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CONSERVATION AND UTILIZATION OF INDIAN MEDICINAL PLANTS*

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The demand for plant-based raw-material, used pre-dominantly in Indian System of Medicine (ISM) has grown enormously in recent years. The over-exploitation by the manufacturing sector of several native medicinal plants are in danger of extinction. The 'Red Data Book of India' has adequately recorded such plants. By citing a few examples, the author has discussed the extent of threat, and the need to conserve variability for current and future use. The variants occuring in protected habitats like 'National Parks' needs to be collected/evaluated and documented.

Key words : Indian medicinal plant, conservation, utilization, extinction/threat

India is known for its rich heritage of medicinal plants. The classical treatise on Ayurvedic medicine of pre-christian era namely, Charak, Sushruta and Bagbhatta described use of 1100, 1270 and 1150 medicinal plants, respectively in drug formulations. This diversity occurs in diverse habitats. Many of these are endemic exhibiting variability in the form of morphotypes, ecotypes and chemotypes existing amongst the populations. The variability in such economically important species is an insurance for continuing research for productivity upgradation. At present, there is a growing awareness and rising demand for plant -based drugs as their products have milder action over body functions with little or no side effects. It is estimated that about forty species currently provide raw materials for all pharmacopoeia based products in modern medicine and has, in turn, a total sale of 50 million US dollars annually; seventy per cent of these plant-based raw materials come from sub-tropical and tropical parts of the world.

The rising demand in the organised manufacturing sector has ruthlessly exploited wild growing plant populations of species which have bulk demand. Obviously, a number of these plants have become rare, endangered or are on the verge of extinction. In this context, the loss of valuable genetic diversity

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in the species is much greater because the frequency of populations decline continuously in the original habitats of the species. At present, a number of large Drug Houses and multinational companies in the country are making plant based formulations which have rendered several species scarce in distribution (Gupta 1988). To site some examples, Sandoz Laboratories and Unichem Laboratories at Bombay are producing patented drugs under the name "Ashoka Cordial" and "Liquid Menorin", respectively based on wood of *Saraca asoka*. The Bengal Chemicals and Pharmaceutical Works uses a large quantity of *Andrographis paniculata* in their preparation, patented under the name of "Kalmegh compound" and CIPLA Laboratories produce 'Guggal lippids' based on gum resin of *Commiphora wrightii*. None of these companies have captive plantations of any species and hence the entire demand of raw materials is met through collections of wild growing populations affecting in turn, distribution, regeneration and productivity in the forests.

The Indian system of Medicine (ISM) which pre-dominantly utilizes plant-based raw materials has an equally large organized consumer sector. It has 6,000 licensed manufacturing units producing drugs for an estimated value of about Rs. 8 billion annually, and 15 prescribed by about 4,00,000 registered medical practitioners. This demand is not only large but is also growing at a faster rate. Many of these plants in bulk demand have a wider gap between their demand and supply in the absence of cultivation. This situation needs redressal through production management of these raw materials in the forests or their introduction as commercial crops.

PERCEPTION OF THREAT

The literature on medicinal plants in India provides evidence of antiquity and early use, before the settled agriculture commenced, in this part of the world. The ancient Aryans (4,000 B.C.) used "Som plant" to make energising and restorative drink which also possessed property of bestowing endurance and longevity. Little is known about the original composition of this famous drink because the plant species had been extensively exploited during those periods. Similarly, the *'Lakshmana booti'* of Ramayan period is now lost in mystery. There is continuing loss of several valuable plants used in classical formulations where their substitutes are currently used.

