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Review

A study on the current status of Pharmacognosy and its place in the future of man

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The use of drugs goes back to time immemorial, ever since primitive man resorted to the world around him to derive remedies, which could alleviate pain and cure illness. The knowledge of drugs has developed together with the evolution of scientific and social progress. The present paper presents an overview on the current status of Pharmacognosy and its place in the future of man.

Key words: Pharmacognosy, allopathic medicine, traditional medicine.

INTRODUCTION

To explore the pharmacognosy is to follow the evolution of man‟s knowledge during the various civilizations from the dawn of the time to the present. The history of the therapeutic use of the naturally occurring drugs went hand in hand with the history of medicine for millennia together, until the scientific progress evidenced peculiar characteristics that enabled it to develop as an autonomous science. The modern pharmacognosy concerns mainly with the plant drugs associated with allopathic medicine, but there are some other systems of great significance such as herbal medicine, homoeopathy, aroma therapy and boch remedies which also employ plants in the treatment of diseases. In addition to these, there are traditional systems of medicine widely practiced outside Europe. Of these the Asian (Ayurvedic and Unani) and Chinese are the two most significant systems of medicine, each having a recorded history.

India has a long tradition of the use of drugs derived from plants and herbs in Ayurveda and Unani Tibb system of medicine. Ayurvedic materia medica is a rich repository of herbs and about 2000 species of plants are mentioned in Ayurveda (Raghunathan, 1987; Dar and Farooq, 1997). In the Veda and Atharveda written around 2000 BC, one finds medical references and prescriptions for a number of maladies such as rheumatism, neuralgia, gout, jaundice, tumours, bronchitis, elephantiasis, skin diseases, etc. In numerous other treatises of Vedico-Brahminic medicine, including the Susruta (1300 BC), myriads of drugs like Opium, Rauwolfia, Nux vomica, Aconite, Hashish, Datura, Mustard seeds, Lemon, Antimony, Sulphur, Gold (which was considered an extremely potent drug), Human Milk, Blood, the Testicles of various animals especially those of *Moschus moschiferus* (recommended against impotence) have been described (Pasquale, 1984). The Aryans had rudimentary knowledge of medicines when they came to this country. The “Oshadi Suktem” of Rigveda, the oldest repository of Indian wisdom is perhaps the oldest scientific account of classification of medicinal plants. A systematic and detailed account of medicinal plants is given in “Charaka” (1000 BC) (Raghunathan, 1987).

The history of Unani (Greco- Arabian) system of medicine can be traced to ancient times (131 - 200 A.D). The Unani system of medicine owes its origin to Greece where Hippocrates (460 - 377 BC) laid the foundation for it. Later, Dioscorides (1st century A.D) gathered the whole gamut of information known up to then about the medicaments in use. His book, “*De Materia Medica*”, spread widely in the Roman and Arab world and exercised a great influence through the middle Ages. For more than 1500 years during the Great Roman period and in the middle ages, this book was the Bible for doctors and pharmacists (Anderson, 1977). In 800 AD, the Greek medicine was transferred to Baghdad, the capital of the Abbasid Caliphate. After going through the

