Chapter

# Medicinal Plants and Its Pharmacological Values

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## Abstract

Plants have been used as a source of medicine for the treatment of different diseases from thousands of years ago. There is numerous evidences are available for use of plants as a medicine in the treatment of diseases in Indian, Egyptian, Chinese, Greek and Roman system of medicine. Pharmacognosy is the study of medicines derived from natural sources, mainly from plants which may further lead to development of new drug. The exploration, extraction and screening of biological diversity such as herbs, spices, microbes and other natural resources is the worldwide activity in recent years. Phytochemicals are the naturally available bioactive compounds which are derived from different plant parts and are primarily responsible for biological activities. The most important chemical compounds which are present in the plants are alkaloids, phenols, saponins, carbohydrates, terpenoids, steroids, flavonoids and tannins etc.

**Keywords:** Medicinal plants, pharmacognosy, phytochemicals, biological activities

## 1. Introduction

Since from ancient period man depended on nature for their survival and lives strictly connected with nature. Man depends upon surrounding environment for their livelihood, healthcare, and sustenance and also for basic needs (food, fibers, shelter, clothing and gum). Besides providing basic necessities, plants also provided his requirement of medicine. Along with the plant man has been started using animal products and other bio-resources available in nature for preparation of medicine. As a result, different traditional medicine systems have evolved based on environmental condition, social and cultural background with respect to the ethnic group in different countries [1, 2].

Plants are served as major natural resources for traditional as well as modern medicinal system all over the world. The therapeutic potential of plants and plant products can be traced back to thousands of years ago. The information with respect to medicinal benefits of plants with other therapies has been preserved in several documentations in Babylonia, Egypt, China, Greece and Rome etc. Previous works of Theophrastus (370–287 B.C.), Aristotle (384–322 B.C.), Hippocrates (460–370 B.C.) and Dioscorides (50–100 A.D) are providing evidence that Greeks and Romans are familiar with many of today's plant drugs. The "Ebers Papyrus", the best known Egyptian pharmaceutical record documented over 700 drugs represents the history of Egyptian medicine (1500 BC). Erh-ya (300B.C), Svu-ching (1000B.C) and Ben-tsao (1250A.D) are the early herbal documentations available in China, describes more than 600 medicinal plants [3]. In Asia, the earliest records of

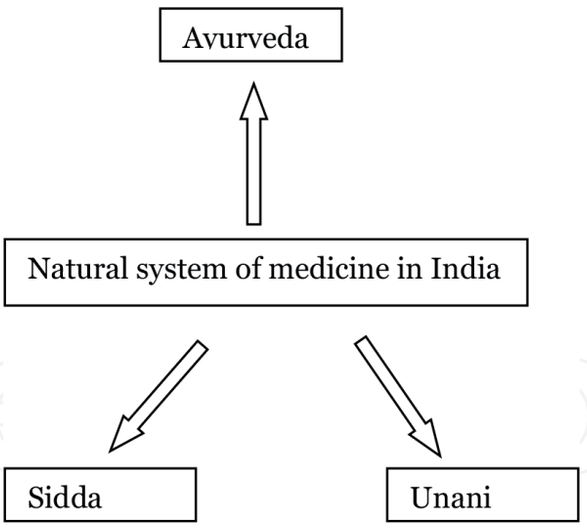


**Figure 1.**
*Natural system of herbal medicine used in India.*

plants usage are found in the clay tablets in Mesapotamia (1700 BC). In India, herbal remedies and health care preparations are also described in ancient texts like 'Charka Samhita' (100–800 B.C), 'Sushruta Samhita' (800–700 B.C), 'Rigveda' (1400–1800 B.C) and 'Atharva-veda' (4500–2500 B.C). Ayurveda is the fundamental source of Vedic knowledge for understanding remedial properties of plants (1000 BC). Ayurveda is considered as ancient medicinal system and it is the compilation of 'Charka Samhita', 'Sushruta Samhita' and 'Ashtanga Hridaya Samhita' [4]. In addition to Ayurveda, Siddha and Unani are other conventional systems of medicine providing additional information of plant based drugs used in India. 'Unani' system of medicine originated in Greece and introduced to India by Arabs and Persians after the discovery of sea route to India. During 10th to 15th century, 'Sidda' system of medicine originated in southern parts of India and is parallel to Ayurvedic system of medicine (**Figure 1**) [5].

