COLLECTION AND CONSERVATION OF MAJOR MEDICINAL PLANTS OF ARUNACHAL PRADESH

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Introduction

India is one of the major biodiversity centres of the world and enriched by nearly 45,000 plant species. Out of these, about 2,500 species are described in Ayurveda along with over 10,000 formulations. The floristic wealth of the North-Eastern region of India is nearly 43% of the country's total flora. All our medicine systems like Ayurveda, Unani, Homoeopathy and Tibetan systems, apart from the folk practices, utilize the plants effectively.

Arunachal Pradesh has been identified as one of the "Biodiversity Hotspot" areas in the world (Myers, 1988). Its unique physiographical position; topography and high degree of precipitation are some of the important factors contributing to the occurrence of a large number of medicinal plants in the forests of the state. The tribes inhabiting the state recognize over 500 species of plants as having medicinal properties (Anon., 2003). These plants are found in different altitudes and vegetation types. The local inhabitants use these plants as herbal medicines, which are highly effective against some diseases and health problems. Due to over-exploitation coupled with poor regeneration and pressure from adverse factors, certain medicinal plants have become endangered. The problem is compounded by market demand driven harvesting without any concern for regeneration and conservation. In this process, essential regenerative components of the plants like roots, tubers, fruits, seeds, flowers etc. are indiscriminately collected, leading to degradation and depletion of resource base and even in certain cases extinction of a particular species. This warrants immediate conservation measures for these species under both *in-situ* as well as ex-*situ* conditions.

The forests of Arunachal Pradesh have been broadly categorized into tropical, sub-tropical, temperate and alpine types (Kaul and Haridasan, 1987). Like the forest types, the medicinal plants of the state are either the tropical, subtropical, temperate or alpine types, according to the forest types and agroclimatic zones of their occurrences. The tropical and subtropical forest types, occupying the lower elevations and foothill regions of the state, are the most disturbed and exploited, mainly to meet the demand for agricultural land, timber, fuelwood and other commercially valuable Non-Timber Forest Products (NTFPs) such as bamboos and canes (Shukla and Rao, 1993). Much of the tropical medicinal plants like *Emblica officinalis, Justicia adhatoda, Acorus calamus, Piper mullesua* and many others are found in low and mid-hill regions of

the state. The temperate forests, which cover nearly 34% of the total forest area in the state, occur between 1,800-3,000 m altitudes and are perhaps the least disturbed, mainly due to inaccessibility and unsuitability for conventional agriculture (Shukla *et al.,* 1994). *Aconitum, Panax, Taxus, Swertia, Rubia, Podophyllum, Picrorrhiza, Berginia, Rheum, Berberis,* etc. are a few of such species that grow abundantly in the high altitude alpine and temperate belts of the state. These species of commercial importance are being clandestinely collected from the wild without the backup of any systematic cultivation/regeneration practices. Indiscriminate collection and lack of management plans cause depletion of resource bases of these important medicinal plants, which could otherwise provide to be a perennial source of income to the poor.

Some of the medicinal plants like 'Mishmi Teeta' are endemic to this state. The tribal communities of the state draw their sustenance largely from the forests. Apart from the traditional and folklore uses, some of the medicinal plants can effectively be used as tools for economic development through commercial and industrial activities. A perusal of literatures reveals that some works have been done on ethno medicinal plants of Arunachal Pradesh (Haridasan *et al.,* 1995; Haridasan, 2001; Hegde, 1988; Rawat and Chowdhury, 1998; Shukla and Rao, 1993).

Methodology

Field trips were conducted in different areas of Arunachal Pradesh covering six districts *viz.,* Papum Pare, East Kameng, West Kameng, Tawang Lower Subansiri and Kurung Kumey (Fig. 1). The first trip was conducted during March-April 2004 covering Itanagar, Banderdewa, Chessa, Tipi, etc. areas under Papum Pare and East Kameng districts. The second trip was conducted during September-October 2004 covering Bomdir, Khirmou, Lhau, Se La Pass, etc. areas under Tawang district and Dirang, Bomdilla, Rupa, Shergaon, Kalaktang, etc. areas under West Kameng district. The third trip was conducted during October 2005 covering Hapoli, Ziro, Supuye Forest, etc areas under Lower Subansiri district and Koloriang, Palin, Sangram, Shakti, Dem, etc. areas under Kurung Kumey district. All the three trips have yielded 64 collections of different medicinal plants belonging to 46 species (Table 1). Collections were made from natural forests, roadsides, forest nurseries, etc. Depending on population size, either random sampling from the population or selective sampling on individual plant basis was followed. Collected materials include live plants, rhizomes, cuttings, suckers, seeds, etc. During the trips tribal people, local healers, elderly persons, gardeners, etc. were interviewed to get the ethnobotanical information like local names of the plants and their uses against different ailments following the method of Jain, 1987. Relevant literatures (Chopra *et al.,* 1956, Chandel *et al.,* 1996, Rawat and Chowdhury, 1998) were also consulted for gathering information on ethnobotany as well as active principles present in a particular species. The collected materials were introduced in the Field Gene Bank of NBPGR Regional Station, Umiam (Meghalaya) for their multiplication and subsequent characterization. Later on, the plants were identified with the help of plant taxonomists and consulting different flora (Hooker, 1885; Kanjilal *et al.,* 1934-40). Upon characterization, the seed/other vegetative parts of the collected accessions