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period of translation, the Arabs came forward and developed the system further. Consequently, Abu-Ali Hussain Ibn Sina popularly known as „Avicenna‟ (980 - 1037AD), Ibn al Baytar popularly known as „Ibn Baithar‟ (1248), and Zakariya Razi popularly known as „Rhazes‟(1826) in the west made tremendous contributions to the advancement of the Unani medicine. Their books, particularly Al-Quanoon (Avicenna), Kitab-al-Jami le Mufradat-al-Advia Wa-al-Aghzia (Ibn al Baytar) and Al-Hawi (Rhazes) were the part and parcel of the medical curriculum in a number of western medical schools till the 18th century. Ibn Baithar described more than 1400 drugs of vegetable origin mentioning their botanical and geographical details and also their biological activity. The Arabs later developed it into an elaborate medical system which reached India around the 13th century AD via the Central Asia (Pasquale, 1984). Initially neglected, it slowly gained the ground and flourished along with the other Indian systems of medicine. The hitherto traditional Unani therapy started receiving strength and support of the modern scientific research methodology in the 20th century when Masihul-Mulk Hakim Ajmal Khan initiated experimentation and engaged Dr. Salim-uz-zaman Siddiqui, an eminent scholar of chemistry of natural products, to streamline research in Unani medicine in the 1920`s. Dr. Siddiqui‟s subsequent discovery of the medicinal properties of Asrol (Chotachand or Pagal bhooti) led to the establishment of its efficacy in curing hypertension, insanity, schizophrenia, hysteria, insomnia and other psychosomatic ailments. This brought a widespread recognition to the Unani system from national and international medical circles. Later, Hakeem Abdul Hameed, the founder of Hamdard (Waqf) Laboratories, a Unani pharmaceutical company of Delhi, promoted experimentation and drug manufacture on modern lines, and also followed the modern protocols for clinical trials etc. before launching the new products. Ajmaloon (for treating hypertension), Lipotab (for reducing cholesterol level), Jigrin (for liver disorders), and Qurs-e-Kilya Jadeed (for toning up the renal function) are among the recent herbal drugs that were developed by the late Hakim Abdul Hameed. He established institutions for teaching and research of Unani medicine and urged the Govt. of India to create an autonomous council for promoting researches in Unani medicine. The Central Council for Research in Unani Medicine (CCRUM) is currently conducting clinical trials on some endemic diseases such as filariasis and acute hepatitis, and other ailments like leucoderma, malaria, rheumatoid arthritis, guinea worm disease, diabetes mellitus, psoriasis, asthma, amoebic dysentery, renal and bladder calculi and the gastric and duodenal ulcers.

REVIEW OF LITERATURE

The re-examination of nature in the search for new therapeutic means has obtained remarkable results. The study of ancient official drugs, which had fallen into disuse because they were suspected by empiricism and ethnography, has brought about a re-discovery of the therapeutic means used for millennia. *Rauwolfia*, *Amni visnaga*, *Galanthus nivalis*, *Stephania cepharantha*, *Vinca*, *Podophyllum peltatum* are some classical examples. *Lonchocarpus cyanescens*, *Costus afar* and *Terminalia ivorensis*, used in the ethnomedicine of the Igbo tribes of Nigeria, have been confirmed as having remarkable anti-inflammatory and anti-arthritic activity. Substances of anti- inflammatory and analgesic properties have been isolated from *Dianthus barbatus* and the leaves of *Aspidosperma quebraco blanco*.

Brucea antidysenterica, a plant of the Simarbaceae employed in Ethiopia and Eritrea in the treatment of cancer, contains bruceantin and bruceantinol, two potent anti- leukemic agents. *Jatropha gossypyfolia* of the Costa Rican popular medicine has been found to inhibit five standard systems of tumour, and its activity is principally due to a macrocyclic diterpenoid, jatrophone. Antitumor activity has also been confirmed in the case of: mezerein from *Maytenus serrata* in Ethiopia; of Camptothecin from *Camptotheca acuminata* in China; of lapachol from *Tabebuia* Sp. and *Tecoma* Sp. in Brazil and from *Jacaranda* Sp. in the Bahamas; of Sanguinarine and the Cheleritrin from *Sanguinaria canadensis* (dragon blood) of the Cherokee Indians, all drugs used in fact for their anti-cancerous activity. Silybin of *Silybum marianum* has been shown to possess antihepatotoxic activity for which it was widely used in Germany and Italy. *Litospermum ruderale*, *Dioscorea composita* and *Myrsine africana* were used as oral contraceptives by the Squaws of the Indian tribe in Neveda, by the Indios in Mexico and in India, respectively. In China, cotton seeds were employed to inhibit male fertility only during the period of treatment. In order to speed labour, *Oldelandia affinis* was utilized by the natives of Zaire. Today all these activities have been pharmacologically confirmed (Stone, 1962; Thorwald, 1962; Farnsworth, 1979; Shellard, 1981; Pasquale, 1984). *Podophyllum hexandrum*, a North-West Himalayan medicinal herb, has been extensively exploited in traditional and Ayruvedic system of medicine for treatment of number of ailments like constipation, cold, bilary fever, septic wounds, burning sensation, erysepelas, insect bite, mental disorders, rheumatism, plaque etc. and to provide relief in some of the allergic and inflammatory conditions (Chatterjee and Pakrashi, 1995). Utility of *P. hexandrum* has been established in the treatment of cancer, venereal warts, monocytoid leukemia, Hodgkin‟s disease, non-Hodgkin‟s lymphoma, and cancer of brain, lung and bladder. It has been considered a drug of choice in the treatment of *Condyloma acuminata* and *Tinea capitis* (Goel *et al*, 1998). Antiviral activity and anti- HIV properties of *P. hexandrum* have also been recently reported (Singh and Shah, 1994; Gowdey et al., 1995; Kumar and Goel., 2000).