Now a day the herbal medicine has renewed attention and hopeful both practical and scientific view points. Herbal remedies are complex mixture different parts of single herb or many herbs which may sometime produce synergistic effect with each other ensuing in the increased therapeutic potential of drug. The identification of biologically active compound responsible for its medicinal property and there is a crucial requirement for quality control. So the correct identification and quality assessment is important to ensure quality of herbal medicine, which contributes to its safety and efficacy. Therapeutic action of herbal formulation depends on its photochemical constituents. The photochemical investigation of the medicinally important plants should be carried out, as this would be beneficial in standardization, quality assessment and efficacy of herbal drugs. Thus pharmacognosy is considered as important tool to study medicinal plants for their identification, validation and standardization [6, 7].

## 2. Bioprospecting of medicinal plants

Biodiversity prospecting or bioprospecting of the medicinal plants is the worldwide activity in the current years. Biodiversity prospecting is the exploration, extraction and screening of biological diversity and indigenous knowledge for commercially valuable genetic and biochemical resources. In early stages, bioprospecting mainly focused on the plants from the forest ecosystem. But in recent

years, various other forms of biodiversity such as insects, algae and microorganisms have been explored with substantial success [8]. During recent years this activity involves the use of advanced technologies to develop new pharmaceuticals, agro-chemicals, cosmetics and other bi-products from biological diversity [9]. With the help of advanced technology and sophisticated techniques and tools it has become effective way to conduct research on metabolic response of living system, genetic manipulation and novel drug discovery through bioprospecting. Various bio-active molecules have been isolated and tested for their pharmacological activities [10].

## 3. Pharmocognosy of medicinal plants

The term pharmocognosy was first time coined by the Austrian physician Schmidt in 1811. A "crude drug" means a dried unprepared natural material of plant, animal or mineral origin, which is used for medicine. The word pharmacognosy is derived from the Greek word *pharmakon*-drug and *gnosis*- knowledge. Pharmacognosy is the study of medicines derived from natural sources, mainly from plants which may further lead to development of new drug. Phytochemicals ('Phyto' means plant) are biologically active natural chemical constituent of plants such as sugar, amino acids, protein, chlorophyll, alkaloids, flavonoids, steroids, tannins etc. Phytochemicals are active ingredients which possess therapeutic properties and are considered as a medicine or drug. More than 4000 phytochemicals have been obtained cataloged and are classified by protective function, physical and chemical characteristics of which 150 phytochemicals have been studied in details [11]. Latest outcome suggest that majority of phytochemicals have beneficial activities like anti- microbial, anti-malarial, anti- diabetic, anti-arthritic and anti-cancerous etc. The medicinal, biological and pharmaceutical value of phyto-constituents helps in the utilization and exploration of plant resources in recent years. The chemical information of plant coupled with medicinal properties and supported by other biological activities will add additional value for development of valuable herbal drugs [12].

During pharmacognostic investigations, physico-chemical analysis also considered as important parameter in evaluation and identification of crude drug. Macroscopic and microscopic analysis is necessary for the detection of adulterants, contaminants of herbal drug and for assessing quality before going for further study. The extractive value and solubility value is useful to evaluate specific chemical constituent dry yield in different solvents. Ash value analysis is useful in determination of unrelated matter (sand and soil) adhering to the surface of plant [13]. Moisture content is essential for evaluation of stability of crude drug. Fluorescence analysis is a reliable tool for standardization of crude drug. The different chemical constituent present in the plant extract showed characteristic fluorescence when illuminated suitably. Certain chemical substances that are not naturally fluorescence themselves are treated with different reagent to attain fluorescence [14].

