Review Article

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Medicinal plants: Sources for potent futuristic medicines

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ABSTRACT

Ayurveda is considered to be the science of life and this makes it an earlier medical science having a positive concept of health to be achieved through a balanced blend of physical, social, moral, mental and spiritual welfare. In Ayurveda, Homoeopathy, Unani, Siddha and several other systems of traditional medication the plants constitute the major resources. The potency of different medicinal plants in controlling diseases has been reviewed together with the status of popular chemically assembled drugs that exhibit several side-effects and after-effects. The present day shift of peoples' inclination towards tribal medicines, ayurvedic, homoeopathic and unani system of medicines is an indication that these constitute the futuristic medications. **[Medicinal Plants 2012; 4(4) : 189-197]**

Keywords : Medicinal plants, Ayurveda, Allopathic medicines, Futuristic medication

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INTRODUCTION

Ninety percent of the herbal industry's requirement is taken out from the forests, resulting into their destruction. There is no reliable assessment of the volume or value of the herb related trade in India, but, the conservatives put the quantity of dry raw material collected at 0.5 million tons each year. The global plant based drug is projected between US$ 30 and 60 billion with a 7% annual growth rate, but India has only a 2.5% share in it. Even so, there is a growing realization that the demand in fast outstripping supply is putting an unreasonable pressure on our wild phyto-resources. This has already placed certain species at risk and others will soon follow, if immediate corrective measures are not taken. Besides tribal, who are authorized to collect the minor forest produce for their livelihood, traders illegally collect a large number of plant species. Without replenishment, such overexploitation has resulted into extinction of several species and caused large-scale destruction of habitats. In India, it is estimated that about 1500 plant species are threatened, of which about 124 are endangered, 81 vulnerable and 100 species have been declared as rare (Nayar and Sastry, 1987).

Out of the list of endangered plants, 35 plant species have been enlisted as medicinally important by Gupta and Chadha (1995), however, the Department of Biotechnology, Ministry of Science and Technology, Government of India has given a list of medicinal plants (Table 1) they are interested in. The need of the hour is to look into the reproductive biology of these plants to assess and apply the effective methods of conservation and multiplication of these individuals.

In an ethno-biological survey conducted by the Ministry of Environment and Forests, Government of India, it has been indicated that our countrymen for their medicinal properties are using about 8,000 plant species.

Indian System of Medicine and Pharmaceutical Industry

The Ayurveda **(***ayur* literally means life and *veda* means the knowledge or science or way of life), the Indian system of medication, is one of the oldest systems of medication prevailing throughout the globe. Ayurveda (1000 – 500 BC) originated from our ancient literature – ***"Atherva-veda"***, the knowledge of which was documented in *'Charak-Samhita'* (1000 BC) and *'Sushruta Samhita'* and are considered to be the

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authentic Books (Tirtha, 1998). Ayurveda is considered to be the science of life and this makes it an earlier medical science having a positive concept of health to be achieved through a balanced blend of physical, social, moral, mental and spiritual welfare (Svoboda, 1992; Tiwari, 1995).

The philosophy of 'Ayurveda' is based on the ***"Panch-bhutas"***, of which our body is supposed to be composed of. In a healthy individual, all the various aspects like the physical body and its mental and spiritual counterparts must be in an equilibrium state. Basically, an absence or a disturbed state of such an equilibrium results into the status of disease or the sickness. For promotive and positive aspects of health, Ayurveda has given a detailed daily and seasonal pattern of regular activities. It emphasizes on regulated diet, sleep and sex (Tiwari, 1995).

Generally having a tropical and sub-tropical climatic condition in the developing countries, the pests and insects carry and generate diseases and for many other diseases like those caused by protozoans, viz., Amoebiasis caused by *Entamoeba histolytica*, Malaria by *Plasmodium falciparum* and Filaria by nematodes; a poor hygienic and socio-economic living conditions are responsible. To have an effective control over such diseases plant-based drugs are required. Sometimes these diseases have attained the status of the epidemics. In 1996, 1.5 to 2.7 million deaths has been reported due to malaria and majority of them were children (Phillipson, 2001). The effective medications, Quinine and Artemisin, both are of plant origin. A recent survey has indicated that the number of patients affected by the diseases like diabetes (Shetty, 2012) and heart-ailments are gradually rising among Indian inmates at a constant pace due to preferential sedentary life style and poor physical workout and therefore, need immediate attention. So, we require many more effective plant-based drugs to combat with certain parasitic diseases, diabetes and heart diseases. Handa (1996) has given the therapeutic potentialities of several plants like *Asparagus racemosus*, *Piper longum*, *Ocimum sanctum*, *Andrographis paniculata*, *Boerhaavia diffusa*, *Berberis aristata*, *Aegle marmelos*, *Bacopa monnieri*, *Phyllanthus emblica*, *Glycyrrhiza glabra*, *Syzygium jambolanum* and *Chlorophytum borivilianum* etc.