The growing disenchantment with the modern allopathic system of medicine is reflected from the upcoming tendencies of people turning to alternative systems of medicine like Ayurveda, Unani, Homoeopathy, Acupuncture, Siddha, and Yoga. Popularity of these systems finds a fillip from the belief that herbal drugs are relatively safe and exhibits a remarkable efficacy in the treatment of various ailments. Medicinal drugs derived from natural sources contribute greatly to the global health care. An estimated 80% of people in developing countries depend on traditional system of medicine for primary health care (Farnsworth et al., 1985). One-fourth of all prescriptions filled by Pharmacies each year are for substances derived from plants, and when drugs from micro-organisms and animals are added in, the total increases to 40% (Wilson, 1992). Some 120 chemicals extracted in pure form from about 90 species of higher plants are used in medicines throughout the world; an extremely wide range of plant species being used medicinally at a local level (Dar and Farooq, 1997). The World Health Organization (WHO) has reported about 4 billion people as relying on herbal medicines and listed over 21,000 plant names (including many synonyms) said to be of medicinal use around the world. However, only about 5,000 higher plant species have been thoroughly investigated as potential sources of new drugs (Dar and Farooq, 1997).

Examination of drugs used in the traditional medicine in various countries of the world is one of the priority programs of WHO. In fact, from 1973 to 1974, WHO along with UNICEF has made a collaborative study of world health with the aim that all the people of the world should have health care by the year 2000. As the cost of general diffusion of health care system of the developed countries is extremely high, it has been deemed indispensable to propose alternative methods represented by traditional therapeutic agents (Pasquale, 1984).

Recently, an Israeli company, Galilee Herbal Remedies, has discovered a cure for pain caused by migraine headaches using a herb *Panacetum parthenium* (commercially known as fever few), that has been known for its medicinal properties for over 200 years. It not only relieves the migraine headache but also helps alleviate pain due to arthritis and pre-menstrual tension. The fight against HIV and AIDS may have recruits from India in the form of an array of plants which have been used in Ayurvedic, Unani and other traditional systems of medicine. Researchers at New Delhi's National Institute of Immunology (NII) have begun investigating the anti-HIV properties of seven plants, namely, Tulsi (*Ocimum sanctum),* Brahmi *(Centella sp.),* Ashwagandha (*Withania somniferum*), Punarnaya (*Boerhavia difusa*), Satavari (*Asparagus racemosus*), Gilogiloya (*Tinospora cordifolia*), and Nirbrahmi (*Bacopa monniera*). For over 1,000 years, these plants have been known for their anti-stress properties, and their ability to stimulate the immune system, says Dr. Ranjit Roy Chaudhury of NII. According to him, no pre-clinical evaluation of the safety of these plants is necessary because they are routinely used in several health tonics and have no side effects. NII researchers are also excited by the results of experiments with Neem (*Azadirachta indica*). Extract from the Neem leaf inhibited HIV in vitro. Elucidation of Neem's anti-HIV properties was a spin-off from researches at NII about the plant's use in birth control (Vasishta and Gill, 1999).

Reports from the southwest Cameroon in Africa reveal a rainforest vine that has shown a remarkable activity against HIV-virus at least *in-vitro*. The National Cancer Institute (NCI) of USA is doing intensive experimentation with the michellamine B, the active biocompound of woody vine, a species previously unknown to the western science. The NCI program is the largest in the world, based on collection of plants in 25 developing countries, to screen natural products for anti-cancer and anti-HIV activity. Since 1987, they have tested some 7000 species and stored hundreds of thousands of natural extracts (Table 1). Since the Rio Earth Summit, many third world countries are moving to control access to genetic resources particularly in view of their immense therapeutic potential (Vasishta and Gill, 1999).