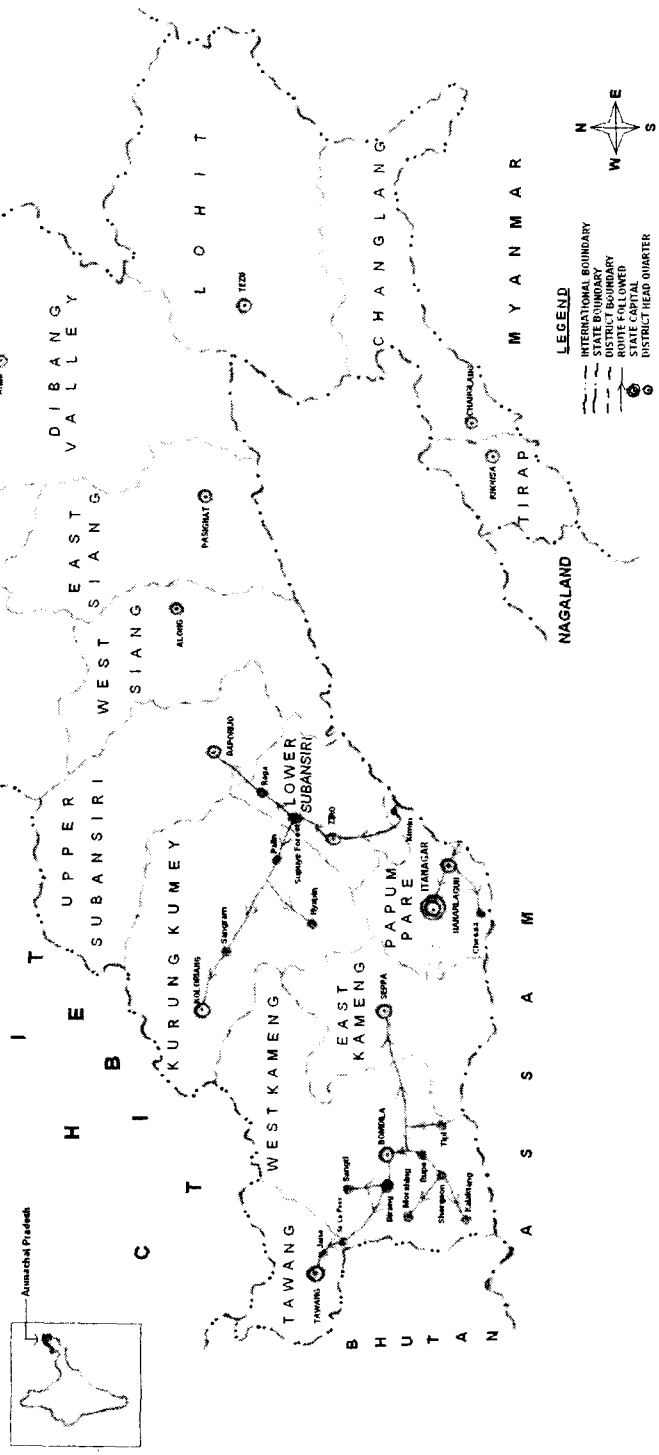

Fig. 1

Route map for the collection of medicinal and aromatic plant germplasm from the six western districts of Arunachal Pradesh.

Table 1

Details of exploration trips and corresponding collection of medicinal and aromatic plant germplasm undertaken in six districts of Arunachal Pradesh.

Sl. No.	Area explored	Period of survey	Diversities collected
1	2	3	4
1.	Itanagar, Banderdewa under Papum Pare Dist. and Chessa, Tipi of East Kameng Distt.	29-03-2004 to 04-04-2004	*Abrus precatorius* (1) *Andrographis paniculata* (2) *Aquilaria malaccensis* (1) *Asparagus racemosus* (1) *Azadirachta indica* (1) *Caesalpinia bonducella* (1) *Coptis teeta* (1) *Elaeocarpus sphaericus* (1) *Emblica officinalis* (1) *Jatropha gossypifolia* (1) *Justicia adhatoda* (1) *Justicia gendarussa* (1) *Oroxyllum indicum* (1) *Piper mullesua* (2) *Plumbago zeylanica* (1) *Rouvolfia sarpentina* (1) *Rubia cordifolia* (1) *Vitex negundo* (1) *Withania somnifera* (3) *Xanthoxyllum armatum* (1) = 24
2.	Bomdir, Khirmou, Lhau, Se La Pass, etc. of Tawang Distt. and Duangba, Dirang, Senge, Bomdila, Rupa, Shergaon, Morshing, Kalaktang, etc. of West Kameng Distt.	23-09-2004 to 02-10-2004	*Aconitum ferox* (1) *Acorus calamus* (1) *Artemisia nilagirica* (1) *Berberis aristata* (1) *Illicium griffithii* (1) *Lavendula vera* (1) *Nardostachys jatamansi* (1) *Panax pseudoginseng* (1), *Pelargonium graveolens* (1) *Picrorrhiza kurrooa* (1) *Plantago major* (1) *Podophyllum hexandrum* (1) *Polygonatum cirrhifolium* (1) *Potentilla fulgens* (1) *Rheum australe* (1) *Swertia chirata* (4) *Taxus baccata* subsp. *wallichiana* (1) = 31

Contd...

