excessive bleeding in female. Fresh leaves chewed to cure dysentery.	Flower juice has the hypolipidemic effect in experimentally induced hypercholesteremic rabbits. <sup>[96]</sup>	E
73.	<i>Rhododendron campanulatum</i> (Ericaceae)	Guras (Bell rhododendron)	Leaves are chewed and the juice from the crushed leaves relieves cough.	Oleamane, the active triterpenoid, has antibacterial and immunomodulatory activities. <sup>[97]</sup>	E, C

S. N.	Scientific Name (Family) <sup>[16,17]</sup>	Vernacular Name (English name) <sup>[16,17]</sup>	Indigenous/Local use	Phytochemical/ pharmacological properties (Literature review)	Distribution <sup>[16,18]</sup>
74.	<i>Rhus semialata</i> (Anacardiaceae)	Arkhar (Sweet sumach)	Sour juice of fruits is boiled with water and raw egg, treats diarrhea and dysentery. It is also used as food preservative.	<i>Rhus semialata</i> fruit extract has the antidiarrheic activity in rats. <sup>[98]</sup>	E
75.	<i>Rauvolfia serpentina</i> (Apocynaceae)	Sarpagandha (Snake root)	Use to lower high blood pressure.	Reserpine, the active alkaloid, produced a dose-dependent depression of the central nervous system. <sup>[99]</sup>	C, E, W
76.	<i>Rubia cordifolia</i> (Rubiaceae)	Mangito (Indian madder)	Root decoction with water is given to cure urinary infection; paste is used as an ointment to skin diseases. Root is also used to make dyes.	Mollugin, a bioactive phytochemical isolated from <i>Rubia cordifolia</i> L, exhibits antimutagenic, antitumor, antiviral, and inhibitory activity in arachidonic acid- and collagen-induced platelet aggregation. It also has Neuroprotective and anti-inflammatory effects in mouse hippocampal and microglial cells. <sup>[100]</sup>	E, C, W
77.	<i>Rubia manjith</i> (Rubiaceae)	Majitho (manjith)	Root paste is applied over scabies and other skin diseases	Anti-proliferative against epidermal keratinocytes and also has antiseptic properties. <sup>[101]</sup>	C, E, W
78.	<i>Rubus ellipticus</i> (Rosaceae)	Ainselu (Yellow Himalayan raspberry)	Young shoot is chewed raw to relieve sudden stomach pain. Root decoction given to the children to get rid of stomach warm. Root paste is applied on forehead during severe headache; fruit is edible.	Triterpenoid saponins from roots of <i>Rubus ellipticus</i> demonstrated inhibitory activities against alpha-glucosidase. <sup>[102]</sup>	E, C
79.	<i>Rumex nepalensis</i> (Polygonaceae)	Halhale sag (Nepal duck)	The root is purgative. Decoction of the root is applied to dislocated bones. A paste of the root is applied to swollen gums. The leaves are used in the treatment of colic and headaches.	Root extracts of <i>Rumex nepalensis</i> has anti-inflammatory, cyclooxygenase (COX)-2, COX-1 inhibitory, and free radical scavenging effects. <sup>[103]</sup>	C, W
80.	<i>Sapindus mukorossi</i> (Sapindaceae)	Ritho (Reetha)	Scalp is washed with fruit to remove dandruff and lice.	Saponins from <i>Sapindus mukorossi</i> has inhibitory effect on bacterial, fungal and viral genital pathogens. <sup>[104]</sup>	E, C, W
81.	<i>Schima wallichii</i> (Theaceae)	Sule-chilauni (Schima)	Bark is rubbed on the caterpillar infected portion removes its hair.	Polyphenolic enriched extract of <i>Schima wallichii</i> bark shows anti-inflammatory activity human peripheral blood mononuclear cells (PBMCs) and <i>in vivo</i> by carrageenan-induced paw edema assay (acute study) and cotton pallet granuloma assay (chronic study). <sup>[105]</sup>	E, C, W
82.	<i>Schleichera oleosa</i> (Sapindaceae)	Kusum (Kusum tree)	Fruits are eaten as an anthelmintic	Extracts of bark of <i>Schleichera oleosa</i> has cytotoxic and hydroxyl radical-scavenging activities. <sup>[106]</sup>	C, W
83.	<i>Semecarpus anacardium</i> (Anacardiaceae)	Bhalaayo (Marking nut)	Root paste is applied externally on the affected portion cures skin diseases. Decoction of the bark is given to the animals to treat worms.	Has hypolipidemic activity in streptozocin induced diabetic rats. <sup>[107]</sup>	E, C
84.	<i>Skimmia anquetilia</i> (Rutaceae)	Narpati (Skimmia)	Leaf infusion is taken for headache and for freshness	Linalool, from this plant, possess anxiolytic effect. <sup>[108]</sup>	W
85.	<i>Smilax aspera</i> (Smilacaceae)	Kukurdaino (Birdweed)	Root decoction is used for venereal disease	Stem juice is used for dropsy and gout. Rutinoside has cancer inhibitory effect. <sup>[109]</sup>	W, C