Amongst these plants, it may be noted that use of multi- ingredient based classical drugs in trade has increased manifold. This could be judged from the production figures of large number of firms manufacturing products like **Astavarga, Dashmool, Chyavanpras, Triphala, Arogyavardhani, Nirdrodaya rasa, Ajeevada Kantaka rasa, Smritisagar rasa** etc. The eight roots which form ingredient of **Astavarga** drug are **Jeevaka** *(Microstylis nucifera)*, **Rsabhak** *(Microstylis wallichii)*, **Kankoli** *(Roscorea procera)*, **Kshira-Kankoli** *(Ros-*

corea alpina), **Meda** (*Polygonatum verticillatum*), **Maha-meda** (*Polygonatum cirricifolium*), **Riddhi**, (*Hebenaria acuminata*) and **Vridhi** (*Hebenaria intermedia*) which are now extremely rare in distribution. The drug manufacturers largely depend an Bagbhatt's direction (c.f. in Astanga Hridayam Samhita) authorising use of alternate source when the original plant prescribed in the text is not available. Thus, **Bidari-Kand** (*Pueraria tuberosa*) is used at present for **Jeevaka, Asgandh** (*Withania somnifera*) for **Kankoli, Kali musli** (*Curculigo orchioides*) for **Kshira-kankoli** and **Taradi** (*Dioscorea bulbifera*) for **Meda** and **Maha-meda** roots in the **Astavarga** drug. Even some of these substitutes are now in short supply. The same is the case of five tree-based roots (out of ten roots) prescribed as ingredient for manufacture of **Dashmool** drug; the other five belong to annual/perennial herbs and are relatively easily available.

Literature on these plants is adequately dealt with in the Red Data book of India and Threatened plants in Indian flora (Jain and Sastry, 1979; Nayar and Sastry, 1987). Similarly, there are several publications on distribution, utilization, conservation, documentation and their introduction into cultivation (Gupta, 1977; Gupta and Sethi, 1983). Based on these reports and demand analysis, the medicinal plants under excessive pressure in forestry sector are **safed musli** (*Chlorophytum arundinaceum, C. borivillianum*), **Chirayata** (*Swertia chirata*), **Ateesa** (*Aconitum heterophyllum*), **Ban-kakri** (*Podophyllum hexandrum*), **Kutaki** (*Gentiana kurroo, Picrorriza kurroo*), **Puskhar mool** (*Inula racemosa*), **Jal-brahmi** (*Bacopa monniera*), **Guggal** (*Commiphora wrightii*), **Gudmar** (*Gymnema sylvestre*), **Bidarikand** (*Puraria tuberosa*), **Salampanja** (*Orchis latifolia*), **Sankhpushpi** (*Convolvulus pleuricaulis*), **Vishnukranta** (*Evolvulus alsinoides*), **Dhoop** (*Jurinia macrocephala*), **Gaozban** (*Anchuria strigosa*), **Resha khatuni** (*Lavatoria kashmeriana*), **Jeevaka** (*Microstylis nucifera*), **Kankoli** (*Roscorea procera*), **Kshira kankoli** (*Lilium polyphyllum*), **Meda** (*Podygonatum verticillatum*), **maha-meda** (*Polygonatum cirricifolium*), **Ridhi** (*Hebenaria acuminata*), **Vridhi** (*Habenaria intermedia*), **Rasna** (*Pluchia lanceolata*), **Vatsanabha** (*Aconitum chasmanthus*), **Sarpangandha** (*Rauvolfia serpentina*), Discorea (*D. deltoidea, D. prazeri*), **Anantmool** (*Tylophora indica*), **Sariva** (*Hemidesmus indicus*), **Somvalli** (*Ephedra gerardiana*), **Bharangi** (*Clerodendron serratum*), **Jatamansi** (*Nardostachys jatamansi*), **Gajpipali** (*Piper cubeba*) etc. These species demand protection of habitats and support for regeneration, growth, seed production and dispersal to improve their populations in the forest both as a conservation effort as well as to improve productivity of each herb growing there.

UTILIZATION

A large part of variability in medicinal plants is the result of intra-species and inter-species natural crossing between populations growing in different ecological conditions. The broad array of natural genepool thus exists in the

forests with differences in form, structure, composition and chemical content which provide base material to be utilized in agriculture through selection where desired characters are genetically fixed in a cultigen. In nature, the genetic variability also occur at different ploidy levels accompanying genetic separation due to in-built preference of each for growing in different geographical regions. Sweet Flag (*Acorus calamus*) provides an interesting example where diploid. (2n =24), triploid (2n = 36) and tetraploid (2n=48) forms occur in different regions in nature. These forms have shown varying composition in oil of root and rhizomes having distinct aroma characteristics and other properties. Thus, the oil of roots of the diploid has a fine odour; it inhabit temperate parts and the oil is used to impart warm and spicy note in liquors, particularly vermouth in Europe. The oil of root of triploid and tetraploid forms have high β-asarone content (9-18%), which have been reported to cause cancer in rats and hence are forbidden for use in food products. It is now found that β-asarone causes sterility in several species of house fly, fruit fly and related other pests and as such have a role in control of crop pests. Similarly, fruits, of *Vicoea indica* found in Tamil Nadu has vicolide-B (a sesqueterpenoid lactone) which has anti- fertility property whereas this compound is absent in plant population found in neighbouring states in the country. Srivastava *et al.* (1990) have reported high percentage of physiologically active terpenic alkaloids in seed oil of **Jyotismati** *(Celastrus paniculatus)* collected from Vindhyan hills; but these constituents are in lower quantity in plants collected from central Himalayan region of Uttar Pradesh, the traditional home of the species in India. The seeds of **Jyotismati** is widely used as a nervine tonic in Ayurvedic medicine.

The utilization of variability in plant genetic resources is best illustrated from recent Indian work on genus *Cymbopogon* and *Ocimum.* The genetic studies on lemon grass (*Cymbopogon flexuosus)* have shown herbitability of economically important traits like oil content and citral to be 9.6 and 20.5 per cent, respectively. This oil is used in imparting specific lemon like odour to soap and detergents; its citral is used to produce β-ionone, which in turn is utilized in synthesis of vitamin-A. A selection from germplasm has yielded cv. OD-19 which produces high herbage and oil yields and is grown as a rainfed crop in Kerala. A further selection from germplasm assembly has brought forward OD-448 (red stemmed) and OD 408 (white stemmed) cultures, which gave higher yield of oil over the OD-19, used as control. Its allied species *C. pendulus* is a source of a new variety 'Praman' which produces higher citral content in the oil. A cross between *C.khasianum x C. pendulus* has produced a new variety "CKP-28" which produces still higher citral (82-85%) content in the oil; this culture is recommended for growing over rich fertile irrigated lands in north India. Similarly, in palmarosa grass (*Cymbopogon martini* var. *motia*), a selection IW-31245 has been identified for producing high overall

herbage and oil yield. A second culture **'Trishna'** is developed as a synthetic by polycross breeding of four inbred parental lines at Lucknow and is claimed to produce 40 per cent higher oil yield. Further, a cross between *C. nardus* var. *confertiflorus* x *C. jwarancusa* has yielded a new variety "Jam-rosa" which produces high geraniol (80-83%) and geranyl acetate (17-8%) content in the oil. This oil is the starting material for production of geraniol commercially in India.

In basil, the occurrance of euploidy in nature has played a major role in speciation. The oil of different species contain major aroma-compounds like eugenol, linalool, linalyl acetate, methyl chavicol, thymol, camphor etc which have commercial demand in food flavouring industry. In sacred basil (*O.Oeimam-sanctum*), a selection from NBPGR produces 55 l/ha of oil in a growing period of 110-120 days under rainfed cultivation; this oil has high eugenol (53%) and caryophyllene (19%) content and is useful in manufacture of medical products for curing cough, throat infection and bronchial irritation. Another variety is 'Clo-Ocimum', developed through a cross between *O.gratissimum O.viride* at Jammu, it has 75 to 85 per cent eugenol in the oil. This oil has replaced clove oil as source of eugenol in industry. A yet another culture is now released as a result of selection and purification from West African material of *O. cannum* called "OC-11"; it contains 70-72 per cent linalool in the oil. These new varieties have placed India as a net exporter of the basil oils to the world market.

CONSERVATION

The Indian Forest Act of 1972 and its comprehensive revision provides guidelines on protection and management of medicinal plants in forests which fall under category of 'Minor Forest produce' (M.F.P.). Several states in India have specific M.F.P. Acts which regulates collection and export (to other state) of these raw materials. The Act facilitates notification of medicinal plants which may be allowed commercial collection by specifying forest areas and season of collection under renewable licence to be granted to an individual or a local cooperative society. However, much of this regulatory activities have got diffused at operational stage due to collection rights of local people, low protection of the forest in terms of guards, lack of trained manpower and non-availability of relevant illustrated literature for field staff.

There are forests which still possess large and sustainable populations of many commercially important medicinal plants from where collection is being done. It is proposed that the State Governments may carry out quick survey and identify rich Protected and Reserve Forests (ranges) which holds exploitably large multi-species communities of medicinal plants. These identified

forests should be managed as model resource base as sustainable producer of major medicinal and aromatic plants raw materials in the country. It is necessary to emphasise that conservation and utilization are two inseparable components of forest management. The increased availability of these scarce materials in the market shall act as a deterrent to out-of season collection from protected forests. An efficient system for medicinal plant resource management should be developed as a part of regular work of States Silviculture Research Division which may be supported with the establishment of a small monitoring cell in office of Chief Conservator of Forests of each state. This will enable net working for investment of all those forests placed under management for production of these raw materials in the forestry sector in states and allow taking up developmental schemes by the Ministry of Environment and Forests in these selected forests for raw materials.

India has established a large number of National Parks and Protected forest habitats in all ecological regions in the country. These protected habitats provide excellent opportunities of studying growth, regeneration, ecological preferences, species association, chemical content, composition and bearing behaviour of endangered medicinal plants. This information would eventually be utilized both for *in situ* regeneration of the species as well as for commercial cultivation as part agro-forestry system. This work should receive allocation of resources by Ministry of Environment and Forests, ICAR, DST, CSIR etc. and operated at different Universities to students to choose these as topic of their postgraduate and doctorate dessertation. The Union Ministry of Agriculture (Horticulture Division) has sanctioned funds to establish sixteen Medicinal Plant Gardens in State Agricultural Universities and Research institutes all over the country. These gardens will collect existing plant diversity in about 100 economically important medicinal plants and 35 endangered species in their respective regions and raise it in these Gardens as *ex-situ* conservancies. These Herbal Gardens will serve as agencies to produce and supply sample seed of plant genetic resources on one hand and bring out educational material and hold short-term training programmes for students, foresters and growers.

Department of Biotechnology, Government of India has established three National Gene Banks for Medicinal Plants with long term stronge facility (modules) installed at Lucknow, Thiruvananthapuram and Delhi. These Gene banks will provide facility to place all plant genetic resource variability with documented information on important characters. Medicinal plants conservation is a complex process, where utilization of material is due to its unique chemical composition. The material fetches higher price due to desired chemical content of the produce. The Gene bank, therefore, should be supported with a detailed programme of collection, systematic evaluation, documentation and development of retreval system involving several multi- disciplinary institutions to

enable retrieval and use of these genetic stocks in developing new cultures for growing in farm and plantation industry.

Changing scenario at global level

The pharmaceutical industry is consistantly bringing out new and more potent medicinal plants in use. In fact, several old sources of remedies have lost their value in industry but others, hitherto unknown in industry, have emerged in the world market. Thus, *Ephedra gerardiana* and *Artemisia maritima* have gone out from world Pharmacopoeias. *Rauvolfia* roots have lost market in industry because a better sources of ajmalicine and reserpine is found in roots of *Catharanthus roseus*. Again, the demand of quinine, quinidine and cephaline have declined drastically due to arrival of synthetics. At present, *Panax ginseng* root is an important medicinal plant raw materials and large quantities are imported in India annually. Related species *P.pseudoginseng* var. *himalaicus* is found in Subansari, Lohit and Kameng districts of Arunachal Pradesh. The root is found at par in quality. Another promising materials is *Silybum marianum* where seed contains a hepato-protective drug for use in modern medicine. This species has been located at Baramulla (Kashmir) and Dehra Dun (U.P.). Similarly, etoposide is produced from roots of *Podophyllum pelatum* (Bristol Meyer) in U.S.A. Whereas an Indian ally *P. hexandrum* is found as equally potent for use as a drug. These examples highlight the potential of the germplasm resources in emerging high value drug plants which is likely to dominate the world pharmaceutical industry in near future. An efficient conservation and management of plant genetic resources of these taxa in India will provide material for raising new plantations in the country.

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