Annals of Phytomedicine 5(2): 27-37, 2016
Journal homepage: www.ukaazpublications.com
Print ISSN : 2278-9839 and Online ISSN : 2393-9885

ANNALS OF PHYTOMEDICINE
An International Journal

Review article

An overview and economical importance of few selected endangered medicinal plants grown in Jammu and Kashmir region of India

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Received July 25, 2016: Revised August 17, 2016: Accepted August 25, 2016: Published online December 30, 2016

Abstract

Medicinal plants as a group comprise approximately 8000 species and account for around 50% of all the higher flowering plant species of India. Millions of rural households use medicinal plants in a self-help mode. Over one and a half million practitioners of the Indian System of Medicine in the oral and codified streams use medicinal plants in preventive, promotive and curative applications. In recent years, the growing demand for herbal product has led to a quantum jump in volume of plant materials traded within and across the countries. Further, in view of the side effects of synthetic drugs coupled with their high cost of production, medicinal plants have become major sectors of trade and commerce and are significantly contributing to the socio-economic developments of certain developed and developing countries. Though India has a rich biodiversity, the growing demand is putting a heavy strain on the existing resources. Among various States of India, Jammu and Kashmir State has a rich diversity of medicinal plants because it provides a diverse type of habitats for their growth. Kashmir valley represents the temperate region, Jammu area represents sub-tropical and tropical and Ladakh as cold desert region. More than 50% of plant based medicines prescribed in British Pharmacopoeia are growing in Jammu and Kashmir State.

In the present paper, 13 important medicinal plants, *viz*., *Achillea millefolium* L., *Aconitum heterophyllum* Wall.ex Royle, *Artemisia absinthium* L., *Asplenuim adiantum-nigrum* L., *Berberis lycium* Royle, *Cydonia oblonga* Miller, *Delphinium denudatum* Wall.ex.H&T, *Picrorhiza kurroa* Royle.ex.Benth, *Podophyllum hexandrum* Royle, *Prunella vulgaris* L., *Salix caprea* L., *Taraxacum officinale* Webber. and *Viola odorata* L. with attributes to traditional system of medicine and their use by local population in primary health care have been described. The vernacular names, distribution pattern, folk use, use in traditional system of medicine (TSM), phytochemical constituents isolated and characterized in each plant species are discussed. The present status, in State of nature of each plant species based on ethnobotanical exploration made by authors from time to time and future prospects for commericial cultivation is discussed.

Key words : Medicinal plants, bioprospection, traditional system of medicine

1. Introduction

Medicinal plants are living resource, exhaustible if over used and sustainable if used with care and wisdom. At present, 95% collection of medicinal plant is from wild. Current practices of harvesting are unsustainable and many studies have highlighted depletion of resource base. Medicinal plants based industries although old and vast are still being managed on traditional ethos and practices and lack a proactive and socially responsible image. As many medical dogmas and beliefs are beginning to fall into disfavour, the benefits of natural health care are enjoying renaissance. With an increase in apprehensions regarding the toxicity and safety of modern drugs, people are once again shifting to traditional system of medicine (Subramonium, 2016).The increasing resistance of some disease producing micro-organisms against synthetic drugs and the interest in herbal remedies shown by the people all over the world has made the policy makers even in developed countries to incorporate herbal medicines in their health care programmes. Medicinal plants play a central role not only as traditional medicines but also as trade commodities, meeting the demand of distant markets (Nayanabhirama, 2016). In USA, as many as one quarter of all medications and pharmaceuticals are derived from plant materials, however, in Germany, the proportion is half as large. In Russia, more than 100 plant species have been approved by the Ministry of Health for prescription use. More than 5000 medicinal plants have been catalogued in China and 1700 of these are in common use. As per the WHO report, 70-80 % of rural population in developing countries depend on traditional health remedies. In India traditional medicine is wide spread. Ayurveda being the oldest one, followed by Siddha, Homeopathy, Naturopathy and Unani System of Medicine. These systems are mostly plant based. Total trade in ISM&H sector in India, is well over Rs 5000 Crores (Shawl, *et al*. 2004). The main market outlets for medicinal plants are traditional medicine, OTC (Over the Counter) prescription drugs, phyto-pharmaceuticals and functional foods (Shawl, *et al*., 2004).

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DOI: 10.21276/ap.2016.5.2.3

India is having a large plant and animal life, owing to diverse climatic conditions, ranging from the cold desert of Ladakh and Spiti to the hot desert of Thar, the temperate forests in the Himalayas to the tropical rain forests of low lands (Manoharachary and Nagaraju, 2016).The State of Jammu and Kashmir occupies a most strategic position in the entire Himalayan region with a wide range of topographic and climatic conditions from tropical/ sub-tropical to sub-alpine/ alpine in Jammu and Kashmir region to that of cold desert of Ladakh region. In fact, due to physical and climatic conditions, many areas of Jammu and Kashmir State have no surface communication with outside world for about 3-6 months a year and the people of these places have been largely relying on plants growing around for the basic necessities of life, be it food, fodder, fuel or medicine.

The diversity of vegetation of the State of Jammu and Kashmir is evident from the presence of diverse type of habitats. Although, the accurate figures about the number of medicinal plants is not available, however, the studies made by different workers from time to time reveal that about 570 plant species are claimed to be of medicinal importance. More than 50% of plant based medicines prescribed in British Pharmacopoeia grow in Jammu and Kashmir State. Most of the areas under the present study fall under the great Himalayan range constitute the Kashmir Himalayas (Kozgar and Khan, 2010).