Continued



Table: Continued

S. N.	Scientific Name (Family) <sup>[16,17]</sup>	Vernacular Name (English name) <sup>[16,17]</sup>	Indigenous/Local use	Phytochemical/ pharmacological properties (Literature review)	Distribution <sup>[16,18]</sup>
86.	<i>Solena heterophylla</i> (Cucurbitaceae)	Bankakri (Creeping cucumber)	Fruits are eaten for common cold and pneumonia of child	Plant extract is hepatoprotective and plant coumarin and flavonoids inhibit platelet aggregation. <sup>[110]</sup>	W
87.	<i>Spermadictyon suaveolens</i> (Rubiaceae)	Ban chanp (Forest champa)	Root paste is applied externally to relieve joint pain.	Ethanol extract of Bark has anti-inflammatory activity on rats. <sup>[111]</sup> Methanol extract of stem bark has hepatoprotective activity on rats. <sup>[112]</sup>	E
88.	<i>Spondias pinnata</i> (Anacardiaceae)	Amaro (wild mango)	Plant latex is applied for wounds and cuts.	Flavonoids of the plant have been known to inhibit intestinal motility and hydro electrolytic secretion, which are known to be altered for diarrheal conditions. <sup>[113]</sup>	W, C, E
89.	<i>Taxus wallichiana</i> (Taxaceae)	Lauthsalla, Barne salla (Himalayan yew)	Respiratory problems. Leaf juice is used for cancer and bronchitis.	Taxol isolated from the bark of this plant shows the <i>in-vitro</i> , <i>in-vivo</i> anticancer activity. It also has antifungal, antiviral anticonvulsant, analgesic, and antipyretic and tumor growth inhibitory activity. <sup>[114-116]</sup>	C
90.	<i>Terminalia bellirica</i> (Combretaceae)	Barro (Baheda)	Fruit is used as laxative, in headache, leucorrhoea, liver diseases to gastro-intestinal complaints	Aqueous extract of <i>Terminalia bellirica</i> stimulates the secretion and action of insulin and inhibits starch digestion and protein glycation <i>in vitro</i> . <sup>[117]</sup>	C, E, W
91.	<i>Terminalia chebula</i> (Combretaceae)	Harro (Chebulic myrobalan)	Fruit is used for abdominal problem, headache, bronchitis, and several ayurvedic formulation	Hydro alcoholic extract of <i>Terminalia chebula</i> fruit shows antiulcerogenic activity in rats. <sup>[118]</sup>	C, E, W
92.	<i>Valeriana jatamansi</i> (Valerianaceae)	Jatamansi (Valerian)	Cuts and wounds, cough and cold	Dried rhizome extract partially reverses the liver cirrhosis and tissue hyper proliferative response in rats. <sup>[119]</sup>	C, E, W
93.	<i>Zanthoxylum alatum</i> (Rutaceae)	Timur (Prickly ash, Zanthoxylum)	Branchlet used as toothbrush to relieve toothache. Berries taken to cure stomach ache and toothache. Berries are crushed and rubbed on the leg which acts as leech guard.	Crude extract of <i>Zanthoxylum alatum</i> has the spasmolytic activity in gut, airways and cardiovascular diseases. <sup>[120]</sup>	E, C

## DISCUSSION

Though considerable advances are made in the pharmaceutical sciences, especially in synthetic chemistry, plants and their derivatives continue to maintain their significance in medicines. Increased interest in natural drugs than synthetic are because of a high degree of adverse side effects caused by the latter. Nowadays natural medicines are gaining prominence, because they are economical, easily available and relatively free from side effects. It is evident from the present scenario that herbal cure is gaining world wide acceptance and has emphasized on modern scientific exploration, extraction and evaluation of foil medicines from plants. These are either used directly as a plant extract or modified through further synthesis.<sup>[121]</sup> The Himalayas

represent the largest mountain chain in the world, and is famous for its rich plant diversity and varied ecosystem, containing large number of plants. The use of plants in curing and healing is as old as man himself. Plants containing beneficial and medicinal properties have been known and used in some form or other by primitive people. Many plants which are found commonly and are mentioned in above texts are traditional medicine have not been investigated thoroughly. It is necessary to conduct systematic evaluation, standardization, documentation and patenting of these plants. Targeted based studies with concentration on mechanism of action, lethal dose/effective dose and bioavailability mechanisms need to be conducted in future to explore scientifically the hidden potential of these plants so that the ill community gets maximum benefits from

traditional system of medicine.<sup>[122]</sup> Biodiversity of Nepal-Himalayas is natural wealth and its conservation is important for economic, ecological, scientific and ethical reasons.<sup>[123]</sup>

## CONCLUSION

Although few researches have been carried out, vast majority of medicinal plant species of Himalayan region are still far behind of pharmacological researches in order to prove their therapeutic potential scientifically. Based on indigenous and ethnic knowledge, medicinal plant of Nepal Himalaya has diverse therapeutic potency. Therefore concise and continues research with advanced instruments is necessary to explore their pharmacological property which may act as milestone to decrease the resistance and adverse effect problem of modern allopathic medicine.

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