There are approximately over 7800 drug manufacturing units in India out of which about 90% industries use plants as the raw material, collected from the forests or from their natural habitats putting an unusual pressure on the natural biodiversity. An estimated 800 species are used in drug production in these industries, but, less than 20% plant species are cultivated commercially. This poses a definite threat to the diversity of medicinal plants' species. During the last forty to fifty years the Indian pharmaceutical units have been bulk producing several plant-based drugs which include morphine, codeine, papaverine, thebaine, emetine, quinine, quinidine, caffeine, hyoscine, psoralen, colchicine, vinchristine, vinblastine, strychnine and ergot alkaloids etc.

Under such circumstances, it is neither possible nor is it advisable to exploit the natural resources of medicinal plants brutally without having thought about their sustainability. It is imperative, therefore, to bring the medicinal plants' species diversity under commercial cultivation for biomass production for the industries. This may be achieved through the conventional as well as the biotechnological approaches.

Table 1. Important Medicinal and Aromatic plant species of the Indian Subcontinent

Aconitum napellus	*Nardostachys jatamansi*
Acorus calamus	*Panax peudo-ginseng*
Amomum species	*Phyllanthus fraternus*
Andrographis paniculata	*Picrorhiza kurrooa*
Azadirachta indica	*Podophyllum hexandrum*
Cassia augustifolia	*Pogostemon cablin*
Commiphora wightii	*Psoralea corylifolia*
Coptis teeta	*Rouwolfia serpentina*
Crataeva nurvual	*Rheum emodi*
Cymbopogon winteriamus	*Swertia chirata*
Dioscorea deltoidea	*Valeriana wallichii*
Ephedra species	*Vetiveria zizanioides*
Ferula asafoetida	*Withania somnifera*
Mesma ferrea	

Source: Department of Biotechnology, Government of India, New Delhi.

Status of popular chemically assembled drugs

Until the chemical industry came into being, with the associated manufacture of synthetic drugs, diseases were exclusively treated by means of natural healing procedures. However, medication with chemically assembled drugs (commonly known as 'allopathic' drugs) achieved ever-increasing significance. Since its inception this system of medication which has been based on the use of pure chemicals, and in case natural products are being used they have been artificially synthesized and the synthesized product is being commercially marketed. The major groups of medicines

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include the antibiotics, vitamins-mineral combinations, antihistaminic, antipyretic, anti-carcinogenic and antispasmodic groups. These medications, without doubt, exhibit definite relieving effects on the body systems by suppressing or stimulating actions on the natural bio-systems and production of biochemicals and; in so doing they hinder the natural bio-pathways resulting into some other abnormal actions called the 'side effects'. Renal problems due to the use of antibiotics and digestive tract problems due to the excess use of anti-inflammatory drugs are some of the examples.

Generally, a medicine is given to control a particular disease and several others are given to have the control over its side-effects. Therefore, in this therapy, a control reaction of the drug is followed by a chain-reaction of supporting drugs to control the "side-effects" and the "after-effects". In this way, a patient who is being treated for a particular disease is caught within the glomeruli of side-effects and after-effects of several supporting medications prior to the complete cure of his/her original disease for which he/she is being basically treated. The patient is, now-a-days, more enlightened than ever and has for a long time been no longer prepared to "swallow", in the truest sense of the word, every side-effect.

Keeping in mind the afore-said problems of side-effects and after-effects, now, peoples' inclination has been shifted towards tribal medications, ayurvedic, homoeopathic and unani system of medicines which exhibit least or no toxic effects and have no side-effects or after-effects.

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Indigenous Knowledge

Indians have one of the world's richest medicinal plants' heritages. Around 8,000 species of plants referred to by over 2,00,000 vernacular names, are used by the people of our country in local health care cultures for human, veterinary and agriculture (bio-fertilizers, seed treatments and bio-pesticides) related applications across country's 10 bio-geographic zones, 25 biotic provinces and 4635 ethnic communities. The knowledge of these plants is undocumented and transmitted through an 'oral' tradition. There are 500 tribal and aboriginal communities in India living in close proximity to forests since time immemorial and have acquired unique knowledge of plants, plant produce and their uses in daily needs and health care and is descended through oral information transmission from one generation to the next.

Bhoxa, the scheduled tribes of tarai belt of Uttarakhand, cure several ailments, disorders and diseases with the use of plants and plant products from the surroundings. Several scientists have documented the valuable ethno-medicinal knowledge of Bhoxas (Kirtikar and Basu, 1935; Chopra *et al*., 1956; Ambasta, 1986; Singh, 2005). Similarly, documentations have been made on the womenfolk's health care knowledge from other tribal communities (Tarafder, 1983 a, b; 1984; Siddique *et al*., 1988; Singh and Ali, 1996; Balik *et al*., 2000; Shashikumar and Janardhanan, 2002; Ramana *et al*., 2005). The tribals and aboriginals like Kola, Kharwar, Gonds, Tharu in Uttar Pradesh and Bhoxas, Bhotia and Jaunsari in Uttarakhand have been using plants and plant products for the treatment of rheumatism, gout and arthritis (Anand Prakash and Singh, 2005). Ramana *et al*. (2005) have recorded the use of the seeds of *Abelmoschus esculentus* Medic. as antiseptic following child-birth; use of the flowers of *Hibiscus rosa-sinensis* in leucorrhoea and *Sida rhombifolia* to cure mal-nutrition during pregnancy and Ramana *et al*. (2005) have documented the informations obtained from the Halakki Okkaligas tribes of Uttara Kannada district in Karnataka about the use of plants for pediatric use and also as an antidote to snake bite.

Other documented tribal information regarding the medicinal plants include the study of lithontriptic plants used by the tribals of Khargone district in Madhya Pradesh (Mahajan and Patel, 2005); birth control practice among rural and tribal women of Chhatarpur district of Madhya Pradesh (Arjariya and Rawat, 2005). Now, as far as possible a scientific documentation of all the practices, for the treatment of diseases using the plant resources, among the tribal communities is required.

Present Status of Herbal Medication

Generally having a tropical and sub-tropical climatic condition in the developing countries, the pests and insects carry and generate diseases and for many other diseases like those caused by protozoans, viz., Amoebiasis caused by *Entamoeba histolytica*, Malaria by *Plasmodium falciparum* and Filaria by nematodes; a poor hygienic and socio-economic living conditions are responsible. To have an effective control over such diseases plant-based drugs are required. Sometimes these diseases have attained the status of the epidemics. In 1996, 1.5 to 2.7 million deaths has been reported due to malaria and majority of them were children (Phillipson, 2001). So, we require many more effective plant-based drugs to combat with other parasitic diseases, diabetes and heart diseases. Handa (1996) has given the therapeutic potentialities of several plants like *Asparagus racemosus*, *Piper longum*, *Ocimum*

sanctum, *Andrographis paniculata*, *Boerhaavia diffusa*, *Berberis aristata*, *Aegle marmelos*, *Bacopa monnieri*, *Phyllanthus emblica*, *Glycyrrhiza glabra*, *Syzygium jambolanum* and *Chlorophytum borivilianum* etc.

With the growing demands of herbal pharmaceutical industries in India, medicinal plants' scientists have done a lot of work, keeping pace with them, to produce useful biochemicals and active principles from medicinally important plants. Several active biochemicals like an essential oil (Choudhary *et al*., 1951), bicyclic sesquiterpene ketone (Govindachari *et al*., 1958), seychellene and patchoulene (Rucker *et al*., 1976), have been isolated and described from the underground rhizomes of *Nardostachys jatamansi*. Bagchi *et al*. (1988 a,b,c,d,e; 1990; 1991) have carried out exhaustive investigations on the chemistry of the rhizomes of *Nardostachys chinensis* and isolated many active principles from it. Prabhuji *et al*. (2005) have also given the occurrence of various biochemicals and active principles in *Nardostachys jatamansi* and *N. chinensis*.