2. Materials and Methods

The plant material and the information on medicinal uses were collected during ethnobotanical explorations conducted from time to time. Most of the survey was conducted in far-flung/ tribal areas of the study area. The information on each plant was recorded in the field through interviews with the persons having knowledge of medicinal plants or practicing as local medicine men. The information on the medicinal use of plants collected from one locality was cross checked with another locality so that the claim can be confirmed. For each plant species, information was collected on common name of the plant, medicinal use, part (s) used, whether used singly or in combination, mode of application and dosage. A review of literature for general information, bioprospection (folk use, part used, traditional use, main phytochemical constituents and bioactivity, *etc*.) for the plants included in the paper was carried out thoroughly. The plant species so collected were properly identified and are being maintained in the plant gene bank of CSIR-Indian Institute of Integrative Medicine, Srinagar and its field stations at Bonera (Pulwama), Yarikah (Tangmarg) .

1. **Name of plant: *Artemisia absinthium* L.**

   Family: Asteraceae

   Local name: Tethwen/Afsantin/Worm wood.

   Local distribution: Throughout Kashmir Valley, usually in open mountainous slopes. Mostly distributed in Tangmarg, Ferozpur Nallah, Verinagh towards Banihal and outskirts of Srinagar.

   Taxonomic note: An erect shrubby herb, 3-4 ft. tall, much branched. Flower heads small, 3-4 mm, globular, pale yellow in colour. Leaves small, pale green to grayish.

   Bioprospection folk use: The decoction of leaves is used as vermifuge. The leaves are also used as insecticide.

   Part used: Aerial part

   Use in TSM: Used in epilepsy, hemiplegia, facial palasy, melancholic, antispasmodic and as antiseptic. In Unani system of medicine, the drug is extensively used for fevers, swellings and inflammation of viscera.

   Phytochemical constituents: The plant contains a volatile oil known as absinthe or wormwood oil (0.12-0.51 %). The oil contains thujyl alcohol, cadinone, phellandrene, α pinene, 5-guaiazulene, 3,6-dihydrochamazu-lene and 5, 6 - dihydrochamazulene. In the oil of leaves and flowers, more than 90 compounds have been identified (Nin *et al*., 1995).The essential oil is also rich in β-thuzone and (z) epoxyocimene, chrysanthenyl acetate (Tucker *et al*., 1993; Juteau *et al*., 2003). A bitter glucoside absinthin, a bitter substance anabsinthin, a crystalline compound artemetin and artebsin. Polyacetylenes like dihydromatricaria ester, C14-trans spiro ketoenol ether and tetra hydrafuro lignans of sesamiu type were isolated from aerial parts (Kelsey and Shafizadeh, 1979; Gregor, 1978; Gregor and Hofer, 1980; Kasimov *et al*., 1987). A guainolide direr, absintholide; a new sesquiterpene lactone, artenolide, parshin C and parshin B isolated from above ground part of the plant (Beauhaire *et al*., 1984; Ovezduriev *et al*., 1987), Ethanolic extracts yielded 24-zeta-ethyl cholesta-7, 22-dien-3β-ol (Ikram *et al*., 1987). Two new diatereomeric homoditerpene peroxides have also been isolated from the aerial part (Rucker *et al*., 1992)

   Bioactivity: Steriod sharing of *Artemisia absinthium* has shown significant effect in crolm's disease (Omer *et al*. 2007). Essential oil is reported to have antimicrobial activity (Juteau, *et al*., 2003). Crude extract of the plant species exhibited hepato protective action partly through microsomal drug metabolizing enzymes and validates the traditional use of plant in hepatic damage (Anwar and Khalid, 1995). 24-ethylcholesta-7, 22-diene-3 β-ol exhibited antipyretic activity (Ikram *et al*., 1987).

   Propagation/cultivation: It can be propagated through seeds. However, vegetative propagation through stem and root cuttings is preferable.

2. **Name of plant: *Achillea millefolium* L.**

   Family: Asteraceae

   Local name: Pehl-ghasa, Panjoli/ Biranjasif/Yarrow

   Local distribution: Commonly found throughout Kashmir Valley, Kishtwar (towards Symthan Pass), waste lands and in open mountainous slopes, *etc*.

   Taxonomic note: A perennial herb, about 2-3 ft. tall. Flowers borne on dense terminals, flat topped spikes, off white. Leaves desiccated.

   Bioprospection folk use: Flowering spikes are used to cure tooth ache, head ache and as an antipyretic

   Part used: Flowering tops

Use in Traditional System of Medicine (TSM): Flowers laxative, diuretic, anthelminthic, analgesic, abortificient and anthotriptic. Plant extract is also used as nasal drops in nasal congestion.

Phytochemical constituents: The aerial part of *Achillea millefolium* growing in Kashmir have essential oil (0.014 %). 86 compounds are identified by GC and GC Mass analysis. Major constituents are camphor (28%), 1,8-cineole (12%), germacrene-D (12%) and *cis*-chrysanthenyl acetate (8%) (Shawl, *et al.* 2002). Many sesquiterpene lactones, *viz*., 8-acetooxyartabsin, acetylbalchanolide, achillicin, achillin, 8-anelooxyastabsin, austrirein, millefin are present besides usual mono and sesquiterpenes. Many alkaloids and quartenary bases have also been isolated (Chandler *et al*., 1982). Aerial part yields a new sesquiterpene lactone - achilifolin (Ulubelen *et al*., 1990). Aerial part yielded desacetylmatricarin, 8-acetyl egelolide and 8-angeloyl egelolide (Ochir *et al*., 1991). A glycosyl-neolignan dihydrodehydrodiconiferyl alcohol 9-O-β-d- glucopyranoside was isolated and characterized; and six flavone derivatives, apigenin, apigenin -7-O-β-d- glucopyranoside, luteolin, luteolin -7-O-β-d-glucopyranoside, luteolin-4'-O-β-d-glucopyranoside, rutin, and two caffeic acid derivatives. 3, 5-dicaffeoylquinic acid and chlorogenic acid also isolated (Innocente *et al*., 2007).

Bioactivity: Essential oil and methanolic extract has shown antioxidant and antimicrobial activity (Ferda *et al*., 2003). Anti-hepatoprotective, antispasmodic and calcium antagonistic activity was reported in the aqueous methanolic extract of *Achillea millefolium* (Yaeesh *et al*., 2006). The plant has shown antiulcer efficacy after chronic treatment in winter rats (Cavalcanti *et al*., 2006). Antiprotozoal activity has been reported in the essential oil on *Tryponosoma cruzi* (Giani *et al*., 2007).

Propagation/cultivation: The plant can he raised through seeds which germinate in 3-4 weeks at 18-25°C. Vegetatively, it can be propagated by dividing the clumps.

3. Name of plant: *Asplenium adiantum-nigrum* L.

Family: Polypodiceae

Local name: Dade/Spleenwort

Local distribution: It is found in the temperate/sub-alpine areas of Jammu and Kashmir mainly in Kishan ganga, Jehlum, Lolab and Lidder Valleys and Pir panchal.

Taxonomic note: A perennial herb with tufted stipes about 1-1½ ft. in height. Fronds bi-tri-pinnate, usually lanceolate coracious, sori cupious.

Bioprospection folk use: It is used to treat diarrhea, jaundice and as diuretic. Young plant claimed as health/ medicinal food and used as vegetable.

Part used: Whole plant

Use in TSM: Although the plant is not documented in the Unani Pharmacopoeia but widely used by Unani physicians for the diseases of spleen, ophthalmology and in various Unani formulations.

Phytochemical constituents: Flavonoids like 2, 4-di-C-glycosides, 1- hydroxyl - 3, 6, 7- trimethoxyxanthone 2, 4-di-C - glucoside and two of its O-rhamnosides, have been found in the aerial parts of the fern (Filippo, 1991). 3, 7, 8-trihydroxyxanthone-1-O-β-lamina-ribioside (Fillipo, 1980). A new hydroxycinnamic acid-1-caffeyllaminaribiose; 3, 7, 8 - trihydroxyxanthone-1-O-β-cellobioside also reported (Rastogi and Mehrotra, 1980).

Bioactivity: The plant is used as expectorant, laxative, purgative and diuretic, antijaundice and as anticonstipative (Vasudeva, 1999).

Propagation/cultivation: Although it can be raised sexually through spores but is very hectic, cumbersome and needs extra care. The best method to propagate the plant is by rhizome cuttings

4. Name of plant: *Aconitum heterophyllum* wall-ex Royle

Family: Ranunculaceae

Local name: Patris, Patis, Atis, Atvika

Local distribution: Throughout Kashmir Himalayas in forest under growth. Apharwat, Sonamarg, Nagbairan, Razdhani and Symthan Pass. Endemic to Western Himalayas.

Taxonomic note: An erect perennial herb. Leaves broad, ovate, orbicular, toothed, upper amplexicaule. Racemes many flowered. Flowers 2-3cm long, blue, veined.

Bioprospection folk use: The root is eaten raw to relieve abdominal pain and also used as antihelminthic.

Part used: Root

Use in TSM: Antiperiodic, aphrodiasic, astringent, tonic, dyspepsia and cough.

Phytochemical constituents: Molecular and crystal structure of hetisine determined (Rastogi and Mehrotra, 1990). Heterophylline, heterophyllisine. heterophyllidene and the strong base fraction of the roots yielded besides atisine two new alkaloids, *atidine* and *dihydroatisine* (Pelletier *et al*., 1968).

Bioactivity: Preparation of Aconitum sp. showed marked influence on the development of inflammation (Pashinskii *et al*., 2006). Plant extract inhibited the spinach mosaic virus (SMV) (Zaidi *et al*., 1988). The plant showed immunomo-dulatory activity (Aral *et al*., 1986) and antihypertensive activity (Raymond, 1954).

Propagation/cultivation: It can be propagated through seeds as well as vegetatively dividing tuberous roots. The vegetative propagation is better because the seeds often show dormancy. *In vitro* regeneration protocol has been standardi/ed and detailed chemoprofiling has been done based on marker compounds (Jabeen *et al*., 2006).

5. Name of plant: *Berberis lycium* Royle

Family: Berberidaceae

Local name: Kaw duck/ Zirishk/Indian, lycium/Berberry

Local distribution: Usually found on dry stony slopes of Kishtwar, Mirpur, Ramban-Reasi, Marwa, Dacchan, Dara, Dacchigham, Sindh Valley, Pir panchal.

Taxonomic note: A stout shrub about 5-9 ft. tall. Stems spiny, branched, more or less white. Flowers dull-yellow.

Bioprospection folk use: Fruit anticoagulant. Decoction of bark and root used for eye infections and boils.

Part used: Root

Use in TSM: Fruits astringent, sedative and antipyretic. Roots are used as resolvent lithotryptic, diuretic, antirheumatic, antiparalytic and in hemicrania.

Phytochemical constituents: Berberine (Zhongguo *et al*., 1993), Tertiary dihydroproto-berberine (Gulam, 1973) and Barbamine (Khan *et al*., 1969).

Bioactivity: The plant collected from western himalayas showed pesticidal effect (Tewery *et al*., 2005). Berberine produced antagonistic effect on ventricular arrhythmia following myocardial ischemia (Zhongguo *et al*., 1993). Berberine (1.0 and 2.0 mg/kg) prevented barium chloride induced ventricular arrhythmia in wister rats. It also increased the required doses of aconitine and oubain for induction of ventricular premature beats, ventricular tachycardia, ventricular fibrillation and cardiac arrest (Zhangguo *et al*., 1990). Hypotensive action of barbamine, an alkaloid isolated from *Berberis lucium* has also been reported (Khan *et al*., 1969).

Propagation/cultivation: It can be raised through seeds as well as vegetatively. Seeds stratified for 2-3 weeks should be sown before winter. Vegetatively it can be raised through leafy cuttings or sometimes by layering.

6. Name of plant: *Cydonia oblonga* Miller.

Family: Rosaceae

Local name: Bum Chunt/ Behi/Beh dana/ Safarjal dana/ Amrit phala

Local distribution: Cultivated

Taxonomic note: A small deciduous tree. Leaves simple, stalked, obviate. Flowers in terminal corymbs, white. Fruits yellow, hairy.

Bioprospection folk use: Fruits are eaten raw and cooked as vegetables also. The jam of fruits is taken particularly during winters to prevent cold and chest complaints. Seed is applied to hair by women for getting silky texture.

Part used: Fruit and seed

Use in TSM: Used as cardiac stimulant, tachycardia, anti-anxiety and in flatulence and liver complaints. Seeds with milk have laxative and cooling effects.

Phytochemical constituents: A homo-monoterpenic compound *trans*-9-amino-8-hydrox-yl-2, 7-dimethylnona-2, 4-dienoic acid glucopyranosyl ester isolated (Sousa *et al*., 2007). Phenolic profile composed of 3-O-caffeoylquinic, 4-O-caffeoylquinic, 5-O-caffeoylquinic and 3, 5-dicaffeoylquinic acids, lucenin-2, vicenin-2, stellarin-2. isoschaftoside, schaftoside, 6-C-pentosyl-8-C-glucosyl chrysoeriol and 6-C-glucosyl-8-C-pentosyl chrysoeriol (Silva *et al*., 2005). Ionone glycosides; 9-O-beta-D-glucopyranoside of (6R)-3-oxo-4-hydroxy-7, 8-dihydro alpha ionol; a oxo-5, 6-epoxy beta-ionol (Roder *et al*., 2002). Martnelolactones A & B from fruits of Cydonia oblonga. (2R, 4S)-2, 7 dimethyl-4-hydroxyl-5 (E), 7 - octadienoic acid lactone (Rastogi and Mehrotra, 1980).

Bioactivity: *Cydonia* peel extract was the most active for inhibiting bacteria growth with minimum inhibitory and bactericide concentrations in the range of 102-5 x 103 microg polyphenol/ml (Fattouch *et al*., 2007). The plant showed anti-oxidant, anti-influenza and antiulcerative activity (Hamauzu *et al*., 2005, 2006).

Propagation/cultivation: Although it can be raised through seeds but vegetative propagation is economical. Root cuttings should be taken in late autumn and stored at low temperature during winter. In spring they can be lined-out horizontally in nursery rows. Leafy cuttings of mature plant can also be used for vegetative propagation.

7. Name of plant: *Delphinium denudatum* Wall. ex. H&T

Family: Ranunculaceae

Local name: Jadwar, Nirbisi/Nirvishi

Local distribution: Found in Kashmir Himalayas on open and stony mountainous slopes. Usually found in Jhelum and Kishen-Ganga Valley, also towards Tragabal and some parts of Kangan-Naranag area.

Taxonomic note: A perennial branched erect herb. Leaves orbicular, segments cuneate to obviate, pinatifid. Flowers in racemes, bluish in colour.

Bioprospection folk use: The roots are chewed to cure tooth ache and the grounded roots are made into paste and applied as an antiseptic.

Part used: Root

Use in TSM: Stimulant, tonic, alterative, antiepileptic and also in hemiplegia

Phytochemical constituents: A new diterpenoid alkaloid, 8 - acetylheterophyllisine. In addition to the known alkaloids vilmorrianone, panicutine. denudatine, isotalatizidine, condelphine, and 3-hydroxyl-2methyl-4H-pyran-4-one isolated (Rahman *et al*., 1997).

Bioactivity: Ethanolic extract of *Delphinium denudatum* showed protective effect in a rat model of Parkinson's disease (Ahmad *et al*., 2006). The plant shows anticonvulsant, anti-anxiety and memory enhancing activity (Nizami *et al*., 2005). The aqueous extract of roots showed a significant effect against morphine-(10 mg/kg) induced tolerance and dependence in mice (Zafar *et al*., 2002). Anticonvulsant activity as effective as world renowned antiepileptic drug phenytoin (Raza *et al*., 2001). Root extract has shown antifungal activity against a number of human pathogenic fungi (Rahman *et al*., 1997).

Propagation/cultivation: It can be propagated through seeds but the rate of germination is very low as the germination is very sensitive to temperature. Seeds fail to germinate at the temperature above 12-15°C. The better method of propagation is by dividing clumps.

8. Name of plant: *Prunella vulgaris* L.

Family: Lamiaceae

Local name: Kalveot/uste-e-kudus/Self heal

Local distribution: Commonly found in Kashmir Valley and Drass.

Taxonomic note: A small perennial herb, stem ascending, 4-8 inches in height. Whorls in dense heads, terminal. Flower violet. Leaves elliptic or lanceolate, upper sessile.

Bioprospection folk use: Flower decoction vapours inhaled for relieving pain in the joints and body. Orally taken decoction of whole plant is used to cure upper respiratory ailments, also used as an antipyretic.

Part used: Whole plant

Use in TSM: It is used in the upper respiratory tract infections and the disease produced by accumulation of Phlegm. The decoction is also used in hepatitis and in ascites. Externally it is applied on painful joints to reduce inflammation

Phytochemical constituents: A prunellin (Tabba *et al*., 1989). Two new hexacyclic triterpenoids (12*R*, 13*S*)-2a, 3a, 24-trihydroxy-12, 13-cyclotaraxer-14-en-28-oic acid and (13S, 14R)-2α, 3α, 24-trihydroxy-13, 14-cyclo-olean-11-en-28- oic acid, isolated from the roots of *Prunella vulgaris* (Kojima *et al*., 1988). Three new pentacyclic triterpenoids, 2α, 3α-dihydroxyursa-12, 20(30)-dien-28-oic acid; 2α, 3α, 24-trihydroxyursa-12, 20(30)-dien-28-oic acid; 2α, 3α, 24-trihydroxyoleana-11, 13(18)-dien-28-oic acid, isolated from roots of *Prunella vulgaris* (Kojima, *et al*. 1987). β-amyrin, duacosterol, oleonolic acid and ursolic acid (Beijing *et al*., 1985).

Bioactivity: Aqueous extract of *Prunella vulgaris* showed a high antiviral activity against Herpes Simplex Virus-1, 2 and Acyclovir (resistant) strain of HSV (Nolkemper *et al*., 2006). P-374 herbal therapy for endometriosis of *Prunella vulgaris* (Self heal) reduces the size and number of enomedriotic xenograft in immune deficient RAG - 2/gamma (C) knockout mice (Collins *et al*., 2006). *Prunella vulgaris* extract demonstrated a concentration-dependent photoprotection against UVA-induced oxidative stress and may be beneficial as a supplement in photoprotective dermatological preparations (Psotova *et al*., 2006). Polysaccharides isolated from *Prunella vulgaris* exhibited both immune stimulatory and anti-inflammatory effects against microbial invasion (Fang *et al*., 2005). *Prunellin* showed anti HIV activity (Tabba *et al*., 1989).

Propagation/cultivation: The plants can be raised through seeds as well as vegetatively. Seeds take 4-5 weeks to germinate.

9. Name of plant: *Podophyllum hexandrum* Royle

Family: Podophyllaceae

Local name: Bun Wangun/ Papra/ Drenmokshu/Indian May apple

Local distribution: Found throughout temperate/ sub-alpine regions of Kashmir, Sonamarg, Gulmarg, Khellenmarg, Naranag-towards Gangabal Sym than Pass, Lolab, Handwara-Gurez region.

Taxonomic note: A small herb about 8-16 inches in height. Stem more or less reddish in colour. Leaves usually two, three or four lobed, blade rounded in outline. Flower cup-shaped, solitary, large, white to pinkish in colour. Fruit brinjal shaped, purple in colour.

Bioprospection folk use: Fruits eaten raw to prevent chest congestion particularly in Ladakh region. Powdered rhizomes are used to cure stomach upsets.

Part used: Fruit and root

Use in TSM: Powered rhizomes are used for stomach upsets.

Phytochemical constituents: Podophyllotoxin-4-O-(D)-6-acetyl-glucopyranoside identified from high-altitude *Podophyllum hexandrum* (Puri *et al*., 2006). 4-O-dimethyldehydropodophyllotoxin and picropodop-hyllone (Atta-u-Rehman *et al*., 1995). Ten aryltetralin lignans, *viz*., podophyllotoxin, 4'-demethylpodophyllotoxin, α - peltatin, β-peltatin, desoxypodophyllotoxin, podophyllotoxone, isopicropodo phyllone, 4'-demethyldesoxypodophyllotoxin, 4'-demethylpodop-hyllotoxone and 4'-demethylisopicro-podophyllone (David *et al*., 1984).

Bioactivity: The plant species modulates gamma radiation induced immune-suppression in balb/ mice implications in radioprotection (Goel *et al*., 2007). A fraction (REC-2001) isolated from the rhizome of *P. hexandrum* exhibited cytotoxic and radioprotective properties (Shukla *et al*., 2006). The plant offers radioprotection by modulating free radical flux, role of aryltetralin lignans (Chawla *et al*., 2006). 4-O-dimethyl-dehydropodophyllotoxin and picropodophyllone showed strong antifungal activity against epidermophytofloccosum (Atta-u-Rehman *et al*., 1995). Podophyllotoxin is a pharmacologically important compound for its anticancer activities. It is used as a precursor for the chemical synthesis of the anticancer drugs etoposide, teniposide and etopophos (Farkya *et al*., 2004).

Propagation/cultivation: The plant can be propagated through seeds as well as by rhizome cuttings. Seeds should be sown before winter to produce better yield. *In vitro* protocol developed and cultivation technology standardized based on marker compounds (Sultan *et al*., 2006).

