



A REVIEW

Medicinal and Aromatic plants: “Natural bio-chemicals and medicine factories”

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Abstract : Since thousands years back approximately around 900 BC, medicinal plants are considered as a source of many biomolecules with therapeutic potential. Herbal medicines are considered as safer, better, physiologically compatible and cost-effective. The oldest evidence of medicinal and aromatic plants depicts that with the emergence of human civilization, plants have been considered as the main source to heal and cure various serious ailments. It has been proven that the secondary metabolites e.g. alkaloid, glycosides, flavonoides, steroids etc present in the medicinal plants possesses ability to prevent occurrence of some of the diseases, means medicinal plants acts as a “preventive medicine”. Medicinal plants have a paramount importance and a great interest due to its pharmaceutical, cosmetic and nutritional values. Some plants are also considered as an important source of nutrition and are known to have a variety of compounds with potential therapeutic properties. India is the principal repository of large number of medicinal and aromatic plants or we can say India is one of the rich mega-biodiversity countries of the world. Medicinal plants are “backbone” of traditional medicinal system (TMS). Crude drugs are usually dried parts of medicinal and aromatic plants (MAPs) such as roots, stems, wood, bark, seeds, fruits, flowers, leaves, rhizomes, whole plant etc. that form the essential raw material for the production of medicines in various systems of Ayurveda, Siddha, Unani, Tibatian, Tribal and Homeopathy. According to the survey of the World Health Organization (WHO), about 80% of the world population are using herbs and other traditional medicines for their primary healthcare and have established three kinds of herbal medicines: raw plant material, processed plant material, and herbal products. Now days, variety of available herbs are used throughout the world and they continue to promote good health. As the benefits from medicinal and aromatic plants are recognized, these plants will have a special role for humans in the future. The present review on medicinal and aromatic plants revealed similar combination of studies.

Key Words : Medicinal, Aromatic plants, Herbal medicines, Phytoconstituents

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INTRODUCTION

Medicinal plants refer to a various type of plants that have medicinal properties and used in Hebraism.

The word “herb” has been derived from the Latin word “herba”. Earlier the term herb was only applied to the non-woody plants, but now a days herb refers to any

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part of plant like leaves, bark, stem, flower, stigma, fruit or a root. It has been reported that herbal drugs and their constituents have advantageous effects on long-term fitness and can be used efficiently to treat human diseases or disorders (Luqman *et al.*, 2014). In Indian subcontinent medicinal plant is a vast repository and used as a traditional medicine for the treatment of various chronic diseases, a huge amount of polyherbal formulation is used and in recent research suggested that combination therapy give effective response for the treatment of complex disease (Pertrovska, 2012). Many scientific investigations have depicted the importance of the different plant families *i.e.* Asteraceae, Apocynaceae, Liliaceae, Rutaceae, Caesalpinaceae, Solanaceae, Piperaceae, Ranunculaceae, Apiaceae, Sapotaceae etc. are used as a medicinal plants and their bioactive compounds which is present in the plants should undergo studies and development of new drugs. Also there are many plant species that have been reported to carry many active compounds which play significant role in management of various human as well as animal chronic diseases.

The most powerful and promising elements of plants are their secondary metabolites, on which humans depend upon (Robinson *et al.*, 2011). Significantly, natural products and their derivatives contribute to more than half of the Food and Drug Administration (FDA) approved drugs (Chavan *et al.*, 2018). Researchers found many combinations in which the active compound/ingredient of the herbal plant combine with the other substance to give an effective response in context to biological properties (Kennedy and Wightman, 2011). Presence of polyphenol compound such as flavonoids

and phenol which contained free radical scavenging molecule that are rich in antioxidant activities. Antioxidant work as to neutralize the action or activity of the free radical which cause the tissue injury or damage (Tayyab *et al.*, 2016). Medicinal and aromatic plants have magical properties such as medicine, food, healing, and recreation. One of the huge benefits from medicinal and aromatic plants is to overcome many difficult illnesses, such as contagious disease, cancer, and AIDS/HIV. The National Cancer Institute (NCI) screens plants for the possibility of new drugs and active plant chemicals for cancer and AIDS/HIV in several on-going collaborative programs (Taylor, 2000). Natural compounds have been extensively explored for new drug discoveries from plants; they played a unique holistic role for the provision of food, drugs, clothing, shelter, etc. (Chandra *et al.*, 2017). Indeed, plants have been used as medicines for more than 5000 years as a source of antibiotics, antineoplastic, analgesics, cardio protective, among others (Brown *et al.*, 2016 and Chen *et al.*, 2019).

Distribution of MAPs:

About 70% India's medicinal and aromatic plants are found in tropical forests of Western and Eastern Ghats, the vindhya, chotta Nagpur plateau, Arawalis, Shiwalik and the Himalayas. According to FAO, forests are the primary source of medicinal plants and MAPs are one of the many valuable categories of non-timber forest products (NTFPs) that include food and beverages, fodder, perfumes, cosmetics, fibre, gums, resins, and ornamentals and materials for dyeing and tanning, plant protection, utensils and handicrafts. Habit wise classification showed that about 33% are trees, 32% herbs, 20% shrubs, 12% creepers and 3% others.

Before the introduction of chemical medicines, we all relied on the healing properties of medicinal plants. Some people value these plants due to the ancient belief which says plants are created to supply man with food, medical treatment and other effects. Various parts of MAPs have of economic importance and used in traditional system of medicines in India (Fig.2). Cultivation of medicinal plants is unlike other agricultural crops. These plants are grown for secondary metabolites and don't have even stress quantity of pesticides or heavy metals. Therefore WHO has insisted to develop Good Agricultural Practices (GAPs) for Medicinal, Aromatic and Potential crops (MAPs) to guarantee quality of raw drugs.

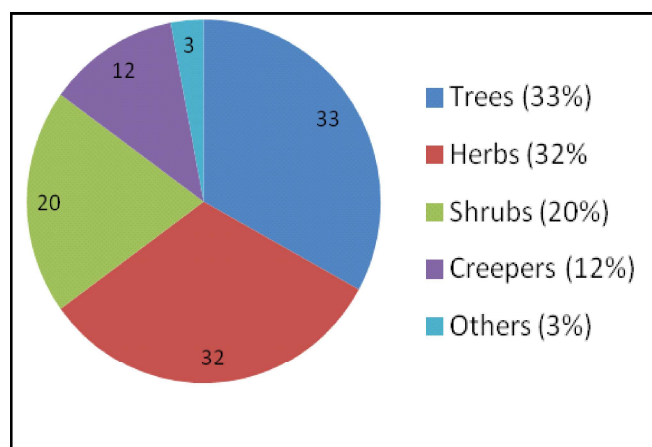


Fig. 1 : Per cent proportion of medicinal plants in India

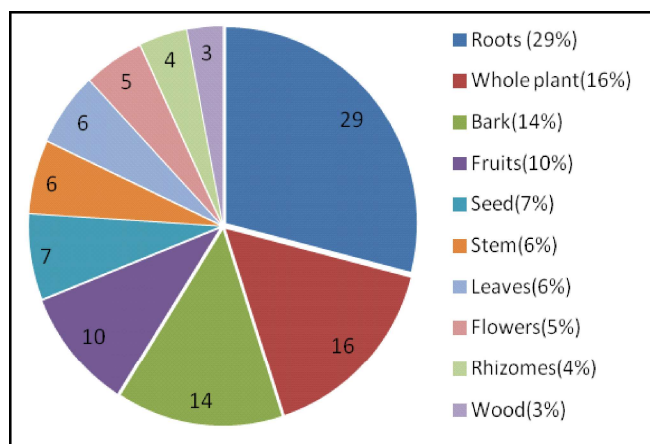


Fig. 2: Per cent distribution of plant parts used in traditional system of medicines in India

Several European countries are in the foreground of MAP cultivation such as Bulgaria, France, Poland, Hungary, or Romania with species cultivated on over 25,000 ha each: to 2030, the total available land for MAP cultivation is expected to reach 26.2 M ha. Spain is considered to possess the largest available land in 2020 (3616 ha), while Poland will be the leading cultivator in 2030 (4079 ha). Spain, Germany, Poland, France, and Romania are the top five MAP cultivating countries. More than 80% of the total land available for non-food crops is provided by these five countries together with Italy, Bulgaria, and Hungary. These eight European countries will continuously increase this contribution to 81.7% and 84.5%, in 2020 and 2030, respectively (CORDIS, 2014).

Use of medicinal plant and their product as medicinal supplements:

Over 8000 phenolic compounds derived from medicinal plants are being used currently in the biotherapy. Medicinal and aromatic plants (MAPs) represent an inexhaustible source of life saving drugs for the majority of the world's population. According to WHO (2019), the issues created by the increase of the human population, together with a reduction in renewable resources, is reflected in the increase of the global demand for medicinal plants. Antibiotics have been considered our best strategy from health perspective, but now studies showed the impact of antimicrobial resistance (AMR), which is a major concern. This results in the greatest loss to individual and social economy (O'Neill, 2016). It is estimated that by 2050, the death rate due to AMR will balloon to 10 million lives per year

at an expense of one hundred trillion dollars (De Kraker *et al.*, 2016). Now the rapid development of MDR in microorganisms is increasing global health problems and presents a challenge for the treatment of infectious diseases (Brown *et al.*, 2016). The best alternative to break AMR is crude drugs derived from herbs. In recent past, humans have been using natural compounds to ward off infections (Newman *et al.*, 2014).

About 70–90% of the population in developing countries continue to use ancient medicines based on plant extracts. Plants are the best hope for safe future medicines and also the important source of income for poor people, local communities as well as for the herbal dealer and in India; almost 70% of modern medicines are derived from natural products (Shinwari, 2010). Aromatic plants contain odorous, volatile, hydrophobic and highly concentrated compounds called essential oils. These are obtained from several organs of the plant such as flowers, buds, seeds, leaves, twigs, bark, wood, fruits and roots. Essential oils from various aromatic plants are isolated by various distillation process/methods and other volatile compounds are isolates by solvent extraction method. Some of the examples of common medicinal and aromatic plants are: Brahmi (*Bacopa monnieri* L.), an annual creeping herb, mainly used to increase the memory and learning power. Medicinally, used in depression, epilepsy, stress, insomnia, insanity, also used in the treatment of tumors and leprosy (Pareek *et al.*, 2014). Liquorice (*Glycyrrhiza glabra*), a number of components have been isolated from liquorice, including a water-soluble, biologically active complex that accounts for 40-50 per cent of total dry material weight. This complex is composed of triterpene, saponins, flavonoids, polysaccharides, pectins, simple sugars, amino acids, mineral salts, and various other substances (Obolentseva *et al.*, 1999). Glycyrrhizin, atriterpenoid compound, accounts for the sweet taste of liquorice root. This compound represents a mixture of potassium-calcium-magnesium salts of glycyrrhizic acid that varies within a 2-25 per cent range. Among the natural saponins, glycyrrhizic acid is a molecule composed of a hydrophilic part, two molecules of glucuronic acid, and a hydrophobic fragment, glycyrrhetic acid. The yellow colour of liquorice is due to the flavonoid content of the plant, which includes liquiritin, isoliquiritin (a chalcone) and other compounds (Yamamura *et al.*, 1992). Artemisinin isolated from Artemisia (*Artemisia annua* L.) effective against multidrug-resistant malaria which act on *P. falciparum*,

Table 1 :			
Name of Plant	Local name	Part used	Medicinal uses
<i>Aloe barbadensis</i>	Gritkumari/ Guarpatha	Leaves	Laxative, Wound healing, Skin burns and care, Ulcer.
<i>Glycyrrhiza glabra</i>	Mulethi /Liquorice	Rhizomes roots	Treating sore throat, chest congestion, kidney problems, bronchitis
<i>Plantago ovata</i>	Isabgol	Husk	Relieves constipation, cures diarrhoea, keep digestive system healthy, aid in weight loss, regulate blood sugar.
<i>Withania somnifera</i>	Aswagandha	Roots, Leafs	Restorative Tonic, stress, nerves disorder, aphrodisiac.
<i>Asparagus racemosus</i>	Satavari	Tuber, roots	Enhance lactation, general weekness, fatigue, cough.
<i>Andrographis paniculata</i>	Kalmegh	Whole Plant	Fever, weekness, release of gas.
<i>Catharanthus roseus</i>	Sadabahar	Whole Plant	Leukamia, Hypotensiv, Antispasmodic ,Atidot.
<i>Centella asiatica</i>	Mandukparni	Whole Plant	Antiinflammatory, Jundice, Diuretic, Diarrhoea.
<i>Ocimum sanctum</i>	Tulsi	Leaves, Seeds	Cough, Cold, bronchitis,expectoran
<i>Casia augustifolia</i>	Senna	Whole Plant	Rheumatism, general debility tonic, aphrodisiac.
<i>Ranwolfia serpentina</i>	Sarpagandha	Roots	Hyper tension, insomnia.
<i>Lepidium sativum</i>	Chandershur/Asalio/ Garden cress	Leaves, Seeds	Treatment of asthma, bronchitis, cough. Seeds acts as galactogogue, emmenagogue.

causes cerebral malaria. The artemisinin-based compound has enlarged to their anti-cancer properties in their last decade (Mahomoodally *et al.*, 2013). Lemongrass (*Cymbopogon flexuosus*) is an aromatic plant, used as traditional medicine in developing countries, also used for the treatment of bacterial and fungal infection in Algeria. Essential oil of lemongrass is used as anti-rheumatic, anti-tussive and also to treat back ache, sprains in different countries (Boukhatem *et al.*, 2014). Main component of lemongrass essential oil (LEO) is "Citral" which is used for anti-inflammatory effect in both human and animals (Han *et al.*, 2017). