

Medicinal plants for human health and welfare

C. Manoharachary and D. Nagaraju*

Mycology and Molecular Plant Pathology Laboratory, Department of Botany, Osmania University, Hyderabad-500007, Telangana State, India

**Department of Botany, Govt. Degree College, Eturnagaram-506165, Warangal, Telangana State, India*

Received May 27, 2016; Revised June 10, 2016; Accepted June 12, 2016; Published online June 30, 2016

Abstract

The utilization of medicinal plants is known since times immemorial. The utility of medicinal plants played important role in Ayurveda, Unani, Siddha and also in modern medicine. 80% of world population utilizes drugs, derived from medicinal plants for their health security. Africa, India and other countries have rich floristics yielding herbal drugs. The world market includes herbal drugs, pharmaceuticals, fragrances, flavors, dyes and other ingredients and their marketing exceeds several billion dollars per year. This review adds worthy information on medicinal plants and their curative properties. This review also adds valuable information on plants used by tribals, marketing, ethnobotanical aspects, usage of medicinal plants in wound healing, as antidiabetics and also as antimicrobials.

Keywords: Biodiversity, ethnobotany, herbal drugs, medicinal plants, marketing, pharmaceuticals

1. Introduction

Nature is bountiful of microorganisms, algae, fungi, lichens, liverworts, primary vascular plants, and flowering plants. These plants have been the traditional source for raw material and finished herbal drugs since ancient times. The usage of medicinal plants as preventive and curative medicines was sufficiently documented in many scholastic works. It is estimated that around 30000 plants species are known to have importance and of which 15000 plants are known to have world wide use as drugs. The trends of using herbal drugs are increasing. Plants harbor a number of known and unknown chemical molecules which are of great importance in pharmaceuticals. In view of the growing population, anthropogenic activities and selfishness of individuals, the plant wealth is eroding rapidly. As a result, many plants are becoming endemic and some might have been lost. Therefore, efforts have to be made to protect the loss through *in situ* and *ex situ* conservation strategies.

1.1 Biodiversity

Biologists are engaged in the identification and naming of species for the last 250 years. Even now also, they are able to name and describe far less number of species of all organisms on the earth that is between 1.7 and 1.8 million, which is lesser than 15 percent of the actual number. It is assumed that the number of total species varies from 10 to 80 million. A summary of the total of known species from major taxonomic groups is given in the Table 1.

India is also having a large plant and animal life, owing to diverse climatic conditions, ranging from the cold desert of Ladakh and

Spiti to the hot desert of Thar, the temperate forests in the Himalayas to the tropical rain forests of low lands. Large plant and animal life is also present in fresh water lakes like Wular and Manasbal in Kashmir, the Chilika in Orissa, the Kolleru lake in Andhra Pradesh and the rugged and rich west line and coral reefs in different sea coasts show number of species of different taxonomic groups.

Table 1: Approximate number of species from major taxonomic groups which have been described from all over the world

Sl.No.	Taxonomic group	Number of species
1.	Higher plants	2,70,000
2.	Algae	40,000
3.	Fungi	1,00,000
4.	Bacteria (including cyanobacteria)	4,000
5.	Viruses	1,550
6.	Mammals	4,650
7.	Birds	9,700
8.	Reptiles	7,150
9.	Fishes	26,959
10.	Amphibians	4,780
11.	Insects	10,25,000
12.	Crustaceans	43,000
13.	Molluscs	70,000
14.	Nematodes and worms	25,000
15.	Protozoa	40,000
16.	Others	1,10,000

Source: Annual Report : Ministry of Environment and Forests, Government of India (2007-2009)

Nature has developed exceeding by complex spectrum of life forms over 600 million years. It is impossible to accurately assess the number of species of organisms present on the earth. It is believed that around 10-80 million species exist on earth.

Author for correspondence: Professor C. Manoharachary
Mycology and Molecular Plant Pathology Laboratory, Department of Botany, Osmania University, Hyderabad-500007, Telangana State, India

E-mail: cmchary@gmail.com

Tel.: +91-9391164243

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Total known plant species are 2,70,000 (Figures 1).

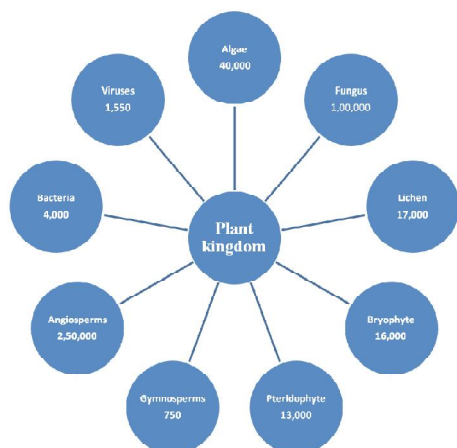


Figure 1: Approximate number of plant species and plant groups from all over the world

Biodiversity exists on the earth in eight broad realms with 193 biogeographically provinces (Khoshoo, 1990). Each biogeographical province is composed of ecosystems which are constituted by communities of living species existing in ecological regions which is described in terms of its three fundamental and hierarchically related levels of biological organizations. There are:

- Species diversity
- Genetic diversity
- Ecosystem diversity and
- Organismal diversity

The existence of human race depends on the well-being of the other life forms present in the biosphere. However, we have been losing this accumulated heritage of millions of years at an alarmingly fast rate over the past 400 years by our activities, thereby undermining the very basis of one own existence of this planet. Our biological systems are constantly impoverished by human activities. All over the world, human beings only have been mostly responsible for the destruction of habitats through intensive agricultural development, over exploitation of resources, urbanization, industrialization, over population, deforestation, pollution, environmental degradation and also ethical degradation nature (Pande, 2014).

1.2 Medicinal plants

The science of life and it's related knowledge is the indigenous system of medicine (Ayurveda) dates back to 1500-800 BC. Since Aryan's time, people were worshipping natural resources like plants, water, forest, fire, air, earth, etc. Yajurveda has dealt with many plants that are used in rituals. Atharvana veda has mentioned the role of medicinal plants in treating diseases. Ayurveda is the most ancient and scientific treatise on medicine and disease and is the branch of Atharvana veda. The majority of medicinal plants yield qualitative herbal drugs which have been in use since times immemorial. However, medicinal plants as raw material suffer from over exploitation, extinction, adulteration, unhealthy processing, storage problems, identification and marketing. Other systems of medicine also use medicinal plants as resource material.

80% world populations depend upon herbal drugs and chemicals derived from medicinal plants for their health security. Pharmaceutical companies all over the world are involved in producing herbal drugs from forest plants, having turnover of more than 3000 million dollars. Taxol, anticancer drug derived from *Taxus baccata* was the first herbal drug, worth of million dollars. Jeevani, a stimulant and energy tonic was synthesized from *Trichopus zeylanicus* which became first patent of tribal's in India. Dasmool was one of the oldest drug and it was made up of ten roots. Charaka Samhita has mentioned the utility of thousands of plants for maintaining human health. Sushrutasamhita, Vishnupurana, The Indian Materia Medica, wealth of India and several other books and thousands of research publications have emphasized the use of medicinal plants in human health security. Guggul, the oleo gum resin extracted from *Commiphora wightii* Armott which has been in use as alternate demulscent, stimulant, tonic, antispasmodic, emmenagogue, antirheumatic agent, as cure for neurosis and serofulous affections has been in use since long time in India.

1.3 Natural drugs: Re-emerging health aid

Since ancient times, herbal drugs have been used as a source of medicine. The widespread use of herbal remedies and healthcare preparations were mentioned. The use of traditional medicine and medicinal plants in most developing countries has been widely observed (UNESCO, 1996). Medicine, in several developing countries, is still the mainstay of healthcare. As defined by WHO, health is a state of complete physical, mental, and social well being and not merely the absence of disease or infirmity. The use of traditional medicine is widespread in China, India, Japan, Pakistan, Sri Lanka and Thailand. In China, about 40% of the total medicinal consumption is attributed to traditional tribal medicines.

Africa is a major source of medicinal plants, and the best known species is *Phytolacca dodecandra*. Extracts of the plant are used as an effective molluscicide to control schistosomiasis (Lemma, 1991). *Catharanthus roseus*, yields antitumor agents such as vinblastine and vincristine; and *Ricinus communis*, yields the laxative-castor oil. In Botswana, Lesotho, Namibia and South Africa, *Harpagophytum procumbens* is produced a crude drug for export. The use of medicinal plants like *Eupatorium perfoliatum* (bonest), *Podophyllum peltatum* (May Apple), and *Panax quinquefolium* (ginseng) in the USA has long been associated with the American Indians. In Europe, some 1500 species of medicinal and aromatic plants, are widely used in Albania, Bulgaria, Croatia, France, Germany, Hungary, Poland, Spain, Turkey, and the United Kingdom. Maintenance of personal health and well-being.

The world market for natural drugs, chemicals, pharmaceuticals, fragrances, flavors, and colour ingredients, exceeds several billion dollars per year. Examples include taxol, vincristine, vinblastine, colchicine, artemisinin, and the Indian ayurvedic drug-*forkolin*. Trade and market in medicinal plants is growing in volume and exports. It is estimated that the global trade in medicinal plants is US \$ 800 million per year.

Keen interest in medicinal plants is the re-emerging health aid has been fuelled by the rising costs of drugs, used in the maintenance of personal health and well-being. Based on current research and financial investments, medicinal plants will continue to play an important role as an health aid (Hoareau and Dasilva, 1999). A list of medicinal plants and their curative properties are given in Table 2.

Table 2: Medicinal plants and their curative properties

Sl. No.	Name	Family	English name	Parts used	Specific activities
1.	<i>Abrus precatorius</i> Linn.	Fabaceae	Rosary pea	Roots, leaves, seeds	Hair tonic, laxative, antiphlogistic
2.	<i>Acalypha indica</i> Linn.	Euphorbiaceae	Indian acalypha	Whole plant	Anthelmintic, scabies, rheumatoid arthritis bronchitic, asthma, earaches, syphilitic ulcers and in acute mania, skin affections
3.	<i>Achyranthes aspera</i> Linn.	Amaranthaceae	Rough chaff .	Root, leaves, seed, whole plant	Used in curing diuretic condition, in renal dropsis, stomachache, bowel complaints, piles, boil and skin eruptions, binge eating disorders, toothache
4.	<i>Acorus calamus</i> Linn.	Araceae	Sweet flag	Dried rhizomes	Dry piles, hysteria, eczema, scabies and acidity, nervinetic
5.	<i>Adhatoda zeylanica</i> Medic.	Acanthaceae	Vasaka .	Root, leaves, whole plant	Alterative, analgesic, antiarthritic antiseptic, antispasmodic, diuretic, expectorant, febrifuge, laxative, neuralgic and sedative. Used in curing asthma, chronic bronchitis chest complaints, haemoptysis, leprosy, pulmonary affections, scabies and skin diseases
6.	<i>Aegle marmelose</i> Linn.	Rutaceae	Bael fruit, Bengal quince	Root pulp, roots	Alterative, antipyretic, antiscorbutic, astringent, digestive, febrifuge, laxative, nutritive, stimulant, stomachic and tonic. Best anti diarrhoeal, antidysenteric, coolant.
7.	<i>Allium sativum</i> Linn	Liliaceae	Garlic	Bulbs	Alterative, antiarthritic, cholagogue, digestive, emmenagogue, expectorant, febrifuge, rubefacient, stimulant, tonic and vermifuge. Used in cough, facial palsy, fatigue, flatulence, fever, hysteria, leprosy, piles, rheumatism, sciatica, swelling and worms, cardiac diseases
8.	<i>Aloe indica</i> Linn.	Liliaceae	Indian aloes	Leaves, mucilage/ juice from the leaves	Laxative, emmenagogue, alternative, blood purifier, abortifacient, anthelmintic, tonic, cooling carminative, cathartic, purgative and stomachic. Useful in amenorrhoea, dyspepsia, glandular enlargement and spleen disorders, jaundice, menstrual suppressions, rectal fissure
9.	<i>Andrographis paniculata</i> (Burm. f.) Wall.	Acanthaceae	King of bitter	Dried aerial parts	Alterative, anthelmintic, febrifuge, stomachic and tonic
10.	<i>Asperagus recemosus</i> Willd var. javanicus Baker.	Liliaceae	Wild asparagus	Roots	Antidiarrhoeal, antidysenteric, antispasmodic, aphrodisiac, cardiac tonic, general tonic, carminative, demulcent, diuretic, galactagogue, nervine tonic
11.	<i>Azadirachta indica</i> Juss.	Meliaceae	Neem plant, Margosa tree	Stem bark, leaves, root bark	Anthelmintic, antimalarial, antiperiodic, antiseptic, appetizer, astringent, bitter tonic, constipative, contraceptive (oral), demulcent, emmenagogue, emollient, expectorant, febrifuge, purgative, stimulant, stomachic and vermifuge. Useful indigestion, catarrhal affections, diabetes, debility, eczema, erysipelas, fever, jaundice, leprosy, liver complaints, lumbago, prurigo, rheumatism, scrofula, ulcers, urticaria, vomiting in fever

12.	<i>Bacopa monnieri</i> (L.) Pennell.	Scrophulariaceae	Indian penny wort	Dried whole plant	Aperient, amprodisiac, diuretic, laxative, nervine tonic, bronchitis, insanity, dropsy, jaundice, epilepsy and hysteria, memory capsules
13.	<i>Boerhavia diffusa</i> Linn.	Nyctaginaceae	Spreading hog weed	Whole plant	Aphrodisiac, cardiac, stimulant, diaphoretic, diuretic, dropsy, emetic, expectorant. Used in internal inflammation, febrifuge, laxative, leucorrhoea, jaundice, asthma, and constipation
14.	<i>Boswellia serrata</i> Roxb. ex Colebr.	Burseraceae	Indian sallaki	Gum	Used in curing cough and cold, purifies blood, dysentery, rheumatism, skin diseases, ulcers, antidote to snake bites and scorpion sting
15.	<i>Cassia occidentalis</i> L.	Caesalpiniaceae	Negro coffee	Roots, leaves, seeds	Potential remedy in hysteria and spasms. Tumours
16.	<i>Catharanthus roseus</i> (Linn.) G. Don.	Apocynaceae	Periwinkle	Roots, whole plant	Most potential anticancerous drug. Antidiabetic, cures hypotension
17.	<i>Centella asiatica</i> (Linn.) Urb.	Apiaceae	Brahmi	Whole plant	Nervine tonic, blood purifier, increases memory, cures anxiety neurosis, sedative and alterative
18.	<i>Chlorophytum borivilianum</i> Sant. And Fernand.	Liliaceae	Safed musli	Roots	Aphrodisiac, oligospermia, anorexia, piles, tuberculosis, anaemia, impotency, galactagogue, analgesic (Mascular pain) and leucorrhoea, sexual ability
19.	<i>Commiphora wightii</i> (Arnott.) Bhandari.	Burseraceae	Indian bodellium	Oleo-gum-resin	Alterative, demulcent, stimulant, tonic, antispasmodic, emmenagogue, antirheumatic, cures anxiety neurosis, scrofulous affections
20.	<i>Cuminum cyminum</i> Linn.	Apiaceae	Cumin seed	Seed	Anthelmintic, astringent, carminative, cooling, digestive, diuretic, febrifuge, stimulant, stomachic and tonic
21.	<i>Curcuma longa</i> Linn.	Scitaminaceae	Turmeric	Rhizome	Alterative, anthelmintic, antiperiodic, antiparasitic, aromatic and astringent, bitter, carminative, hot, stimulant and tonic. Useful in boils, bruises, chronic bronchitis, cold, cough, coryza, eosinophilia, jaundice, swelling and skin diseases
22.	<i>Dioscorea bulbifera</i> Linn.	Dioscoreaceae	Potato yam	Rhizome	Indicated as tonic, rheumatoid arthritis
23.	<i>Eclipta alba</i> (Linn.) Hassak.	Asteraceae	Trailing eclipta	Whole plant	Tonic, alterative, emetic, purgative, antihepatic
24.	<i>Ephedra gerardiana</i> Wall.	Ephedraceae	Ephedra	Dried young stem	Indicated in asthma, rheumatism, cardiac diseases, urinary disorders, and inflammation of mucous membrane, sinusitis, chronic asthmatic attacks, pneumonia, and diphtheria
25.	<i>Ferula asafoetida</i> Regel.	Apiaceae	Asafoetida	Root gum	Useful in cough, gastritis, jaundice, rheumatism and repeated threatened abortion
26.	<i>Foeniculum vulgare</i> Mill.	Apiaceae	Fennel	Seed	Appetizer, cardiac stimulant, carminative, diaphoretic, diuretic, emmenagogue, expectorant, febrifuge, stomachic, stimulant, tonic, vermifuge and purgative
27.	<i>Gloriosa superba</i> Linn.	Liliaceae	Malabar glory lily	Roots	Abortifacient, alterative, anthelmintic, antiperiodic, purgative, stimulant and tonic

28.	<i>Glycyrrhiza glabra</i> Linn.	Fabaceae	Indian liquorice	Roots and stolons	Cures abscess, bite troubles, boils, leprosy, expels skin parasites and intestinal worms Cooling, demulcent, diuretic, emmenagogue, emollient, febrifuge, laxative, ophthalmic, restorative, supportive and tonic. Useful in abdominal pains, asthma, bronchitis, dysuria, oedema, epilepsy, gastric and duodenal ulcer, skin diseases and sore throat
29.	<i>Holarrhena antidyenterica</i> Linn.	Apocynaceae	Kurchi plant	Bark and seeds	Anthelmintic, antidote to poison, antiperiodic, aphrodisiac, tonic, astringent, bitter, carminative, expectorant, febrifuge, antilithic. Cures amoebic dysentery, anaemia, asthma, bile and bowel complaints, broncho-pneumonia, colitis, diarrhea, dysentery, dysuria, leprosy, rheumatism, vomiting and nausea
30.	<i>Indigofera tinctoria</i> Linn.	Fabaceae	Indigo plant	Roots, fruit colour	Useful in epilepsy, sores and bronchitis, antidote to arsenic poison, rheumatism, leprosy, hydrophobia, palpitation of heart and dropsy
31.	<i>Madhuca indica</i> Muell. Arg.	Sapotaceae	India butter tree	Stem bark, seeds, leaves, flowers	Antiarthritic, antibilious, appetizer, astringent, cooling, detergent, emollient, nutritive, sedative, supporative, tonic. Cures itches, bleeding gums, leprosy, skin diseases, diabetes, cold and cough
32.	<i>Mentha piperita</i> Linn.	Lamiaceae	Wild mint	Leaves	Carminative and spasmolytic
33.	<i>Momordica charantia</i> Linn.	Cucurbitaceae	Bitter gourd	Leaves, fruits and root	Malignant ulcers, skin affections, gout, rheumatism, liver and spleen diseases, melancholia, leprosy and piles
34.	<i>Moringa oleifera</i> Sm.	Moringaceae	Horse radish tree	Root bark, flowers, seed, oil	Abortifacient, anthelmintic, antilithic, carminative, digestive, diuretic, emmenagogue, rubifacient, stomachic, stimulant. Useful in burns, bleeding piles, constipation, dysentery, scalds
35.	<i>Mucuna prurita</i> Hook. F.	Fabaceae	Cowhage plant	Seeds, root, fruit	Anthelmintic, aphrodisiac, astringent, diuretic, nervine tonic. Useful in cholera, dropsy, leucorrhoea, tonic and seminal weakness
36.	<i>Ocimum sanctum</i> Linn.	Lamiaceae	Holy basil	Leaves, seeds, roots	Anticatarrh, demulcent, diaphoretic, digestive, diuretic, expectorant, febrifuge, stomachic. Useful in bronchitis, catarrhal fever, hepatic infection, skin diseases, aphrodisiac coolant
37.	<i>Oroxylum indicum</i> (Linn.) Venten.	Bignoniaceae	Indian trumpet flower	Root bark	Highly effective in diarrhea and dysentery. Analgesic, anti-inflammatory. Good drug for rheumatoid arthritis
38.	<i>Phyllanthus emblica</i> Linn.	Euphorbiaceae	Indian gooseberry	Fruits	Refrigent, diuretic, antiscorbutic and laxative. Cooling, digestive, antioxidant and astringent
39.	<i>Picorrhiza kurroa</i>	Scrophulariaceae		Rhizomes, roots	Cholagogue, immune-stimulant, slow intermittent fever, asthma, ascitis
40.	<i>Piper longum</i> Linn.	Piperaceae	Black pepper	Dried fruits, leaves	Alexipharmic, antiperiodic, digestive, diuretic, stimulant, fever, dysentery, cough, hysteria, cholera, dyspepsia, piles, aphrodisiac

41.	<i>Piper nigrum</i> Linn.	Piperaceae	Black pepper	Dried fruits	Anticonvulscent, bioenhancer, appetizer, used in viral hepatitis, antihistaminic, counterirritant, antifatulent
42.	<i>Plantago ovata</i> Forsk	Plantaginaceae	Blond psyllium	Dried seeds, husk	Aphrodisiac, cooling, emollient, demulcent, diuretic, expectorant, chronic diarrhea, constipation, rheumatism, gout, highly mucilaginous
43.	<i>Plumbago zeylanica</i> Linn.	Plumbaginaceae	Leadwort	Roots, leaves	Dyspepsia, piles, anasarca, diarrhea, skin diseases, abortifacient, asa styptic in post partum haemorrhages, useful on leucoderma along with cow's milk
44.	<i>Rauwolfia serpentina</i> (Linn.) Benth. Ex Kurz.	Apocynaceae	Rauwolfia	Dried roots	Anthelmintic, antidote to snakevenom, depressant, expectorant, tonic, febrifuge, hypnotic. Cures insanity, insomnia, and high blood pressure
45.	<i>Sida cordifolia</i> Linn.	Malvaceae	Indian mallow	Whole plant	Demulcent, emollient. Useful in gout, bleeding piles, rheumatism, pulmonary tuberculosis, swelling and as tonic. To treat post-partum infections
46.	<i>Solanum nigrum</i> Linn.	Solanaceae	Black night shade	Fruits, leaves, roots	Cough, skin diseases, rheumatism and gout, chronic enlargement of liver, eye diseases. Highly effective in vertigo and nausea
47.	<i>Syzygium aromaticum</i> Linn.	Myrtaceae	Clove	Dried flower buds	Carminative, stomachache, antiemetic
48.	<i>Syzygium cumini</i> (Linn.) Merr. And Perry.	Myrtaceae	Blackberry	Fruits, leaves, bark	Astringent, carminative, diuretic, febrifuge and stomachic. Used in diarrhea, dysentery, indigestion, leucorrhoea, against ringworms, antidiabetic
49.	<i>Terminalia arjuna</i> (Roxb. ex. DC). Willd. And Arn.	Combretaceae	Arjuna	Bark	Astringent, cooling, cardiac stimulant, blood purifier and antirheumatic
50.	<i>Terminalia chebula</i> Retz.	Combretaceae	Chebulic myrobalan	Dried mature fruits	Astringent, dentifrice, purgative, stomachic, tonic. Cures asthma, ulceration, dysentery, diarrhea, fever and flatulence, piles, vomiting and worms
51.	<i>Tinospora cordifolia</i> Miers.	Menispermaceae	Heart-leaved moonseed plant	Leaves and mature stem	Alterative, anthelmintic, anti-arthritis, antiperiodic, antipyretic, aphrodisiac, bitter, tonic, blood purifier, cardiac, carminative, digestive, diuretic, expectorant, febrifuge, nutritive and stomachic. Useful in jaundice and idiopathic fever, palpitation of heart, kidney complaints
52.	<i>Tribulus terrestris</i> Linn.	Zygophyllaceae	Bindii plant	Fruits, roots, whole plant	Alterative, anthelmintic, anti-arthritis, aphrodisiac, cooling, demulcent, expectorant, tonic, calculous affections, kidney diseases and urinary discharges
53.	<i>Trigonella foenumgraecum</i> Linn.	Fabaceae	Fenugreek	Seeds	Aperients, aphrodisiac, astringent, carminative, demulcent, diuretic, emollient, suppurative. Used in cough, diarrhea, dysentery, dyspepsia, dropsy, enlargement of spleen and liver, inflammatory affections, leucorrhoea, swellings
54.	<i>Vitex negundo</i> Linn.	Verbenaceae	Five leaved chaste	Leaves	Anodyne, anti arthritic, appetizer, astringent, cardiac, cephalic, demulcent, emmenagogue, expectorant, febrifuge, nervine tonic. Useful in asthma, bladder irritation, catarrhal diarrhea, dyspepsia, intestinal haemorrhage, sciatica, general fatigue
55.	<i>Zingiber officinale</i> Rosc.	Zingiberaceae	Ginger root	Rhizomes	Anorexia, rheumatoid arthritis, dyspepsia, nausea

1.4 Medicinal plants and people

Plants have been one of the important sources of medicines ever since the dawn of human civilization. Chemically, medicinal plants may have secondary metabolites like alkaloids, glycosides, steroids or other groups of compounds which have marked pharmaceutical action as anticancer, antimalarial, antidiabetic, antidysenteric, *etc.* In spite of tremendous developments in the field of allopathy during the 20th century, plants still remain as one of the major sources of drugs in modern as well as traditional system of medicine throughout the world.

India has 15 agroclimatic zones and 17000-18000 species of flowering plants of which 6000-7000 are estimated to have medicinal usage in folk and other documented systems of medicine, like Ayurveda, Siddha, Unani and Homoeopathy. About 960 species of medicinal plants are estimated to be in trade of which 178 species have annual consumption levels in excess of 100 metric tons. Medicinal plants are not only a major resource base for the traditional medicine and herbal industry but also provide livelihood and health security to a large segment of Indian population. The domestic trade of the AYUSH industry is of the order of Rs. 80 to 90 billion. There is global resurgence in traditional and alternative healthcare systems, resulting in world herbal trade which stands at US \$ 120 billion and is expected to reach US \$ 7 trillion by 2050. Indian share in the world trade, at present, however, is quite low (1-2%).

The World Health Organization (WHO) estimated that 80% of the population of developing countries rely on traditional medicines, mostly plant based drugs, for their primary healthcare needs. Also, modern pharmacopoeia still contains at least 25% drugs derived from plants and many others which are synthetic analogues built on prototype compounds isolated from plants. Demand for medicinal plants is increasing in both developing and developed countries due to growing recognition of natural products, being non-narcotic, having no side-effects, easily available at affordable prices and sometimes the only source of healthcare available to the poor. Medicinal plant sector has traditionally occupied an important position in the socio-cultural, spiritual and medicinal arena of rural and tribal lives of India. Millions of rural households use medicinal plants in a self-help mode. Over one and a half million practitioners of the Indian System of Medicine in the oral and codified streams use medicinal plants in preventive, promotive and curative applications. There are estimated to be over 7800 manufacturing units in India. In recent years, the growing demand for herbal products has led to a quantum jump in volume of plant materials, traded within and across the countries. Though, India has a rich biodiversity, the growing demand is putting a heavy strain on the existing resources. While the demand for medicinal plants is growing, some of them are increasingly being threatened in their natural habitat. For meeting the future needs, cultivation of medicinal plants has to be encouraged.

It is evident that the Indian people have tremendous passion for medicinal plants and use of them for wide range of health related applications, from a common cold to memory improvement and treatment of poisonous snake bites to a cure for muscular dystrophy and the enhancement of body's general immunity. In the oral traditions, local communities in every ecosystem from the trans Himalayas down to the coastal plains have discovered the medicinal uses of thousands of plants, found locally in their ecosystem. India has one of the richest plant medical cultures in the world. It is a culture that is of tremendous contemporary relevance because it can on one hand ensure health security to millions of people and on

the other hands, it can provide new and safe herbal drugs to the entire world. There are estimated to be around 25000 effective plant based formulations, used in folk medicine and known to rural communities all over India and around 10000 designed formulations are available in the indigenous medical texts.

Plants have been one of the important sources of medicines ever since the dawn of human civilization. In spite of tremendous developments in the field of allopathy, plants still remain as one of the major sources of drugs in modern as well as traditional system of medicine throughout the world. The use of plants as medicines has involved the isolation of active compounds, beginning with the isolation of morphine from opium in the early 19th century. Later, isolation of drugs such as cocaine, codeine, digitoxin, and quinine, in addition to morphine, of which some are still in use.

Prevention is better than cure. But the question is can prevent some disease by taking plant based phytochemicals? Probably the answer is difficult; however, phytochemicals have been used to prevent certain types of cancers and heart diseases. In advanced countries including USA, phytochemicals are available as dietary supplements. In these countries, the diet is rich in fat and protein and very poor in dietary fiber which is one of the major reasons for colon cancer.

The probable remedy lies in practicing organic farming or vigilant practice of integrated management of pests and diseases, thereby, such healthy food can be produced. Man should continue to find newer, more effective drugs either synthetic or plant based to cure diseases. Focus should be given to possibly prevent diseases by eating healthy, nutritive food with better life styles. Organic farming may give solutions to get pesticide free, nutritive, quality food. And finally, let us keep away from junk food and switch back to our rich traditional food (Biradar, 2015).

Local people mostly depend on medicinal plants because these plants are good source of materials needed in primary healthcare and local people use these medicinal plants in different situations (Table 3).

- (i) People use medicinal plants for the treatment of various ailments on the basis of indigenous knowledge passed to them generation after generation.
- (ii) They use medicinal plants on the advice of elders such as wise men, herbalists and traditional practitioners (Anonymous, 1948-1976).

People use medicinal plants singly in their own preparation for the treatment of various ailments on the basis of indigenous knowledge passed on to them generation after generation. They are used on the advice of elders, wise men and religious teachers. They are used with advice of non-qualified but professional traditional medicine workers (hakims), who have also gained some experience through the apprenticeship with some registered practitioners. They are prescribed by qualified registered practitioners (traditional herbalists) of the Unani system of medicine for a wide range of diseases and ailments.

Among the plant parts: leaves, aerial parts, fruits, bark, flowers, rhizomes, roots, tubers, rinds, seeds and bulbs are commonly used. All medications are classified as:

- (i) Single plant based product(s)
- (ii) Based on more than one plant species.

Table 3: List of plants that have been used by tribals

Sl. No.	Name	Parts used	Usage	Community
1.	<i>Gymnema sylvestre</i> (Retz.) R. Br. Ex: Roemer and Schultes.	Leaf, fruit	Diabetes	Santhal Munda <i>etc.</i>
2.	<i>Memordica charantia</i> L.	Fruit	Diabetes	Santhal Kannada
3.	<i>Adina cordifolia</i> (Roxb.) Hook. F. ex. Brandis	Wood	Fuel	Tribes
4.	<i>Terminalia tomentosa</i> (Dc.) Wight and Am.	Leaves, branches	Fodder	Tribals
5.	<i>Emblica officinalis</i> Gaertner	Fruit	Vit. C, Worship	Tribals
6.	<i>Argemone mexicana</i> L.	Fruits	Eczema on Animals	Dewari
7.	<i>Aloe vera</i> (L.) Burm f.	Leaves	Boils, Burns, Piles	Gonda
8.	<i>Carica papaya</i> L.	Fruit	Edible, Abortion	Tribals
9.	<i>Catharanthus roseus</i> (L.) Don.	Leaves, root	Anticancer	Tribals
10.	<i>Zingiber officinale</i> Rose	Rhizome	Diarrhoea Rheumatism	Tribals
11.	<i>Curcuma longa</i> L.	Rhizome	Antiseptic, Antidiarrhoeic	Tribals
12.	<i>Madhuca indica</i> (J. Konig) J.F. Macbr.	Plant parts	Beverages	Tribals
13.	<i>Oroxylum indicum</i> (L.) Benth ex Kurz	Seed	Hypertension	Tribals
14.	<i>Solanum nigrum</i> L.	Plant parts	Skin allergy	Tribals
15.	<i>Anemone revularis</i> Buch. Ham ex Dc.	Plant parts	Sinus problem	Tribals
16.	<i>Panax assamicum</i> Ban.	Plant parts	Ginseng	Tribals
17.	<i>Paris polyphylla</i> Sm.	Plant parts	Anticancer	Tribals
18.	<i>Taxus wallichiana</i> Zucc.	Bark and wood	Taxol, Anticancer	Tribals
19.	<i>Ocimum sanctum</i> L.	Leaves	Cough, Sacred	Tribals
20.	<i>Rauwolfia serpentina</i> (L.) Benth ex. Kurz.	Plant parts, root	Snake bite	Tribals

1.5 Marketing of medicinal plants

The marketing of crude herbal drugs need special attention due to their widespread use by traditional practitioners of the Greek-Arab system of medicine. Poor families residing in the remote hilly areas are engaged in the collection of medicinal plants during the summer months among climatic factors, the important ones are snow fall, wind, drought and frost. Agriculture forms another factor. Man has used plants as food and in curing various ailments since times immemorial and this has been documented in (Manilal, 1989), Rigveda (4000-1500 BC), Atharvaveda (1500 BC), Upanishads (1000-600 BC), Mahabharata and Puranas (700-400 BC).

Rudraksha varieties are mentioned in Lakshmi puranam and Vishnu puranam. Twelve hundred drugs are mentioned in Sushruta Samhita (500 BC) and Charaka Samhitha (100 AD). Opium, pomegranate, aloe, onion were used by Egyptians 6000 years ago. Emperor Shah Nung (2700 BC) mentioned 365 drugs in his book. Aristotle (384-322 BC) listed more than 500 plants. More than 10,000 plants are in use in offering health security and 80 percent world populations are dependent on drugs derived from plants. These are only examples of ancient times. In modern era herbal drugs worth of millions of dollars are in use.

1.6 Ethnobotanical studies

It has been defined as the traditional knowledge of indigenous communities of the surrounding plant diversity and the study of

how the people of a particular cultural tribe and region make use of indigenous plants for the benefit of human health, food and other uses. The Swedish naturalist, Carl Linnaeus on July 4, 1732, recorded in his diary that some medicinal remedies used by the Sami people: I here made the following observations relative to the remedies used by the Laplanders. Their Moxa, as the Japanese call it, but which they term tool, is made of a fine fungus found on the birch. They apply a piece as large as pea upon the effected part. Many of today's drugs have been derived from plant sources. However, as modern medicine and drug research advanced, chemically synthesized drugs replaced plants as the source of most medicinal agents in industrialized countries (Chopra *et al.*, 1996). Vast literature is available in Chinese Materia Medica. In India and Pakistan, three traditional systems of medicine, namely; i) Ayurveda, ii) Siddha, and iii) Unani are distinguished. Ethnomedicine is an area of research that deals with medicines derived from plants, animals, or minerals that are used in the treatment of various diseases and ailments based on indigenous Pharmacopoeia, folklore, and herbal charm (Vartak and Madhav, 1980).

Two fundamental strengths of applied ethno botany are (Jain and Mudgal, 1999).

- (i) To allow the knowledge, wisdom and practices of local people to play fuller roles in identifying and finding solutions to issues of conservation and sustainable development.

- (ii) Local people are fundamentally involved in all stages of research and practical follow up, so there is a better chance of “buy-in” and more robust solutions (Manoharachary and Rajithasri, 2014).

1.7 Medicinal plants usage

Since times immemorial, people have tried to find medications to alleviate pain and cure different diseases. In every successive century, the healing properties of certain medicinal plants were identified, noted, and conveyed to the successive generations. The continuous and perpetual people’s interest in medicinal plants has brought about today’s modern and sophisticated fashion of their processing and usage. Healing with medicinal plants is known since times immemorial. The connection between man and natural drugs

is as old as mankind itself. Awareness of medicinal plants usage is a result of the efforts of man to discover drugs in barks, seeds, fruit bodies, and other parts of the plants. Contemporary science has acknowledged their active action, and it has included in modern pharmacotherapy, a range of drugs of plant origin, known by ancient civilizations and used throughout the millennia (Petrovska, 2012).

1.9 Medicinal plants with potential wound healing activity

Wounds are major case of physical disabilities and wound which is disturbed state of tissue caused by physical, chemical, microbial (or) immunological insults (or) typically associated with loss of function. Many plants have an important role in the process of wound healing. Plants are more potent healers because they have capacity of repairing wounds in natural way (Kumarasamyraja *et al.*, 2012, Table 4).

Table 4: Wound healing plants

Sl.No.	Name	Family	Activity
1.	<i>Allium cepa</i> Linn.	Liliaceae	Antioxidant, antihypertensive, antithrombotic hypoglycemic, hyper lipidemic
2.	<i>Alternanthera sessilis</i> Linn	Amaranthaceae	Eye, cuts and wounds, antidote for snake bite, skin diseases
3.	<i>Aspila africana</i> C.D. Adams	Compositae	Rheumatic painanti bacterial, anti-inflammatory
4.	<i>Mussaenda frondosa</i> Linn.	Rubiaceae	Jaundice, ulcer, leprocy, antimicrobial, diuretic, hepato-protective asthma and cough
5.	<i>Heliotropium indicum</i> L.	Boraginaceae	Ophthalmic disorders, erysipelas, pharygodynia, antitumor and leukemia
6.	<i>Aristolochia bracteolata</i> Lam.	Aristolochiaceae	–
7.	<i>Cassia tora</i> L.	Leguminosae	Gastric stimulantcance, lung inflammation, dysentery and snake bite
8.	<i>Mimosa pudica</i> L.	Mimosaceae	Antivenom activity
9.	<i>Tecomaria capensis</i> (Thumb.) Lind.	Bignoniaceae	Astringent
10.	<i>Anthocephalus cadamba</i> (Roxb.) Miq.	Rubiaceae	Anemia, skin diseases, leprocy, desentery
11.	<i>Lantana camara</i> L.	Verbenaceae	Antimicrobial, fungicidal, insecticidal, hematicial activity
12.	<i>Ageratum conyzoides</i> L.	Asteraceae	Antioxidant, antimicrobial activity
13.	<i>Moringa oleifera</i> Linn.	Moringaceae	Anti-inflammatory, antibacterial activity
14.	<i>Mimusops elengii</i> Linn.	Sapotaceae	Cardiotonic, alexipharmic, stomachic, anthelmintic
15.	<i>Carapa guianensis</i> Aubl.	Meliaceae	Natural insect repellent, massage oil
16.	<i>Curcuma longa</i> Linn.	Zingiberaceae	Antibacterial, anti-inflammatory activity

1.8 Antidiabetic medicinal plants

Diabetes is a common and prevalent disease, affecting the people of both developed and developing countries. It is found that 25% of the world population is affected by this disease. Diabetes caused by abnormality in carbohydrate metabolism that is linked to low blood insulin level or insensitivity of target organs to insulin. Despite lot of progress in the treatment of diabetes by oral hypoglycemic agents, efforts for newer drugs continue because the available synthetic drugs have several limitations. The herbal drugs with antidiabetic activity are yet to be commercially formulated as modern medicines, even though they have been acclaimed for their therapeutic properties in the traditional systems of medicine. Type 2 diabetes usually occurs in obese individuals and is associated

with hypertension and dyslipidemia. The treatment is to reduce insulin resistance and to stimulate insulin secretion. Diabetes is a metabolic disorder where in human body does not produce or properly use insulin, a hormone that is required to convert sugar, starches, and other food into energy. Diabetes mellitus is characterized by constant high levels of blood glucose (sugar). Human body has to maintain the blood glucose levels at a very narrow range which is done with insulin and glucagon.

The ethnobotanical information reports about 800 plants that may possess antidiabetic potential. Several herbs have shown antidiabetic activity when assessed using presently available experimental techniques (Arumugam *et al.*, 2013).

Some of the important antidiabetic potential herbal plants sources are given in the Table 5.

Table 5: Medicinal plants having antidiabetic activity

Sl.No.	Plant name	Family	Parts used	Activity
1	<i>Alangium lamarckii</i>	Alangiaceae	Leaves	Antidiabetic
2	<i>Catharanthus roseus</i>	Apocynaceae	Leaf	Hypoglycaemic
3	<i>Costus speciosus</i>	Costaceae	Rhizome	Antidiabetic
4	<i>Curcuma longa</i>	Zingiberaceae	Rhizome	Antidiabetic
5	<i>Dillenia indica</i>	Dilleniaceae	Leaves	Antidiabetic
6	<i>Gymnema sylvestris</i>	Minispermiaceae	Leaves	Antidiabetic
7	<i>Momordica charantia</i>	Cucurbitaceae	Fruit	Antidiabetic
8	<i>Ocimum sanctum</i>	Lamiaceae	Arial parts	Antidiabetic
9	<i>Psidium guajava</i>	Myrtaceae	Fruit	Antihyperglycemic
10	<i>Solanum torvum</i>	Solanaceae	Fruit	Antihyperglycemic
11	<i>Vitex negundo</i>	Lamiaceae	Leaves	Antihyperglycemic
12	<i>Vaccinium arctostaphylos</i>	Ericaceae	Fruit	Antidiabetic

A number of medicinal plants are known to exhibit antimicrobial activity (Table 6). This has paved the way for creation of some herbal drugs to treat microbial infections (Silva *et al.*, 2010).

Table 6: Antimicrobial activity of medicinal plants

Sl.No.	Plant name	Microorganism
1.	<i>Baccharis trimera</i>	<i>Streptococcus uberis</i> <i>Salmonella gallinarum</i> <i>Escherichia coli</i>
2.	<i>Ruta graveolens</i>	<i>Bacillus cereus</i>
3.	<i>Zingiber officinalis</i>	<i>Bacillus cereus</i>
4.	<i>Achillea millefolium</i>	<i>Streptococcus pneumonia</i> <i>Clostridium perfringes</i> <i>Candida albicans</i> <i>Mycobacterium smegmatis</i> <i>Acinetobacter lwoffii</i> <i>Candida krussei</i>
5.	<i>Allium sativum</i>	<i>Staphylococcus aureus</i>
6.	<i>Maytenus ilicifolia</i>	<i>Staphylococcus aureus</i>
7.	<i>Psidium guajava</i>	<i>Staphylococcus aureus</i>
8.	<i>Cynara scolymus</i>	–
9.	<i>Achyrocline satureioides</i>	<i>Bacillus cereus</i> , <i>B. subtilis</i> <i>Pseudomonas aeruginosa</i> , <i>S. aureus</i>
10.	<i>Cymbopogon martini</i> <i>Cymbopogon winterianus</i>	<i>E.coli</i>
11.	<i>Mikania glomerata</i> , <i>Psidium guajava</i> , <i>Baccharis trimera</i> , <i>Mentha piperata</i> , <i>Cymbopogon citratus</i> , <i>Allium sativum</i> , <i>Syzygium aromaticum</i> , <i>Zingiber officinale</i>	<i>Staphylococcus aureus</i>
12.	<i>Vernonia polyanthes</i>	<i>Lieshmania strains</i>
13.	<i>Baccharis dracunculifolia</i>	<i>E. coli</i> , <i>Pseudomonas aeruginosa</i> , <i>S. aureus</i>
14.	<i>Pelargonium graveolens</i>	<i>Bacillus cereus</i> , <i>B. subtilis</i> <i>S. aureus</i>
15.	<i>Origanum vulgare</i>	<i>E. coli</i>
16.	<i>Allium sativum</i> <i>Zingiber officinale</i> <i>Caryophyllus aromaticus</i> <i>C. citrates</i> <i>Psidium guajava</i> <i>Mikania glomerata</i>	<i>Enterococcus sp.</i> <i>E. coli</i> , <i>S.aureus</i> , <i>Salmonella</i>
17.	<i>Croton zehntneri</i>	<i>Shigella flexneri</i> , <i>Salmonella typhimurium</i> , <i>E. coli</i> , <i>S. aureus</i> , <i>Streptococcus</i>
18.	<i>Croton urucurana</i>	<i>Enterococcus faecalis</i> , <i>S. aureus</i> , <i>Staphylococcus epidermidis</i> , <i>Streptococcus pyogenes</i> , <i>E. coli</i> , <i>Klebsiella pneumonia</i> , <i>P. aeruginosa</i> , <i>Salmonella typhimurium</i> <i>S. flexneri</i>
19.	<i>Annonasenegalensis</i> <i>Englerophytum magalismontanum</i> <i>Dicerocarym senecioides</i> <i>Euclea divinorum</i> , <i>Euclea natalensis</i> , <i>Solanum panduriforme</i> , <i>Parinari curatellifolia</i>	<i>Actinobacillus</i> , <i>Actinomycetem comitans</i> , <i>Actinomyces naeslundii</i> , <i>Actinomyces israelii</i> , <i>candida albicans</i> , <i>Porphyromonon gingivalis</i> , <i>Prevotella intermedia</i> <i>Streptococcus mutans</i>
20.	<i>Lippia alba</i>	<i>S. aureus</i> , <i>B. subtilis</i> , <i>E.faecalis</i> , <i>Micrococcus luteus</i> , <i>E.coli</i> , <i>P. aeruginosa</i> , <i>Serratia marcescens</i> , <i>Mycobacterium smegmatis</i> , <i>Monilia sitophila</i> <i>C. albicans</i>
21.	<i>Hyptis martiusii</i>	<i>E.coli</i>

22.	<i>Myrtus communis</i>	<i>B.subtilis, S. aureus</i>
23.	<i>Punica granatum</i>	<i>S.aureus</i>
24.	<i>Rosmarinus officinalis</i>	<i>Streptococcus mitis, S. sanguinis, S.mutans, S. sobrinus, Lactobacillus casei</i>
25.	<i>Listeria monocytogenes</i>	<i>S. aureus, E.coli, Salmonella enteritidis</i>
26.	<i>Bowdichia virgiliodes, Callophyllum brasiliense, Cariniana rubra, Lafoensia pacari, Stryphnodendron obovatum, Simaba ferruginea, C.urucurana,</i>	<i>S. aureus, S. epidermidis, S. agalactiae</i>
27.	<i>Origanum vulgare</i>	<i>E.coli, E. faecalis, Acinetobacter baumannii, K. pneumoniae, P. aeruginosa</i>
28.	<i>Baccharis boliviensis, Chilotrichiopsis keidelii, Chuquiraga atacamensis, Fabiana bryoides, Fabiana densa, Fabiana punensis, Frankenia triandra, Parastrephia lucida, Parastrephia lepidophylla, Parastrephia phyciciformis, Tetraglochin cristatum</i>	<i>S.aureus, E. faecalis, E.coli, K.pneumoniae, Proteus mirabilis, Enterobacter cloacae, Morganella morgani, P. aeruginosa</i>
29.	<i>Rosa officinalis, Caryophyllus aromaticus, Zingiber officinalis, Citrus citrates, Mentha piperita, Cinnamomum zeylanicum</i>	<i>E. coli, S.aureus</i>
30.	<i>Albizia gummifera</i>	<i>C.albicans, Candida krusei</i>
31.	<i>Origanum vulgare, Thymus vulgaris, Oryganum majorana, Ocimum basilicum</i>	<i>L. monocytogenes, Salmonella enteritidis</i>
32.	<i>Conyza bonariensis, Lippie sidoides, Plectranthus ambionicus, Eucalyptus citridora</i>	<i>S. aureus, S. epidermidis, P. aeruginosa, E.coli</i>
33.	<i>Agastache rugosa</i>	<i>Blastischizomyces capitatus</i>
34.	<i>Pelargonium graveolens</i>	<i>Aspergillus sp.</i>
35.	<i>Melaleuca alternifolia, Thymus vulgaris, Mentha piperata, R.officinalis</i>	<i>S.aureus, K. pneumonia</i>
36.	<i>Cinnamomum aromaicus, Zingiber officinale, Mentha piperita, Cinnamomum zeylanicum</i>	<i>S.aureus, E.coli</i>
37.	<i>Cinnmorum zeylanicum, C. citrates, M. piperita, Z. officinalis,</i>	<i>S.aureus, E.coli</i>
38.	<i>Eugenia uniflora, Baccharis dracunculifolia, V. polyanthes, M.chamomilla</i>	<i>S.aureus, E.coli</i>

Conflicts of Interest

We declare that we have no conflict of interest.

Acknowledgement

Professor C. Manoharachary is thankful to NASI, Allahabad for awarding NASI Senior Scientist and Platinum Jubilee Fellowship. Dr. D. Nagaraju is thankful to Commissioner of Collegiate Education, Telangana State, Hyderabad, for encouragement.

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