10. Name of Plant: *Picrorhiza kurroa* Royle. ex. Benth.

Family: Scrophulariaceae

Local name: Kode/Kutki/Gentian/ Kudu

Local distribution: The plant is found in sub-alpine/ alpine areas of Kashmir Himalayas, usually found in alpine meadows of Mahadev, Zojila range from upper reaches of Thajwas, Gumri onwards, Vishansar to Gangabal, Razdhani top, Symthan pass. Endemic to western Himalayas, present rate of utilization is very high and is in the red list.

Taxonomic note: A low perennial herb, more or less hairy. Leaves basal, narrow elliptic, sometimes round tipped and shoot petioled. Flowering scape ascending, stout. Flower bracteate, pale-purplish blue in colour.

Bioprospection folk use: Powdered roots with water or milk are taken orally as a tonic. Roots used as antipyretic and stomachic.

Part used: Root

Use in TSM: Used in epilepsy, cough, swollen piles, leucoderma, ascites. It is also antiflatulent, tranquilizer and abortificient.

Phytochemical constituents: Extract of the seeds of *Picrorhiza kurroa* yielded a new triterpenoid, 2α, 3β, 19β, 23-tetrahydroxyolean-12-en-28-O-β-D-glucoside, along with live known triterpcnoids. 2α, 3β, 19β, 23-tetrahydroxyolean-12-en-28-oic acid. 2α, 3β, 23-trihydroxyolean-12-en-28-O-β-D-glucoside, 2α, 3β, 23-trihydroxyolean-12-en-28-oic acid, 2α, 3β, 19β, trihydroxyolean-12-en-28-oic acid, and 2α, 3β, 6β, 23 -tetrahydroxyolean-12-en-28-oic acid (Zhang *et al*., 2005). Extract of roots and rhizome of *Picrorhiza kurroa*, picroliv yielded picroside I, picroside III, picroside IV, kutkoside, 6-feruloyl catalpol/ minecoside, Scrosicle B (Kumar *et al*. , 2004). Apocyanin (4'-hydroxyl-3'-methoxy-acetophenone) (Worm *et al*., 2001). A new iridoid, pikuroside, isolated from the roots of *Picrorhiza kurroa*, together with three known iridoids, picroside-I, picroside-II, and 6-feruloyl catalpol (Jia *et al*., 1999). The four new cucurbitacins isolated and identified as 2-beta-glucosyloxy-3. 16, 20, 25-tetrahydroxy-9-methyl-19-nor lanosta-5, 23-diene -22-one, 2-beta-glucosyloxy-3, 16, 20, 25-tetrahydroxy-9-methyl-19-nor lanost-5-ene-22-one, the 2-O-glucoside of cucurbitacin Q (25-acetoxy-2 beta-glucosyloxy-3, 16, 20-trihydroxy-9-methyl-19-nor lanosta-5, 23-diene-11, 22 -dionc), and the 2-O-glucoside of deacetoxycueurbitacin B (2-beta-glucosyloxy-16, 20-dihydroxy-9-methyl-19 nor lunosto -5, 24-dien-3, 11, 22-trione) (Stuppner *et al*., 1989),

Bioactivity: Hypolipemic effect of water extract of the plant in high fat diet feeded hyperlipemic mouse (Lee *et al*., 2006). The biopolymeric fractions RLJ-NE 205 isolated from rhizome of *Picrorhiza kurroa* improves the immune system and might be regarded as a biological response modifier (Gupta *et al*., 2006). The apocyanin (4'-hydroxy-3'-methoxy-acetophenone) a non toxic compound proved to be effective in the experimental treatments of several inflammatory diseases such as arthritis, colitti and atherosclerosis (Worm *et al*., 2001). The methanolic extract of *Picrorhiza kurroa* exhibited antistress, immuno-modulatory, anti-inflammatory and antiaging effects, (Russo *et al*., 2001). Picroliv, the iridoid glycoside mixture from rhizome of *Picrorhiza kurroa* exhibited antihepatotoxic action in adult male albino rats (Ansari *et al*., 1991).

Propagation/cultivation: The plant is difficult to propagate through seeds. Therefore, the best method is to raise the plants vegetatively by splitting roots. *In vitro* regeneration protocol and chemoprofiling based on the Picroside I to IV standardized (Jan *et al*., 2005).

11. Name of plant: *Salix caprea* L.

Family: Salicaceae

Local name: Beid/ Bred Mushk/Goat willow

Local distribution: Cultivated

Taxonomic note: A tree like shrub about 20-25 ft. tall. Leaves elliptic, oblong, obviate, crenate, dark green above, margins often recurved, base cuneate or cordate. Catkins sub-sessile, densely silky, male very stout, sweet scented, 1 inch; female 2-3 inches. Flowering is before leaves emerge.

Bioprospection folk use: The decoction of the flowers is used to core chest congestion and other respiratory ailments and also against fevers.

Part used: Flower

Use in TSM: In TSM apart from flowers, leaves and stem bark are also used as stimulant, refreshing, cardiac and brain tonic, sedative, laxative, in jaundice, in enlargement of spleen and anti pyretic.