The medicinal herbs assume a tremendous importance at a time when the whole world is showing a resurgence of interest in the healing properties of plants. These herbs not only provide raw materials for the manufacture of allopathic drugs but have also served the hillman for decades and suit his local medicinal system. Plants are the great source of natural chemicals. From among the 2.5 Lakh plant species in the world, two thousand species are used for medicinal purpose (Anonymous, 2000). It has been reported that there has been an alarming increase in number of diseases and disorders caused by synthetic drugs prompting a switch over to traditional herbal medicine. It is said that the herbs restore the *tridosha* balance in an individual which when upset results in disease or disorder. The rising demand for complementary and alternative medicine over the past decade is a true gross- root phenomenon. They are also cost effective and gaining wide spread acceptance for their effectiveness (Anonymous, 2000).

The renaissance of medicinal and aromatic plants for health care is gaining immense popularity in the recent years, not only in the developing countries but also in developed industrialized countries. A large number of manufacturing units, some with multicrore investment and some multinationals, have also entered in this area of drugs and pharmaceuticals. A majority of raw materials, used by these industries, are plant based and the bulk of these are made available from forest or other natural / wild sources through various trade channels but these, generally lack in uniform quality. This creates a frightening to the desired therapeutic efficacy of drugs.

This situation further worsened due to various

Table 1. Potential medicinal plant species with their active principles and usage.

Species	Part used	Active ingredients	Medicinal usage
Acorus calamus.	Rhizome, Stem.	Asarone, Acoron.	Epilepsy and depression.
Aconitum heterophyllum.	Tuber.	Atesine, Aconitine.	Aphrodisiac, Antipyretic, Astringent, Anti-rheumatic.
Adhatoda vasica.	Leaves and young apical buds.	Vasicine.	Expectorant.
Aloe barbadensis.	Succulent leaves.	Aloin.	Purgative and in the treatment of piles
Ammi majus.	Fruits.	Xanthotoxin.	Anti-leucoderma.
Artemesia annua	Whole plant.	Artemizinine, Santonin.	Anti-malarial.
Artemesia cina	Flowers	Santonin.	Anti-helmintic.
Artemisia absinthium	Leaves, Un-opened Flowers.	Santonin.	Anti-helmintic and Stomachic, Stimulant and Tonic.
Artemisia maritima	Flowers.	Santonin.	Anti-helmintic.
Atropa acuminata.	Roots, Leaves.	Atropine, Hyoscyamine, Hyoscine	Sedative, Anti-spasmodic.
Atropa belladonna.	Roots, Leaves	Atropine, Hyoscyamine.	Dilation of Pupils, Anti-cholinergic.
Bacopa monniera.	Whole plant.	Bramhine.	Nervous tonic, Mental disorders,Diarrhoea, Cataract, Bronchitis.
Berberis aristata.	Root bark.	Berberine.	Ophthalmic.
Butea monosperma.	Stem. Flowers.	Butrin, Isobutrin,	Anti-hepatotoxic.
Camellia sinensis.	Leaves.	Caffeine.	CNS stimulant.
Cannabis sativa.	Leaves, Flowering tops.	Cannabidiol, Cannabidolin, Cannabinol, Trans- tetrahydro-cannabinol.	Narcotic, Analgesic, Hysteria and Nervous disorder.
Carica papaya. Leaves, Root, Fruit, and Seed. Menstrual disorder, Papain.			Proteolytic, Digestive, Anthalinthic.

Table 1 Contd.