## 4. Phytochemicals of medicinal plants

The curative properties of medicinal plants are due to presence of major group of active components which are mainly alkaloids, triterpenoids, essential oils and phenolic compounds etc. Alkaloids are the secondary metabolites of plants having noticeable pharmacological activity. Roots, leaves, bark and seeds are common parts of plants which contain alkaliods. In general the alkaloids occur as salts of citric acid, oxalic acid, acetic acid and tartaric acid. These are mostly colorless, water

insoluble and non-polar solvents soluble in nature. Pharmacologically, alkaloids act as cardiac depressants, antihypertensive, anti-leukemic, analgesic, nerve stimulants and local anesthetic. Triterpenoids are made up of six isoprene units. Saponins, sterols and cardiac glycosides are chief triterpenes. The medicinal plants which have saponins are roots of *Glycyrrhiza glabra*, tuberous roots of *Asparagus racemosus* and roots of *Smilax glabra*. Typically sterols are animal substances but recently detected from plants also. Ergosterol, stigmasterol, campesterol and β- sitosterol are chief sterols derived from plants. In several plants characteristic odor is due to presence of essential oils or volatile oils which occur in lysigenous or schizogenous cavities, in glandular hairs or in specialized tubes. A variety of plant parts such as leaves of lemongrass, bark of cinnamon, flower buds of clove, nutmeg seeds and camphorwood contains volatile oils. The phenolic compound are soluble in water and includes phenols, phenolic acids, phenyl propanoids, coumarins, phenyl propenes, flavonoid pigments, anthocyanins, flavonols, flavones and tannins [15].

## 5. Biological activity of medicinal plants

Due to the presence of bioactive molecules plants are used as phytomedicine to cure many complaints. *Catharanthus roseus* has 'vinblastine' and 'vincristine' and used in cancer. *Rauwolfia serpentina* is hypotensive due to presence of 'serpentine', 'reserpine' and 'ajmalicine'. *Papaver somniferum* contains 'morphine' and 'codeine' and is analgesic and sedative. 'Artemisinin' is effective against malaria derived from *A. annua*. Similarly, the bioactive components of plants 'Withanaloides' reported from *Withania somnifera* useful in treatment of arthritis. 'Charantin' a steroidal saponin, isolated from *Momordica charantia* reported for anti-diabetic activity. 'Diospyrin' reported from *Diosyros species* acts as anti-leishmanial agent. 'Tephdidoside' is a flavanol glycoside derived from *Tephorsea candida* found to be active against human cancer [16]. 'Berberine' derived from *Berberis vulgaris* reported for antidiabetic, hepatoprotective, antimicrobial activity. 'Digoxin'obtained from *Digitalis lanata* used in heart diseases. Similarly, 'Quinine' isolated from *Cinchona robusta* acts as antimalerial, antiparasitic agent. Another compound 'Allicin' isolated from *A. sativum* reported for its cardioprotective, anti-inflammatory activity [17].

More than 35,000 plant species have been investigated and resulted in the discovery of anticancer drugs such as 'Vincristine', 'Vinblastine', 'Taxol', 'Etoposide analogs', 'Camptothecin' etc. Many number of effective drugs derived from higher plants were alkaloid 'Paclitaxol', isolated from *Taxus brevifolia* used in treatment of ovarian and breast cancers [18]. 'Andrographolide', active diterpine derived from *A. paniculata* acts as a noble anticancer agent against cancers of breast, ovary, stomach, colon, prostate, kidney, nasopharynx malignant melanoma and leukemia. 'Thymoquinone' and 'dithymoquinone' of *Nigella sativa* shows anticancer activity against different types of cancers such as colon, prostate, pancreas, uterus, malignant ascites, malignant lymphoma, malignant melanoma, sarcomas and leukemia. However, 'Plumbagin' isolated from *Plumbago zeylanica* hinders growth and spread of breast cancer, liver cancer, fibro-sarcoma, malignant ascites and leukemia by cell proliferation [19].

A wide range of reports are available on phytochemicals and pharmacological activity of medicinal plants. Several workers have reported biological activity of medicinal plants. Pharmacognostic and preliminary phytochemical analysis of *Colocasia esculenta* dried tubers were calculated. The tubers are good source of carbohydrate, protein and starch. Nutritional analysis showed moisture content (56.8%), ash content (1.22%), carbohydrate (3000 mg/100gm), protein (824 mg/100gm)

and starch (2700 mg/100gm) in dry tubers. Phytochemical analysis revealed the presence of alkaloids, glycosides, flavonoids, terpenoids, saponins and phenols [20]. *A. aspera* important medicinal plants reported in Ayurvedic literature with number of medicinal property. Phytochemical investigation of plant extracts were subjected to qualitative screening test for various constituents. This revealed the presence protein, glycosides, alkaloids, tannins and phenolic compound, steroid reducing sugars and saponin glycosides [21]. Pharmacognostic and phytochemical evaluation of *Tridax procumbens* were studied. The quantitative microscopical and histological study is done revealed the presence of Tricomes, palisade tissue, trachieds and vessels in powder microscopy. Phytochemical analysis of the whole plant is done and the presence of carbohydrates, sterioids, phenols and tannins were reported and quercitin is confirmed using HPTLC [22].