Some active and very potent active principles like bacoside (Rastogi *et al.*, 1994; Rastogi and Kulshreshtha, 1998); bacopasaponins (Garai *et al*., 1996; Mahato *et al*., 2000; Hou *et al*., 2002); bacopaside (Chakravarty *et al*., 2001; Hou *et al.*, 2002; and Chakravarty *et al*., 2003); and bacogenins (Kulshreshtha and Rastigi, 1973a, 1974; Kawai *et al*., 1973; Garai *et al*., 1996a) have been isolated and identified from the leaves of *Bacopa monnieri*. Prabhuji *et al.* (2005) have also given the occurrence of various active principles in *Bacopa monnieri*.

Safed Musli (*Chlorophytum borivilianum*) has been a very important medicinal plant, the tuberous roots of which yield certain highly effective biochemicals like steroidal saponins (Gupta *et al*., 1979; Tandon *et al*., 1992; Tandon and Shukla, 1992, 1993). Mimaki *et al*. (1996) have isolated three new spirostanol pentaglycosides from the tuberous roots of *Chlorophytum comosum*. Later, Prabhuji *et al*. (2005) have enlisted the active principles isolated from the tuberous roots of *Chlorophytum borivilianum*, *C. comosum* and *C. malayense*.

The storage roots of *Asparagus racemosus* have been found to exhibit a positive action on female reproductive system and are used as lactogogue and aphrodisiac in traditional systems of medicine and several active biochemicals have been isolated there from (Prabhuji *et al*., 2005). Similarly, Tulsi (different species of *Ocimim*) contains many active principles having anti-microbial properties. There are a number of other plants of medicinal importance, which have been used by the tribal communities in various ailments or are enlisted in ayurvedic system of medicine. Such plants need to be investigated scientifically for their active ingredients and centre of action on the human body.

Among the mosquito-borne diseases, filariasis, though not fatal, is the most horrifying, reducing the poor sufferer to a miserable and grotesquely disabled creature all through his life. It is caused by the parasite – *Wuchereria bancrofti* (97.8%) and *W. malayi* (2%) in India and is characterized by both chronic and acute clinical manifestations. Based on ancient literature (Sloka 125; *Saranghdhar Samhita* – 1363 A.D.), the Filaria Research Clinic of the Institute of Medical Sciences, B.H.U., Varanasi has developed an efficient drug – "Filacid" containing the stem bark of *Streblus asper* Lour. (Singh and Hashmi, 2002). Comley *et al*. (1990) have studied the drug filacid at Wellcome Research Laboratory, U.K. and have found that it is macro-filaricidal at 500 µg/ml with motility suppressed within 4 hours.

Cancer is a fatal disease of uncontrolled cell growth. In this disease of variable etiology *Withania somnifera* (as an anti-tumour remedy containing a steroidal lactone – Withaferin-A), *Catheranthus roseus* (as anti-lymphomas, anti-reticulum sarcomas and anti-neuroblastomas containing Vinchristine and Vinblastine; Ali *et al.*, 1998) have been found to be effective. The aqueous extract of *Nigella sativa* seeds along with *Smilax china* and *Hemidesmus indicus* (1:3:2) has been reported to be beneficial in curing oral cancer (Siddiqui and Sharma, 1998). An active constituent of Menhdi (*Lawsonia inermis*) is Lawsone which shows anti-cancer activity (Hartwell, 1967; Hannan, 1997). Aloe (*Aloe barbadens*) contains various anthraquinone glycosides, aloin, isobarbaloin and emodin. The plaster of leaf juice of Aloe has been found to cure condylomata, warts and other abnormal skin growths and for cancer or tumors of the lip, anus, breast, larynx, liver, nose, prepuce, stomach and uterus etc. The rhizomes of *Podophyllum hexandrum* contain the active principles – podophyllin, popdopyllol, quercetin and podophyllotoxin; and are useful in controlling timorous growths and skin cancer as cytotoxic agent (Bakhru, 1992; Ali, 1994). *Euphorbia peplus* (the radium weed) has been indicated for topical treatment of basal cell carcinoma, corns, warts and callouses (Jacqui and Satter, 1997).

The *Taxus baccata* plant contains various physiologically active chemical constituents in its various parts. The stem bark of the plant has yielded Taxol (Pacletaxel), isolated and the structure of the

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compound was established from its spectral data and X-ray crystallography which are highly functional diterpenoid and is a strong anti-mitotic (anti-cancerous) agent. Taxol, from inner bark of *Taxus brevifolia*, has been found to be a remarkably successful anti-cancer agent, particularly against tumours of the ovary and breast (Stierle *et al.*, 1995). The compound is highly toxic and its solubility is very poor, however, its semi-synthetic analogue, taxotere (docetaxol) has less toxicity and high solubility. The anti-cancer properties of the garlic (*Allium sativum*) are partly due to the potent enzyme inhibiting activities of adenosine deaminase and cyclic AMP phosphodiesterase organo-sulphur compounds that inhibit the growth of animal tumors and to modulate the activity of diverse chemical carcinogens (Murad, 1997). The Scopadulic acid – B, isolated from the plant *Scoparia dulcis*, has been found to exhibit anti-tumor promoting activity (Nishino, 1993) and the extracts obtained from *Mussaenda pubescence* and *Clematis chinensis* have been found to show anti-tumor activities (Xu *et al*., 1996).

Kumar and Kuttan (2004) have found that the extracts of *Emblica officinalis, Picrorrhiza kurroa and Phyllanthus amarus* inhibited the hepato-carcinogenesis in Wistar rats, experimentally induced by N-nitrosodiethylamine (NDEA). The anti-carcinogenic activity of the plant extracts has been evaluated by their effect on tumour incidence, levels of carcinogen metabolizing enzymes, turnover markers and liver injury markers.

Metastasis (one of the major problems faced by oncologists), by definition is a secondary tumour growing in a site in the body distant from the primary tumour. For most tumours, surgical removal and systemic chemotherapy and radiation therapy are of limited effect once metastasis has occurred. The plant derived products have been observed to inhibit the metastasis, without showing any side effects as chemotherapy and radiation therapy do. Kuttan (2004) have found that curcumin, catechin and rutin (all are plant derived biochemicals) could effectively inhibit the metastasis exhibiting no side effects and with significant increase in life span.

Amygdalin (also known as 'latrial' and 'Vitamin B_{17}'), which is found in nuts, peaches, apricot, strawberry, raspberry, germinated gram and wheat etc., has been very successfully used to control cancerous condition preventing its metastasis. It contains two molecules of glucose together with a molecule of benzaldehyde and cyanide radical each, bound closely together and therefore, is non-toxic. The dissociating key enzyme is β-glucosidase which is present in and secreted by the cancerous cells only (the cancer cells, themselves, activate the dissociation process for Amygdalin; and that results into the targeted action). The β-glucosidase breaks amygdalin into two molecules of glucose and one each of hydrocyanic acid and benzaldehyde within the cancer cells; out of which the hydrocyanic acid and benzaldehyde kill the cell itself. The rhodinase enzyme, secreted by the healthy cells has the potency to deactivate the residual hydrocyanic acid (this particular enzyme is altogether absent in cancerous cells, and therefore, they could not escape the killing action of hydrocyanic acid). Later, the residual cyanide radical, in presence of rhodinase enzyme and sulphur traces, is transformed into thiocyanates (regulator of blood pressure) which changes to cyanocobalmin (Vitamin B_{12}). Similarly, benzaldehyde oxidizes to benzoic acid and functions as pain reliever in joints (Prabhuji, 2010).

The afore-said characteristics of controlling the diseases of varying etiologies by plant derived metabolites indicate that they are vigorously potent without exhibiting any side effects and after effects. Therefore, these medications are supposed to surpass over all those medicines that show side effects and after effects, in future.

FURTHER PROSPECTS

Medicinal plants constitute the bio-wealth of our country and as per our ancient literature; they are also deeply involved in our rituals for human welfare. With the population explosion, particularly in the developing countries, there has been an unexpected pressure on our natural resources in general and on medicinal bio-wealth in particular to meet our health care needs. Therefore, we should very seriously think on the following lines keeping in view the overall assessment:

1. Conducting researches to identify the properties of various plants in respect of its medicinal qualities so that the active principles and the biochemicals present there in, may be isolated to study the phyto-chemistry.
2. Proper documentation of our indigenous knowledge, lying with the tribal people, and its recognition together with the scientific assessment.
3. Sustainability of our bio-wealth must be maintained to avoid the situation making the particular species endangered or extinct.
4. For the conservation of medicinal plant

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germplasm 'herbal gardens' must be maintained in different geographical regions.

5. Development of latest biotechnological approaches, particularly in the field of micro-propagation, reproductive biology, domestication of selected species and agro-technological practices.
6. Enforcement of regulatory acts to protect our natural forest resources. Those industries which implement mass cultivation using the plant tissue culture techniques for the mass production of active principles and biochemical should be encouraged.

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