1	2	3	4
3.	Ziro, Hapoli, Supuye Forest, etc. of Lower Subansiri Distt. and Koloriang, Palin, Sangram, Shakti, Dem, etc. of Kurung Kumey Distt.	15-10-2005 to 24-10-2005	*Acorus calamus* (3) *Aloe barbadensis* (1) *Artemisia vulgaris* (1) *Berberis aristata* (1) *Clerodendrum colebrookianum* (2) *Costus speciosus* (1) *Hedychium spicatum*(1) *Houttuynia cordata* (3) *Kalanchoe pinnata* (1) *Panax pseudoginseng* (1) *Pelargonium graveolens* (1) *Stemona tuberosa* (1) *Swertia chirata* (2) *Valeriana herdwickii* (2) = 20
	Total		= 64

Number within parentheses indicates the number of accessions collected.

will be sent for long term conservation in the National Gene Bank, New Delhi.

Study area

Arunachal Pradesh, the most fascinating state of the Eastern Himalayas, is situated between 26°30' to 29°28' N latitudes and 91°25' to 97°24' E longitudes. It is bounded by Assam in the South, by Bhutan in the West, by China and Tibet in the North and by Myanmar in the East. The total geographical area of the state is 83,743 km^2, out of which 68,847 km^2 is under forest cover. The total population of the state is 10,91,117 (Census, 2001), of which 79.59% live in rural areas. The state can be broadly divided into four physiographic regions viz.:

(i) the plains and valleys, which are in continuity of Assam plains,
(ii) the sub-mountainous belt with altitudes up to 1,700 m,
(iii) the lower Himalayas between 1,700-3,500 m altitudes that receives heavy rainfall and
(iv) the greater Himalayas with altitudes above 3,500 m.

The average annual rainfall of the state is about 2,972 mm in the humid subtropical region and about 2,087 mm in the temperate humid region. The present study was concentrated in the six western districts of the state. The study area falls within approximately 27° to 29° N latitudes and 91°30' to 94 E longitudes having great altitudinal variations of less than 200 m in Papum Pare district adjoining Assam to more than 4,000 m in Tawang District. Among the major ethnic groups numbering 20-25 in the entire state, Monpa, Sherdukpen are dominant in Tawang District; Akas, Mijis, Monpa, Sherdukpen, Khowas are dominant in West Kameng District; Bangni, Nishi, Nishang, Adi, Daflas, Solungs, Hill Miris are dominant in East Kameng, Papum Pare and Kurung Kumey districts while Apatinis, Nishi,

Table

Ethnobotanical information of the

Sl. No.	Botanical name (Family)	Local name	Habitat	Parts used
1	2	3	4	5
1.	*Abrus precatorius* L. (Fabaceae)	Jesthamadhu	Found throughout India and up to 1000m altitudes on the outer Himalayas.	Seeds, leaves & roots
2.	*Aconitum ferox* Wall. ex Ser. (Ranunculaceae)	Bikhumma	Wild in hilly areas.	Rhizome
3.	*Acorus calamus* L. (Araceae)	Bojo	Grows in marshy land.	Rhizome
4.	*Aloe barbadensis* Mill. (Liliaceae)	Gheukumari	Grows wild as well as cultivated.	Whole plant
5.	*Andrographis paniculata* Wall. ex Nees (Acanthaceae)	Kalmegh	Prefers hot and humid climate, exposed or partially shaded areas within 800m altitude.	Whole plant
6.	*Aquilaria malaccensis* Lam. (Thymeliaceae)	Agar	Grows wild as well as cultivated in Eastern Himalayas, NE India.	Agar wood & agar oil
7.	*Artemisia nilagirica* (Clarke) Pamp. (Asteraceae)	Dona	Grows wild throughout the hilly region of India.	Stem & flower
8.	*Artemisia vulgaris* L. (Asteraceae)	Nagdona	Found in open situation and slopes.	Leaves & roots
9.	*Asparagus racemosus* Willd. (Liliaceae)	Satavari	Grows wild as well as planted throughout the tropical and sub-tropical regions of India.	Roots
10.	*Azadirachta indica* Tuss. (Meliaceae)	Neem	It grows wild as well as planted throughout India.	All parts

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collected medicinal plant species.

Uses with active principles
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The leaves and roots are astringent, sweet and emitic. Seeds are abortifacient and aphrodisiac. It contains glycyrrhizin, the principal constituent of liquorice and their decoction is given for coughs and cold. Seeds contain abrine, a poisonous principle.
The plant is considered bitter tonic febrifuge and antidiabetic. It is used in malaria, fevers, abdominal pains, diarrhoea and indigestion particularly for children. Roots contain pseudo-aconitine, bikhaconitine, chasmaconitine, indaconitine, bikhaconine, acetylbikhaconine.
It is used for the treatment of epilepsy and other mental ailments, intermittent fever, chronic diarrhoea, colic pains, as a brain tonic, etc. It is also used against asthma, cough and sore throat. Essential oil contains two isomeric substances- α and β asarone. Roots yield acoric acid and coline.
It is used as stomachic, tonic, purgative, anthelmintic. Leaf juice is put on head in high fever to reduce body temperature. Leaves contain barbaloin, aloe-emodin. Other constituents are aloesin and aloesone.
A decoction of the plant is blood purifier. It is a liver protective and used in jaundice, general debility, dyspepsia and malaria. It contains andrographolides.
Used in incense, as fixative in high-grade perfume, in oriental medicines, cosmetics, flavour industry. Its essential oil y ields α- and β-agarofuran, dihydro-β- agarofuran, iso-dihydro-α-agarofuran, selinene. Stem wood yields gmelofuran, agarol and aquillochin.
Its stem and flower are blood purifiers, it is also used in worm troubles and nervine affections. Essential oil contains camphor, 1:8-cineole and borneol along with a little quantity of β-tujone & β-pinene.
It is used as emmenagogue, anthelmintic, febrifuge etc. Leaves are used in asthma, nervous and spasmodic affections. Root is used as a tonic and antiseptic. Plant yields adenin and volatile oil, a good larvicide.
Roots are used as tonic, aphrodisiac and galactogenic. Plants contain satavarins I – IV. Flowers yield quercetin, hyperoside rutin. Leaves contain rutin, diosgenin and a flavonoid glycoside.
Leaf paste is useful in skin diseases; twigs are used in toothache, and seeds used as insecticide. It contains azadirachtin, nimbin, nimbicidin and fatty acids.

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1	2	3	4	5
11.	*Berberis aristata* DC. (Berberidaceae)	Daruhaldi	It grows as undergrowth in temperate conifer forests and sub-alpine scrub lands.	Root, basal stem, berries & flowers
12.	*Caesalpinia bonducella* Flem. (Asclepiadaceae)	Lataiguti	Found throughout the hotter parts of India.	Seeds, leaves & bark
13.	*Clerodendrum colebrookianum* Walp. (Verbenaceae)	Ban bhati	Grows wild in forest edges and cultivated in homestead and Jhum areas.	Leaves
14.	*Coptis teeta* Wall. (Ranunculaceae)	Mishmi Teeta	Found above 1800m in temperate and alpine forests receiving brief winter snowfall.	Rhizomes
15.	*Costus speciosus* Smith (Koenig) Sm. (Zingiberaceae)	Betlauree	Common in moist, shady places in the forests.	Rhizome & root
16.	*Elaeocarpus sphaericus* Gaertn. (Elaeocarpaceae)	Rudraksha	Grows wild as well as cultivated.	Fruits
17.	*Emblica officinalis* Gaertn. (Euphorbiaceae)	Amla	Grows wild and also cultivated in deciduous and tropical forests in lower hills and plains.	Fruits, leaves, bark & flowers
18.	*Hedychium spicatum* Sm. (Zingiberaceae)	Sara	Grows wild in moist places, hilly areas.	Rhizome
19.	*Houttuynia cordata* Thunb. (Saururaceae)	Siahamang (Nishi)	Grows wild in forests and wastelands and cultivated in Jhum areas.	Whole plant
20.	*Illicium griffithii* Hook.f. & Thoms. (Illiciaceae)	Lissi	Grows in open and shady areas in hill slopes of moist temperate forests within 1600-2500m altitudes.	Fruits
21.	*Jatropha gossypifolia* L. (Euphorbiaceae)	Bherenda	Grows wild in forests, planted in hedges throughout India.	Seed & oil

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It is used in the treatment of jaundice, enlargement of spleen, eye disease, sores, piles, intermittent fever, etc. Root bark is rich in berberine, berbemine, oxyacanthine, pendulin, aromoline, oxyberbemine, taxilamine and karachine.

It is used as a tonic and also against fever, colic, malaria, skin diseases, rheumatic pain, etc. The leaves and seeds are used in external application for dispersing inflammatory swellings. The leaves and barks are considered emmenagogue, febrifuge and anthelmintic.

Leaves are taken as vegetables or as decoction for reducing blood pressure. Young leaves are useful as anthelmintic. Roots contain triacontane, clerodin, *l*-amyrin, β-sitosterol and clerodolone.

It is used in the treatment of fever, stomach problems and eye diseases. It is also used as a tonic used for debility and dyspepsia. In China, it is used as antidiabetic. It contains beerberine and coptine.

It is used as stimulant, anthelmintic and antiinflammatory. Also used in gout, jaundice and anaemia, bronchitis, fever, rheumatism, etc. Boiled extract of rhizome is given in urinary stone cases. Tubers and roots contain diosgenin, sitosterol, β-sitosterol-β-D-glucoside, dioscin, gracillin and quinones.

Fruits are cardio stimulant, stress reliever and used in circulatory problems, stomach disorders. Decoction of seed is used in mental disorder, epilepsy, asthma, liver disorder and hypertension; bark is used to treat enlarged spleen. It contains rudrakine, elaeocarpine, ellagic acid and gallic acid.

Fruits are useful in diabetes, anaemia, jaundice, tridosha, flatulence and grayness of hairs and also used in many Ayurvedic preparations like Chavanprasha. It is astringent, cooling and laxative and a rich source of Vitamin C. It contains tannin, sitosterol and phytosterol.

It is used to treat liver disorders, vomiting, and stomach ailments. Rhizomes contain sitosterol and its glucoside. Essential oil contains cineole, γ-terpinene, limonene, β-phellanderene and β-terpineol.

Leaves are used in measles, dysentery, gonorrhoea and eye and skin troubles, stomach ulcers. It contains quercitin, Menonyl ketone and acetaldehyde. Aerial parts contain abzelin, hyperin, rutin, chlorogenic acid and β-sitosterol.

Fruits are used as spice. It has carminative and stimulative properties. On steam-distillation, seeds yield an essential oil resembling that from aniseed (*Pimpnella anisum* L.) and fennel (*Foeniculum vulgare* Mill.)

The leaf is used in skin diseases, boils; seed is emitic; plant is used in cancer. The latex is purgative and good for wounds. The oil is used in rheumatism. Seeds contain jatropholones A & B. The plant contains lignans, jatrophine that is similar to quinine in properties.

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1	2	3	4	5
22.	*Justicia adhatoda* L. (Acanthaceae)	Basak	Common in wasteland and forests.	Leaves & roots
23.	*Justicia gendarussa* Burm. f. (Acanthaceae)	Tita Basak	Frequently grown as a hedge or border plant.	Leaf
24.	*Kalanchoe pinnata* (Lam) Pers. (Crassulaceae)	Patharkuchi	Grows wild as well as cultivated.	Leaves
25.	*Lavendula vera* DC. (Lamiaceae)	Lavender	Cultivated in well-drained soils of hilly region at around 1500m altitudes.	Leaves & oil
26.	*Nardostachys jatamansi* DC. (Valerianaceae)	Jatamansi	Found in high altitude hilly regions	Rhizome
27.	*Oroxylum indicum* Vent (Bignoniaceae)	Bhatghila	Found in open secondary forests and degraded lands up to 800m altitudes. *It is a good light demander.*	All parts
28.	*Panax pseudoginseng* Wall. (Araliaceae)	Ginseng	Grows wild in high altitude forests	Rhizome
29.	*Pelargonium graveolens* L'Herit. (Geraniaceae)	Rose scented geranium	Cultivated in porous open soil in temperate, sub-tropical and tropical climate.	Green leafy shoots
30.	*Picrorrhiza kurroa* Royle *ex* Benth. (Scrophulariaceae)	Kutki	Grows wild in upper hilly tracts	Root
31.	*Piper mullesua* Buch.-Ham. (Piperaceae)	Pipli	Grows in partially shaded riverbanks and boundary areas up to 900m altitude.	Leaves & inflorescence
32.	*Plantago major* L. (Plantaginaceae)	Shomh-gon	Grows wild on roadsides, hill slopes of temperate and alpine region.	Whole plant
33.	*Plumbago zeylanica* L. (Plumbaginaceae)	Chitrak	It grows wild in forests as well as cultivated throughout India.	Roots

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Fresh leaf paste is given in dysentery, cough, fever, bronchial congestions, muscular sprains and gout. Fresh root paste is applied on abdomen and vagina just minutes before childbirth for easy delivery. The leaves contain very small quantity of an essential oil, a crystalline acid and an alkaloid, vasicine.

It is a febrifuge, emitic, emmenagogue and diaphoretic. It is used in the treatment of debility, snakebite and stomach troubles. Leaf contains a bitter and slightly toxic alkaloids.

Leaves are applied on wounds, bruises, swellings and insect bites. It is also believed to dissolve kidney stone. Leaves contain ρ-coumeric, ferulic, syringic, caffeic and P-hydrobenzoic acids, β-amyrin and sitosterol.

It is a stimulant. It provides fragrant oil, which is used in cosmetics. It contains linalyl acetate, linalool, geraniol and its esters, levandulol, nerol, cineole, caryophyllene, coumarin, limonene, β-ocimene, furfural, ethyl amyl ketone, thujone and pinocamphone.

It is used as a substitute for valerian. It is a tonic, stimulant, diuretic, antispasmodic used in flatulence. Oil is good for hair growth. The essential oil contains an alcohol ($C_{15}H_{24}O$), a sesquiterpene ketone (jatamansone), jatamansic acid, etc.

It is highly demanded for its bark, known as 'jigat bark'. Root bark is tonic and astringent, which is used diarrhoea and dysentery. Tender shoots are stomachic. Seeds are purgative. It contains oroxylin-A, baicalein, crysin and traces of an alkaloid, tannic acid, sitosterol and galactose.

Roots are known to be stimulant and helpful in combating general debility and weakness, headache, vomiting, blood pressure, etc. It is a carminative tonic and expectorant.

It yields a highly priced volatile oil, which is extensively used for perfuming soaps and cosmetics. Its oil contains geraniol and citronellol and their esters, isomenthone, isoamyl alcohol, ethyl alcohol, methyl pentanol, hexanol, methyl hexyl carbinol, borneol, etc.

It is used as bitter tonic, laxative, stomachic, effective in dropsy, etc. Also used in fever, diseases of liver and spleen including jaundice, anaemia, scorpion stings, etc. Roots contain kutkin, picroside, kutkoside, kutkiol and kutkisterol.

Leaves yield a volatile oil with an odour reminiscent of lime oil.

It is used in burns and inflammation of tissues, healing of wounds, headache, earache, toothache, diarrhoea, piles, etc. and also as an antipyretic agent. Its leaves contain aucubin, tannin, volatile oil, citric acid, Vitamin A, C and K.

The roots are used in piles, diarrhoea, rheumatism and as appetizer. Roots contain napthaquinone derivatives, plumbagin, chloroplumbagin, biplumbagin, elliptinone, chitranone.

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1	2	3	4	5
34.	*Podophyllum hexandrum* Royle (Berberidaceae)	Bankakri	Grows wild in upper hills or forests	*Rhizome* & root
35.	*Polygonatum cirrhifolium* Royle (Liliaceae)	Sirakal	It grows wild as well as cultivated in the temperate Himalayas (1200-4200m altitudes).	Roots & leaves
36.	*Potentilla fulgens* Hook. (Rosaceae)	Roi-shing	It grows wild in the hills of North-eastern India & temperate Himalayas.	Root
37.	*Rheum australe* D. Don (Polygonaceae)	Ko-chum	It grows wild in the hills as well as cultivated in high altitude areas.	Roots & rhizomes
38.	*Rouvolfia serpentina* Benth. ex Kurz (Apocynaceae)	Sarpagandha	Cultivated at lower elevations.	Roots & leaves
39.	*Rubia cordifolia* L. (Rubiaceae)	Manjisth	Common in forests of hilly region throughout India.	Roots & stem
40.	*Stemona tuberosa* Lour. (Stemonaceae)	Satamul	Found in Tamil Nadu, coastal Andhra Pradesh and Arunachal Pradesh, up to 1200m altitudes.	Tubers
41.	*Swertia chirata* Buch.-Ham. ex C. B. Clarke (Gentianaceae)	Chirato	Grows wild in well-drained, porous and exposed areas within 1800-3000m altitudes.	Whole plant
42.	*Taxus baccata* subsp. *wallichiana* (Zucc.) Pilger (Taxaceae)	Yew	Grows wild in moist temperate Himalayas between 1600-3600m altitudes.	Leaves and bark
43.	*Valeriana hardwickii* Wall. (Valerianaceae)	Saru Tagar	Found in the temperate Himalayas in between 1200-3600m altitudes.	Rhizomes & roots
44.	*Vitex negundo* L. (Verbenaceae)	Nisinda	Found throughout India, up to 1500m altitudes in the outer Himalayas.	Leaves, roots & bark

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Rhizome and roots are used as purgative, hepatic stimulant, bile expellant, bitter tonic, anti-diarrhoeal and in skin diseases. Roots contain podophyllotoxin, demethylpodophyllotoxin, α and β-peltatin & podophyllotoxone.

The leaves of the plant are eaten as vegetable. The plant is used as a tonic and vulnerary.

Root with betel leaf is chewed to get relief from toothache. It is also used in diarrhoea.

Roots and rhizomes are used as tonic and purgative. The plant contains the drug rhein and emodin and also sennosides A–F.

The roots are useful in hypertension. It is also used in painful affections, uterine contraction and removal of opacities of eye cornea. It contains reserpine, ajmaline and serpentine.

Root is used as tonic, astringent; stem is an antidote for cobra-bite and scorpion sting. It is also used as a blood-clotting agent, menorrhazia. The roots contain purpurin, xanthopurpurin, munjistin, pseudopurpurin. The plant contains rubicoumaric and rubifolic acid.

Roots show bacteriostatic and antiseptic properties and used in phthisis and cough. It soothes the respiratory centers without affecting the heart. It contains stemonine, stenine, tuberostemonine, isotuberostemonine, oxotuberostemonine, hypotuberostemonine.

It is used as bitter tonic and febrifuge. Also used in liver disorder, cough, constipation, fever, skin diseases and worms. Plants contain alkaloids- gentianine, gentiocrucine, enicoflavine & severchirin.

It is the source of anticancer drug – taxol. Leaves are anti-spasmodic, used in nervousness, hysteria and epilepsy. A tincture of young shoots is used in headache, giddiness, diarrhoea, liver disorder, etc. Bark contains taxol, ecdysterone, β-sitosterol, campesterol; leaves contain ephedrine, millosine, taxine A and B^4.

Rhizomes and roots of this plant are used against hysteria, hypochondriasis, nervous unrest, emotional troubles, and urinary troubles. The plant yields monoterpenic derivatives known as valepotriates, used as tranquilizers and sedatives.

Leaves are tonic and vermifuge; smoked for relief in catarrh and headache. Extract of leaves shows anticancer activity. Roots are tonic, febrifuge, diuretic, used in rheumatism and dyspepsia; also employed as a demulcent in dysentery and piles. Vitexin has been reported to be isolated from the leaves and root-bark of this plant.

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1	2	3	4	5
45.	*Withania somnifera* Dunal (Solanaceae)	Ashwagandha	Tropical areas with partial shade and well-drained localities.	Roots, seeds fruits & leaves
46.	*Zanthoxyllum armatum* DC. (Rutaceae)	Honam (Nishi), Yorkhung (Apatini)	Found in the hot valleys of the Himalayas up to 2000m altitudes.	Bark, fruit & seeds

Solungs are dominant in Lower Subansiri District (Hore, 1991). Each of these tribes has their own distinct culture, dialect and traditions. These tribes also have rich ethnomedicinal traditions. The areas under study fall within the altitudinal range of less than 200m in the adjoining areas of Assam under Papum Pare District to more than 4,000m in Tawang district with perpetual snowy mountain ranges. The tough terrain and vast natural barriers force the people of this region to depend on herbal medicine.

Results and Discussion

Medicinal plants have curative properties due to the presence of various complex chemical substances of different composition, which are found as secondary plant metabolites in one or more parts of these plants. These plant metabolites, according to their composition, are grouped as alkaloids, glycosides, corticosteroids, essential oils, etc. (Purohit and Prajapati, 2003). The etnobotanical information serves as a base for new compounds with active principles for phytochemical, pharmacognostical, pharmacological and clinical research. The allopathic systems of medicine, being partially, while the Homoeopathic and Ayurvedic systems are predominantly dependent on plant products. As per available statistics, there are nearly 7,850 manufacturing units utilizing medicinal plants as raw materials consuming large quantities in the country (Anon., 2003). Similarly, the indigenous people use many of the medicinal plants traditionally for treating their ailments. In each village and community, there are experts who practice such treatments and thus an effective local health care tradition exists. There are numerous instances when patients abandon allopathic medicines/ local hospitals to get treated by such experts for specific problems like fracture, piles, jaundice and other problems. All the collected plants were found to be used by the tribal people for treating various ailments like stomach disorders, fever, venereal diseases, cuts, toothache, headache, urinary disorders, rheumatism, menstrual disorders, etc. People use these plants in different forms such as juice, extract, decoction, paste, infusion, powder, etc. Obviously, there is a large market potential for such drug yielding plants. Nearly 95% of the raw materials required, come from wild sources (Rawat and Uniyal, 2003). Exploitation from the wild results in depletion of resource bases endangering the species.

Collection and population enhancement

In the present attempt 64 accessions

6
Roots are used to improve vigour and stamina. Useful in general weakness and rheumatism. It contains withanolides and withferin.
Fruits are used in stomach disorders, common cold, cough and fever. The seeds and bark are used as aromatic tonic in fever, dyspepsia and cholera. Steam-distillation of fruits yields an essential oil, which contains linalcol, linalyl acetate, citral, permanoil methyl cinnamate, limonene and sabine.

of medicinal and aromatic plants belonging to 46 species distributed over 45 genera and 36 families were collected from six districts of Arunachal Pradesh. The ethno-medicinal aspects covering their botanical name, local name, habitat, family and uses with active principles, of all the 46 species are enumerated in Table 2. Both vegetative propagation by cutting or by some specialized structures like suckers, rhizomes, tubers, etc. and sexual propagation through seeds were being followed for their population enhancement.

Conservation strategies

Realizing the ecological importance and economic utility of medicinal plant resources, there is growing concern throughout the world about the need of their conservation. During the recent past such concern has found expression in the establishment of several national and international initiatives and committees such as Genetic Resource Conservation Initiative of the CBD and WHO Committee on Good Agriculture and Field Collection Practices (GAFCP).

Under the present circumstances, it has been felt necessary to undertake both *in-situ* as well as *ex-situ* conservation strategies for medicinal plants. *In-situ* conservation may be done by way of setting up of Biosphere Reserves, Gene Sanctuaries, National Parks, etc. Similarly, *ex-situ* conservation means conservation of plants outside their natural habitats. This includes cultivation and maintenance of medicinal plants in botanic gardens, field gene bank, other suitable sites and through long term preservation of plant propagules in gene banks (seed bank, pollen bank, DNA libraries, etc.) and in plant tissue culture repositories by cryopreservation.

The varying ecological condition prevailing in the region necessitates identification of right species to be brought under cultivation in a particular locality. In the present attempt, all the collected materials, which include 24 herbs, 11 shrubs, 5 climbers and 6 tree species, have been introduced in the field gene bank of the regional station, located at mid-hill (1,000m amsl) situation of Meghalaya. Inspite of taking utmost care for their maintenance and subsequent multiplication, some of the high altitude plant species *viz., Podophyllum hexandrum, Picrorrhiza kurroa, Aconitum ferox, Nardostachys jatamansi, Rheum emodi,* etc., collected during exploration trips could not acclimatize in this mid-hill situation. Therefore, it is suggested that in addition to their *in-situ* conservation, *ex-situ* conservation measures should also be taken in some high altitude areas like

Tawang for *Aconitum ferox,* Sela Pass for *Podophyllum hexandrum, Rheum emodi,* Dirrang for *Picrorrhiza kurroa, Nardostachys jatamansi, Illicium griffithii,* etc. Subsequently, seeds/ vegetative parts of all the accessions acclimatized in the field gene bank of the station will be sent to the National Gene Bank for their long-term conservation.

Conclusion

The medicinal plants included in this paper are by no means exhaustive. It is only a part of the actual medicinal plant wealth, adapted to scientific but diverse ecological conditions within the study area. Further exploration, survey and collection of ethno-medicinal information will provide cheap and reliable source of medicine to the masses. Phyto-chemical screening and botanical identification of the plants materials along with detailed description of their growing sites will help in recovering endangered or relic species. Finally, with cultivation and selection, it would be possible to create immense number of plant varieties adapted to diverse conditions that would eventually sustain our biodiversity and thus preserve and halt our massive habitat loss.

SUMMARY

Arunachal Pradesh has been identified as one of the "Biodiversity Hotspot" areas in the world. The tribes inhabiting the state recognize over 500 species of plants as having medicinal properties. The authors have conducted field trips in different areas of Arunachal Pradesh covering six western districts during March, 2004 – October 2005. In this attempt, they have collected 64 accessions of medicinal and aromatic plants belonging to 46 species distributed over 45 genera and 36 families. The local people were interviewed to get the ethnobotanical information on collected material, including live plants, rhizomes, cuttings, suckers, seeds, etc. The collected materials were also introduced in the Field Gene Bank of the NBPGR Regional Station, Umiam (Meghalaya) for their multiplication and subsequent characterization. The ethno-medicinal aspects of medicinal and aromatic plants, covering their botanical name, local name, habitat, family and uses with active principles, of all the 46 species are presented in the paper. The authors have also emphasized *in-situ* as well as *ex-situ* conservation strategies for medicinal plants.

Key words **: Medicinal Plants, Arunachal Pradesh, Collection, Conservation.**

अरुणाचल प्रदेश के मुख्य औषध–पादपों का संग्रह एवं संरक्षण

एस० हुसैन व डी०के० होरे

सारांश

अरुणाचल प्रदेश को विश्व के जैवविविधता सम्पन्न क्षेत्रों में गिना जाता है। इस राज्य में बसने वाली जनजातियां 500 से भी ज्यादा जातियों के पेड़–पौधों को पहचानते हैं जिनमें औषधीय गुण मिलते हैं। प्रस्तुत अभिपत्र के लेखकों ने अरुणाचल प्रदेश के विविध क्षेत्रों में कई क्षेत्र यात्राएं सम्पन्न की हैं जिनमें मार्च 2004–अक्टूबर 2005 में उन्होंने वहां के छह पश्चिमी जिलों की जांच पड़ताल की है। अपने इस प्रयत्न में उन्होंने 36 कुलों की 45 प्रजातियों में पड़ती 46 जातियों के औषधीय एवं सौरभिक पादपों की अवाप्तियां संग्रह की। संग्रहीत सामग्री की जाति–वनस्पति जानकारी प्राप्त करने की उन्होने स्थानीय लोगों से पूछताछ की। इस सामग्री में सजीव पौधे, शिफास्तम्भ कलमें, जडवे, बीज आदि सम्मिलित हैं। इस संग्रहीत सामग्री को एनबीपीजीआर, क्षेत्रीय

केन्द्र, उमियम, मेघालय के क्षेत्रीय जीन बैंक को बहुलन और विशिष्टिता अभिज्ञान प्राप्त करने को दिया गया। औषधीय और सौरभिक इन सभी 46 जातियों के पेड़–पौधों के जाति वनस्पति पक्षों को इस अभिपत्र में बताया गया है जिनमें इनके वनस्पति शास्त्र नाम, स्थानीय नाम, प्राकृतावास, कुल उपयोग और इनके सक्रिय तत्व आ जाते हैं। लेखकों ने इनके मूलस्थान में तथा उनसे बाहर के स्थानों में औषध पादपों के संरक्षण की समरनीतियां अपनाने पर भी जोर दिया है।

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