In parallel, phytochemical screening of *Cinnamomum zeylanicum* shows the presence of carbohydrate, glycoside, protein, tannins, saponins, flavonoids and terpenoids. The proximate analysis revealed that water soluble extractive values of leaves was 29.75, total ash value was 9.75, acid insoluble ash was found to be 2.50 and sulphated ash was 37.35. Anti- microbial activity of the disk diffusion method showed that chloroform and hydro-ethanol extracts of leaf were more effective against Gram–positive bacteria in vitro [23].

Antimicrobial activity of different extract of *Cynodon dactylon* was tested against disease causing bacterial pathogens using the agar well diffusion method. Areal parts of ethanol extract show more activity against *Pseudomonas aeruginosa* and *Staphylococcus aureus* with zone of inhibition 13.83 ± 0.29 mm and 2.0 ± 0.10 mm respectively. A total 20 compounds were identified from the hydroalcoholic extract of the whole parts through GC–MS analysis. Among all, hexadecanoic acid, ethyl ester inolenic acid, ethyl ester was the major components of the hydroalcoholic extract and hexadecanoic acid ethyl ester was abundant. The antioxidant activity of the hydro-alcoholic extract of aerial parts was studied *in vitro* by different methods. Of this superoxide radical scavenging assay revealed a maximum inhibition of 93.33%. Total antioxidant capacity equivalent of ascorbic acid was 172.39 mg/g of extract. Similaly, anticancer activity of methanolic extracts of leaves was studied in ascitic lymphoma (ELA) in Swiss albino mice. Results demonstrate that methanolic extract was found to be antiproliferative at lower concentrations and induced apoptotic cell death in COLO 320 DM cells [24].

*Pothos scandens* another medicinally important plant screened for its various biological activity. At lower concentration of ethanol extract was found to have more antimicrobial activity compare to other. The ethanol extract of root showed significant free radical scavenging activity with DPPH and superoxide radical scavenging activity (IC50 0.284 mg/mL and 70.84%). The active compounds of ethanol extract of aerial parts investigated through GC–MS analysis. This depicts that Dodecanoic acid, tetra decanoicacid and n- hexadecanoic acid acts as antioxidant. Similarly cytotoxicity of same plant was evaluated against MCF-7 (breast cancer) cell lines by MTT assay and results revealed that the extract has significant cytotoxic activity with an IC50 of 90.18 ± 5.20 μg/ml and also cell death of MCF-7 treated with the extract was due to the induction of apoptosis, which was confirmed by comet assay [25].

The in vitro cytotoxic activity of *Colocasia gigantea* extract on cervical cancer (Hela) and human white blood cells (WBC) was conducted. Bioassay-guided fractionation method showed that not all parts promote cytotoxic activity. The leaf fraction of dichloromethane showed significant cell proliferation effect on Hela cells, but not on WBCs. The n-hexane tuber fraction only exhibited significant cytotoxicity on Hela cells ($IC_{50}$ 585 μg/ml) and encouraged WBC cell proliferation. From the GC–MS spectrometry it was found the 4, 22-Stigmastadiene-3-one,

Diazoprogesterone, 9-Octadecenoic acid (Z)-, hexyl ester, and Oleic Acid were the components of n- hexane tuber fraction which had cytotoxic potential. Tuber fraction of n- hexane shows potential for cervical cancer treatment [26].

## 6. Current status of herbal medicine

World Health Organization estimated that 80% of the populations of developing countries still depend on plant drugs for their primary health care needs. According to survey of World Health Organization, the practitioners of traditional medicinal system treat about 8% of patients of India, 85% in Burma and 90% in Bangladesh. India comprises of 2.4% of the total geographical area of the world. The country accounts for an average of 8% of the total global biodiversity with approximately 49,000 species of plants of which 4,900 are endemic [27]. Approximately 2,65,000 species of seed plants exists on earth and less than half of these have been studied systematically for their chemical composition and medicinal value [28].

Greater part of drugs now available in the market is simple semi-synthetic derived from naturally occurring substances. Up to 50% the approved herbal drugs used today are from either directly or indirectly synthesized from natural products including plants, microorganisms, fungi and animals. According to an estimate, about 25% of the world pharmaceutical products find a significant degree of origin in indigenous communities, which represents more than a 2000 billion dollar share market [29].

In many developed countries, the percentage of the population which has used herbal medicines at least once is 48% in Australia, 70% in Canada, 42% in USA, 38% in Belgium and 75% in France. Malaysia, spent US$ 500 million annually on herbal health care, compared to about US$ 300 million on allopathic medicine. In USA, annual spending on conventional medicines was estimated at US$ 2700 million. In Australia, Canada and the United Kingdom, annual expenditure for herbal medicine is estimated US$ 80 million, US$ 2400 million and US$ 2300 million respectively. In several parts of the world, outflow on herbal medicinal products is not only significant, but also growing rapidly [30].

The allopathic medicine has side effects and hazardous to human beings. After realizing toxicity and adverse effects of allopathic medicines, a shift in universal trend from synthetic to herbal medicines has been observed both in developed and developing countries [27]. The most important facts about herbal medicine are that these medicines have no side effect and available in low of cost. Therefore high dose of herbal medicine or wrong medicine consumed by patient mistakenly does not cause any adverse effect on the body.

## 7. Conservation of medicinal plants

Medicinal plants are the basic raw materials of pharmaceutical industries and is highly depends on medicinal plant for extraction of medicinally important compounds. During this time with the advancement of science and technology, over growing demand of pharmaceutical industries, the useful medicinal plants were over exploited by the men. So there is a need of conservation and propagation of valuable, rare and endangered medicinal plants by using advanced biotechnology methods [31].

Plants occupy a major sector of health care system and represent a most important natural resource. Therefore conservation of species is most effectively achieved through the management of the wild population and natural habitats. In most of cases medicinal plants either do not produce seeds or too small seeds. In order to

overcome these barriers *ex-situ* techniques can be used to complement *in-situ* methods and for some instance it may be appropriate for some species. So conservation of medicinal plants can be accomplished by the *ex-situ* that is outside the natural habitat by cultivating and maintaining plants through long term conservation of plant propagules in plant tissue culture repositories [32]. *In vitro* techniques have been increasingly applied for mass propagation and conservation of germplasm as it has superiority over alternative strategies. Hence there is a need for conservation of medicinal plant biodiversity for the present and forth coming generation by adapting the appropriate strategy with proper conservation method [33, 34].

Recently in India, several institutes and organizations involved in different aspects of drug discovery and conservation medicinal plant from natural resources. Initiative work designed for finding novel bioactive compound from plant, fungi, microbes etc. are set up by Council of Scientific and Industrial Research (CSIR), Central Drug Research Institute (CDRI), Regional Research Laboratory (RRL), Jammu and Kashmir. Golden Triangle Partnership (GTP) in collaboration with Department of Ayush, CSIR and ICMR involved in the validation of traditional ayurvedic medicine for effective drug discovery. During last few decades, the Department of Biotechnology and Government of India has set up two Micropropagation Technology Parks at National Chemical Laboratory (NCL), Pune and Tata Energy Research Institute (TERI), New Delhi [16].

## 8. Conclusion

Since time immemorial plants are utilized as chief source of therapeutic agents. The medicinal plants are not only the source of healthcare but also an important product of world trade. In last few years the trade of medicinal plant is increase rapidly because herbal drugs are easily available at lowest prices and less side effects [35]. The remedial properties of plants due to presence of intricate chemical components with different compositions and biological function.

Herbal medicine is widely practiced in worldwide and is considered to effective and affordable. Recently significant attention has been made to utilize eco-friendly and bio-friendly plant based product for cure of different human diseases [28]. This increases global pharmaceutical demand from last few years. Due to increasing demand of supply of plants as a raw material in pharmaceutical industries, biological diversity of plants is in danger. Therefore there is a need to advance research for the development and characterization of natural drugs with the help of better screening methods from plants and other natural sources. However, medicinal plants often being subjected to scientific validation and for discovery of safe and potential natural drug to fight against diseases [36, 37].

## Conflict of interest

The authors declare no conflict of interest.

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