Phytochemical constituents: 1, 4-dimethoxybenzene (a floral scent compound) (Dotterl *et al*., 2005). 12-O-tetradecanoyl-13- phorbol acetate isolated (TPA) (Sultana *et al*., 2004). *Salix caprea* stemwood and knots were found to contain the phenolic compounds, *viz*., vanillic acid, 3-p-coutharyl alcohol, coniferyl alcohol, sinapylaldehyde, dihydrokaemerol, catechin, naringenin, gallocatechin, dihydromyrcetin and taxifolin (Pohjamo *et al*., 2003).

Bioactivity: The plant has shown significant antioxidant and hepato-protective activity (Alam *et al*., 2006). The floral scent compound (1, 4-dimethoxybenzene) of the plant has shown attracting effect of an oligolectic bee (Dotterl *et al*., 2005). The plant inhibits skin carcinogenesis in marine skin, inhibition of oxidative stress, ornithine decarboxylase activity in DNA synthesis (Sultana *et al*., 2004).

Propagation/cultivation: It is difficult to propagate by seeds. The seeds retain their viability for 1-2 months even under most unfavourable conditions. The best method is to raise the plant by stem and root cuttings.

12. Name of Plant: *Taraxacum officinale* Webber.

Family: Asteraceae

Local name: Hundh /Dudhi/ Bathur/ Dandelion

Local distribution: Commonly found throughout Himalayas, grass lands, shady and moist conditions.

Taxonomic note: A glabrous perennial herb. Leaves all radical, sessile, oblanceolate or narrowly oblong toothed. Flowering heads solitary on leafless scape about 3-8 inches in height. Flowers yellow in colour.

Bioprospection folk use: The leaves are cooked as vegetable and given to the women during and after pregnancy as general and as uterine tonic. Also used as anti-inflammatory.

Part used: Aerial part

Use in TSM: Used in ascites, jaundice, cholecystitis and as liver and spleen tonic, resovlent. deobstruent. Seeds are used in tachycardia and enlargement of spleen. The decoction of root is used as blood purifier.

Phytochemical constituents: Lutein epoxide isolated from petals of dandelion *Taraxacum officinale* (Martinez *et al*., 2006). Luteolin and luteolin 7-O-glucoside (Hu *et al*., 2004). Five germacrane and guaiane type sesquiterpene lactones including two taraxinic acid derivatives, isolated from the roots of *Taraxacum officinale*, together with benzyl glucoside, dihydroconiferin, syringin and dihydrosyringin. The other lactones isolated and identified are 11 β-dihydrolactucin, ixerin D and ainslioside (Kisiel *et al*., 2000). Taraxalisin-a serine proteinase isolated from latex of roots of *Taraxacum officinale* (Rudenskaya *et al*., 1998). Three flavonoid glycosides: luteolin 7-glucoside and two luteolin 7-diglucosides isolated from dandelion flowers and leaves together with free luteolin and chrysoeriol in the flower tissue. The hydroxycinnamic acids, chicoric acid, monocaffeyltartaric acid and chlorogenic acid found throughout the plant and the coumarins. ciehoriin and aesculin identified in the leaf extracts of *Taraxacum officinale* (Williams *et al*., 1996).

Bioactivity: The dandelion flower extract possesses marked antioxidant in both biological and chemical models (Hu and Kitts, 2005). Luteolin and luteolin 7-O-glucoside from the plants suppresses the iNOS and COX-2 in RAW 264.7 cells (Hu and Kitts, 2004). The ethanol extract for antidiabetis herbal preparation of which *Taraxacum* is one of the component, has been found significantly to decrease the glucose and fructose amine levels in alloxan induced non obese diabetic mice (Petlevski *et al*., 2001). Hot water extract of the plant shows correlation with antitumor activity and administration timing (Baba *et al*., 1981). *Taraxacum officinale* increases nitric oxide production and synthesis from recombinant interferon-γ (rIFN-γ) primed mouse peritoneal macrophages. The synergy between rIFN-γ and *Taraxacum officinale* is mainly dependent on *T. officinale* induced tumor necrosis factor-α (TNF-α) secretion (Kim *et al*., 1999).

Propagation/cultivation: It can be propagated through both vegetative and seeds. However, seed propagation is more common. Seeds are sown in autumn to produce crop in late spring or early summer.

13. Name of plant: *Viola odorata* L.

Family: Violaceae

Local name: Nun-u-Posh/ Bunafsha/Garden violet

Local distribution: Throughout Jammu and Kashmir in shrubberies, forest clearings, rocky and shady areas. Bandipora - Tragbal, Kangan, Sindh valley, Baltal, Lidderwatt and Kishtwar.

Taxonomic note: A perennial herb with stout creeping root-stock. Leaves all radical, petiolate, heart shaped. Flowers purplish blue with long pedicels.

Bioprospection folk use: Flowers are taken internally to cure bronchitis and other upper respiratory ailments.

Part used: Whole plant

Use in TSM: Antipyretic, resolvent, laxative, emollient and demulcent. Also used in eczema and to cure certain eye-diseases and bronchitis.

Phytochemical constituents: Linear cyclotide, violacin A (Ireland *et al*., 2006). Two polypeptides-Vodo M and Vodo N isolated from *Viola odorata* (Svangard *et al*., 2003).

Bioactivity: Plant extract exhibited 100% repellency effects against aedes aegypti, Anopheles stephensi, and Culex quinquefasciatus (Amer *et al*., 2006). The chemical and biological stability of cyclotides of *Viola odorata* have the potential, as pharmacological tools and antitumor agents (Lindholm *et al*., 2002). Significant oral antipyretic activity in rabbits was exhibited by hexane. Chloroform and water soluble extracts of *Viola odorata*, comparable to aspirin. Antipyretic activity was more prominent in the hexane-soluble portion (Khattak *et al*., 1985).

Propagation/cultivation: Propagation through seeds is not common. Vegetative propagation is the best and productive method to raise the plants. It grows by rhizome like stems that can be separated from others on the crown and taken as cuttings with some roots present. These cuttings should be planted in autumn.

3. Results and Discussion

India's centuries old heritage of traditional medical systems have been utilized for preventive as well as curative aspects of health care. The Jammu and Kashmir State's contributing part to this treasure is also rich in ethnic folklore, culture and heritage. Because of the fact of its typical agroclimatic conditions, the vegetation is not only diverse but even the targeted plant species contain important secondary metabolites in large concentrations than growing in other parts of the country. The authors have collected a large number of folk claims during ethnopharmacological explorations but only 13 plants, which seem to have better prospects for commercial production have been discussed in the paper. It is well known that the modern system of medicine has been continuously attracting the attention of the people of Jammu and Kashmir State. However, still there is a large population who prefer to use natural herbs in primary-health care. These plants are used by locals in crude form besides being easily available and have successfully cured their ailments for generations (Lone and Bhardwaj, 2013).

A perusal of literature indicates that the use of many medicinal plants, *viz., Artemisia absinthium, Achillea millefolium, Berberis lycium, Cydonia oblonga* and *Viola odorata, etc*., have already been reported in literature. However, the modes of application in many

cases are different as far as the part of plant used, method of preparation of drugs and modes of administration are concerned. This suggests that folk medicinal therapies developed through personal experiences in tribal and other folk communities are mostly endemic in nature. Similarly the different names given to the plants in different areas also makes the ethnobotanical study important, *viz., Achillea millefolium* is known as "Pahl Ghasa" in the southern and eastern parts of the State, while as the same plant is known by the name of "Panjoli" in northern part of State. Same is the case *with Podophyllum hexandrum* which is known as Drenmokshu in Suru Valley (Ladakh), Papra in the upper reaches of the Naranag and Bun-wangun in the other parts of the State. *Viola odorata* is usually known by its Unani name, Bunafsha yet there are many places where it is called as Nun-u-posh. Another interesting observation about *Prunella vulgaris* locally known as Kalvoet is also known as Uste-kudus, particularly in the local herbal market. However, Uste-kudus is the Unani name given to *Lavandula stoechas* in Unani literature. Probably the name Uste-kudus to *Prunella vulgaris* was given by the medicine men from Central Asia who came to Kashmir during Mongol invasions and used it as a substitute of the Uste-kudus, More than one name given to the same plant, strongly suggests the preparation of comprehensive dictionary of local names of the plants to avoid confusions.

Unani system of medicine owns its origin to Greece. In India, Arabs introduced Unani system of medicine and had the State patronage up to 17th century. But during the British rule it suffered a set back due to withdrawal of Governmental support. Hakim Ajmal Khan championed the cause of this system in early twenties and had the vision of bioactive molecules present in various plant species. He is to be credited to integrate this system with modem system of medicine where mostly single drug molecules operate. In Unani system of medicine, single drug or their combinations in raw form are preferred over compound formulations. Moreover, substantial importance is attached to the temperament of the individual. The system offers time tested and excellent remedies for various diseases where modern medicine fails. However, the weaknesses/ shortcomings in traditional medicines involving plant based products is inadequate process of standardization and quality control. There is no proper finger printing of the ingredients in herbal medicines. Therefore, the methods need to be developed particularly to standardize polyherbal preparations (Gupta *et a*l., 2013). The present biological investigations of the plants showed promising activities that coincides with the folk claims already presented in materials and methods. It reveals that it is the traditional use that gives an impetus towards the modern biological activities and lays the foundation of reverse pharmacology. There is a need to undertake detailed phyto-chemical and pharmacological studies for the plants used locally. Since chemical investigation of plants have already yielded many new compounds of therapeutic value in recent years (Cotton, 1996; Buckingham, 1999), such detailed investigations may lead to the discovery of new bioactive molecules for the treatment of specific ailments for which there is no satisfactory cure in modern system of medicine.

The conservation and bioprospection of these medicinal plants is of utmost importance. What is the need of the hour is the integration of new molecular biological assays into the screening of extracts and plant constituents to evaluate detailed pharmacological profile. These methods should elucidate the synergistic effects of various constituents of an extract and herbal drug preparation and gain a better understanding of the mechanism.

Conservation of these plant species should be done involving both conventional as well as biotechnological approaches. Further, identification, isolation of novel genes and development of transgenics for designer plants will be quite fruitful for these listed plants. Domestication of certain high altitude plant species like *Picrorhiza kurroa* and *Podophyllum hexandrum* is a challenge. At CSIR-IIIM-Srinagar propagation through rhizomes and tissue culture in case of *Picrorhiza kurroa* and *Podophyllum hexandrum* has been completed. Identification of genes responsible for cold stress and the relation of this stress with glucosides content in *Picrorhiza kurroa* is underway. Cultivation protocols of elite accessions of *Podophyllum hexandrum* based on marker compounds has been successfully achieved by the Institute. The strategy for the development of medicinal plants will, thus include *in situ* and *ex situ* cultivation in near to nature conditions. Keeping in pace with the present international intellectual property rights (IPR), it is important to maintain authentic profiles of these important plant genetic resources through chemo and DNA profiling.

Conflict of interest

We declare that we have no conflict of interest.

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