Cassia acutifolia.	Fruits.	Sennoside.	Against vulnus Incisinus ulnus, Purgative.
Cassia angustifolia.	Leaves.	Sennoside.	Laxative.
Cassia fagopyrum.	Leaves.	Rutin.	Vaso-protective, Anti-diabetic, Anti-allergic.
Catharanthus roseus.	Roots.	Vincaleucoblastine, Leucocristine, Ajmalicine.	Anti-cancerous.
Cephalis ipecacuanha.	Roots and Rhizomes.	Emetine.	Emetic, Expectorant.
Chrysanthemum cinerariaefolium.	Flowers.	Pyrethin.	Insecticide, Anti-fungal, Anti-bacterial.
Cinchona ledgeriana.	Bark.	Quinine.	Anti-malarial.
Cinnamomum camphora.	Wood of the plant.	Camphor.	Rubefacient, Anti-septic, Analeptic & Cardiac stimulant.
Citrulus colocynthis.	Pulp of ripe Fruits.	Colocynthin, Cucurbitacin E.	Violent Purgative.
Citrus spp.	Peeling of Fruit.	Hesperidin.	Cosmetic.
Colchicum autumnale.	Corms.	Colchicine.	Anti-tumour agent. Treatment of gout.
Colchicum luteum.	Seeds and Corms.	Colchicines.	Relieving of pain of joints, Bronchial diseases and Anti-Inflammatory.
Crocus sativa.	Stigma, Upper part of style.	Protocrocin, Crocetin, Picrocrocin,	Cosmetic, Tonic, Aphrodisiac, Sedative, Sposmolytic, Anti-cold.
Curcuma longa.	Rhizomes.	Curcumin, Termerone.	Antibiotic, Analgesic, Anti-inflammatory, Blood purifier.
Cymbopogon citratus.	Whole Plant	Citral, Geraniol, Citronellal.	Anti-septic and Anti-mosquito.
Datura innoxia.	Flowers.	Scopolamine.	Sedative.
Datura metal.	Seeds,Leave	Hyoscine.	Anti-spasmodic, Autonomic.

Table 1 Contd.

Datura stramonium.	Leaves and Flowering Tops.	Hyoscyamine.	Anti-asthmatic.
Digitalis lanata.	Leaves.	Acetyldigoxin, Degitoxin, Digoxin, Lanatosides.	Cardio-tonic.
Digitalis purpurea.	Leaves.	Digoxin , Digitoxin.	Cardio-vascular disorders,
Dioscorea deltoidea.	Tubers.	Diosgenin.	Oral Contraceptive, Steroidal and Ant-fertility.
Ephedra sinica.	Stem, Leaves.	Ephedrine.	Stimulant, Nasal and Bronchial decongestant.
Glycyrrhiza glabra.	Roots and rhizomes.	Glycirrhizin.	Expectorant, Duodenal ulcer treatment; Anti-inflammatory.
Hyoscyamus niger.	Leaves, Flowering tops.	Hyoscine, Hyoscuamine, Atropine.	Treatment of asthma and Whooping cough;Purgative.
Mentha arvensis.	Leaves and Flowers.	Menthol.	Rubefacient, Carminative, Anti-spasmodic.
Moringa oleifera.	Seeds.	Althomin.	Antibiotic.
Panax quinquefolia.	Roots.	Panaquilon.	„All-Cure" in China.
Papaver somniferum.	Capsules.	Codein, morphine, Narcotine, papaverine.	Analgesic.
Picrorhiza kurroa.	Rhizome.	Picroside, kutkoside, Apocyanin.	Bitter tonic, Cathartic, Stomachic, Febrifuge, Anti-malarial, Hepatotoxic, Cholagogue.
Plantago indica.	Seeds.	Xylin.	Carthartic, Purgative.
Podophyllum hexandrum.	Rhizomes.	Podophyllotoxin, Podophylloresin.	Anti-cancerous and Anti-HIV.
Rauwolfia serpentina.	Roots.	Serpentine, reserpine, ajmalicine, rescinamone.	Anti-hepatotoxic, Cure for snake bite and Mental disorders.
Rhamnus purshiana.	Bark.	Cascarosides. Emodin.	Purgative and Bitter tonic.
Rheum emodi.	Rhizome.	Anthraquione, Emodin, rhein, Sennosides A&B.	Purgative.

Table 1 Contd.

Salix alba.	Bark.	Salicin.	Analgesic, Febrifuge, Anti-rheumatic.
Saussurea lappa.	Roots.	Saussurine, inulin Potassium nitrate, Kushtin.	Cardiac stimulant, Anti-septic, Anti-infectant, Sposmolytic.
Silybum marianum.	Roots, Seeds	Silybin,Silymarin, Silydianin.	Treatment of liver disorders, Jaundice and Gall stone.
Stizolobium deeringianum.	Fruits and Seeds.	Hyoscymine. L-Dopa.	Anti-parkinsoninan.
Strychnos naxvomica.	Seeds.	Strychnine.	CNS stimulant.
Strychnos toxifera.	Seeds.	Curare.	Muscle relaxant.
Taxus bacata.	Stem.	Taxol.	Anti-cancerous.
Thymus vulgaris.	Leaves.	Thymol.	Anti-fungal.
Valeriana wallichii.	Roots.	Valerian.	Treatment of Epilepsy.
Withania somnifera.	Roots, Stem.	Somniferin.	Anti-ulcerogenic.

vernaculars, used in indigenous literature, creating lot of confusion with regard to the correct botanical identity of raw materials. Hence, a number of crude drugs whose botanical identity has not yet been established were subjected to adulteration and substitution. Likewise, the herbal drug market is also full of adulterants and substitutes of genuine drugs. Sometimes, not only various species of a particular genus but entirely similar looking different taxa are being sold under the same vernacular names. Thus, the adulteration of genuine drug material is the main factor responsible for degradation of desired therapeutic efficacy of a drug. In view of this, there is an urgent need that adulterants and substitutes be defined in terms of pharmacopoeial standards. Ultimately, such standards can be identified as quality markers for raw drugs by the pharmaceutical industries, enabling them to obtain real therapeutic action of a particular drug. In this context, the pharmacognosy institutions of the country are currently engaged in the quality evaluation of herbal drugs / formulations or products, using different botanical/ chemical parameters and have standardized a number of single herbal drugs and generated valuable expertise in this direction (Anonymous, 1999).

Reliance on medicinal plants is again gaining ground even in the most developed countries. However, due to various anthropogenic factors (such as, various developmental activities, over-exploitation, uncontrolled grazing and frequent forest fire) and natural catastrophes (like land sliding and earth-quakes), there is a perceptile decline in the population of many medicinal plants, making them rare and threatened. On the basis of their declining trend and status of existing population, these species are included into new IUCN Red list categories. The endangered species of the Himalayas listed in Red Data Book of IUCN include *Aconitum heterophyllum*, *Podophyllum hexandrum, Acorus calamus*, *Dioscorea deltoidea*, *Delphinium denutatum*, *Polygonatum verticilltium, Arnebia benthemii* etc. (Anonymous, 1999). It is relevant to mention here that India is rich in endemism and a large number of endemic and other taxa are threatened with depletion and extinction (Jain, 1987).

About one third of India"s 1,5000 flowering plants are endemic and about three thousand species are threatened (Jain and Roa, 1983; Jain and Sastry, 1985). The excessive collection of medicinal plants has led to depletion of many such species from their natural homes in various parts of the world. Two thousand and fifty six medicinal plants in India have been listed in the Indian Red Data Book as endangered. Most of these wild

medicinal plants are confined to certain habitats with a restricted geographical range (Kaushalappa, 1996). Their rarity coupled with large-scale destruction collection from the wild has resulted in conservation efforts being initiated by governmental and non-governmental agencies (NGO"S) focused on their conservation and sustainable use. The situation bears wide-ranging implications particularly with respect to the N. W. Himalayas, which represents a rich repository of a highly variable germplasm (Dhar and Kachroo, 1983). If the present rate of habitat destruction and exploitation goes unchecked, many commercially important species of this part of the Himalayan range will be lost for all times to come.

The available records reveal that several pharmaceutically important species growing in this region are already on way to extinction and face a serious threat. It is, therefore, an immediate need of the hour to salvage whatever we can, by launching action to conserve the existing germplasm. This will help in protecting the species from extinction and ensure a sustained supply of raw materials to the drug industry and to users of the indigenous system of medicine.

Under the duress of over-exploitation and habitat degradation a number of wild medicinal and aromatic plants are presently facing constant threat of extinction. Most of these plants are specific and scientifically little understood. The immediate and most effective way of protecting these rare and endangered wild medicinal and aromatic plants is through their protection in the natural habitat (in-situ) conservation. But the mounting demand of these plant species from various sources necessitates domesticating and propagating them in large scale. Under domestication outside their normal ecological range or under the changed ecosystem condition many of the wild medicinal and aromatic plants tend to behave differently. In some cases it becomes difficult to grow them or it may not even survive. In certain other cases it survives and grows but may not be producing the desired traits. A thorough understanding on their reproductive and growth biology as well as identification of the biological and ecological constraints leading to their reduced fitness, restricted distribution or even extinction etc., is therefore, become necessary. An understanding of the biological and ecological background of the species in their normal habitat is also essential to understand their conservation biology as well as to predict their behaviour under artificial cultivation (Pushpangadan, 1992).

The population of a species is the visible manifestation of gene pools and is the unit of evaluation. It is in a population that new genes and novel gene combinations arise. Any change in the population is bound to have impact on the species survival and endurance. A study on the heritability of the traits of economic importance- viz the active principle of medicinal and aromatic plants is to be made in detail. The active principles in medicinal and aromatic plants are due to the presence of are certain secondary metabolites like alkaloids, glycosides, coumarins or steroids in case of medicinal plants and volatile oil known as essential oils containing different compounds of terpenes or phenols in case of aromatic plants. These secondary metabolites are, however, not directly involved in the normal growth and reproduction of these plants. These are produced by plants, perhaps, as a biochemical adaptation to prevent illness or as defence against predators or adaptation to live in association with other plant and animal communities in the particular ecological or edaphic or climatic niche. In other words, these are involved in the ecology rather than normal physiology of the plant. The biosynthesis of these compounds is controlled genetically and the heritability and expression of which are greatly affected by the above abiotic and biotic environmental factors. These eco-biological aspects of these plants are to be understood well and conditions optimal for its growth, development and expression of desirable traits (secondary metabolites in case of medicinal and aromatic plants) etc. have to be worked out. After completing these fundamental investigations one can embark upon a programme of selection and genetic upgrading to develop suitable cultivars for cultivation. Both conventional and modern crop improvements tools and agro-management methods may then be developed for commercial cultivation of these plants (Pushpangadan, 1992). Medicinal and aromatic plants in general have short history of cultivation and direct artificial selection (Pushpangadan and Rajasekharam,1987). Leaving aside a few, most of the requirements for these plants are met from the wild source. The collection of these plants scattered in forests is troublesome and it often leads to the high cost of production. The disadvantages regarding the collection of these plants when they are growing in the state of nature in scattered areas are: (a) sparse distribution, (b) difficulty of access and transport when the natural habitat of the plant is at some inaccessible areas,

(c) indiscriminate collection leading to extermination, (d) scarcity of these plants further escalated by the depleting resources due to mass scale destruction of forest areas or clearing of the forest areas for plantation of cash crops, and (e) ignorance of the collection leading to the admixture of genuine with spurious plants (Pushpangadan, 1992).

In addition to the above cited problems and difficulties, the collection of medicinal and aromatic plants from forests cannot cope up with the ever increasing and changing demand from the pharmaceutical and perfumery / cosmetic industries. In order to provide regular and sustained supply of these plants, it is essential now to domesticate and develop commercial cultivation methods those plants. History of systematic cultivation of medicinal plants in India is relatively very recent. Experimental cultivation of some of the exotic plants was started in India as early as the beginning of

the 18th century, when exotic medicinal plants such as *Digitalis*, *Cinchona*, *Ipecacuanha*, *Pyrethrum* etc. were introduced and tried their cultivation by government and private agencies in botanic garden and the tea or coffee plantations (Chopra et al., 1958; Pushpangadan, 1992). There is practically no information on the domestication and cultivation of most of the medicinal plants. Therefore, the technological packages for cultivation and post harvest technology of most of these have to be worked out before hand. This involves the joint effort of a multi-disciplinary team of scientists drawn from different disciplines like botany, agronomy, breeding, chemistry etc. This kind of programme may take over several years of dedicated work. Scientific approach and methodology for domestication and commercial cultivation of medicinal plants need to be worked out in detail (Pushpangadan and Rajasekharan, 1987). In this context, institutions like ICAR, CIMAP, RRL Jammu, TANU-Coimbatore, International Institute of Ayurveda- Coimbatore, University of Kashmir- Srinagar, Jamia Hamdard- New Delhi, are actively concerned with the cultivation and processing of many medicinal and aromatic plants. The research and development data available from these organizations could be utilized for planning the cultivation of such medicinal plants.

CONCLUSION

To conclude, the medicinal and aromatic plants continue to play an important role in the modern world. Germplasm conservation is one of the most important and urgent tasks facing plant scientists today, and this need is greatest in the North West Himalaya where the existence of many economically important medicinal plant species are threatened. In order to develop any product from plant, germplasm conservation must be an integral part of the whole operation.

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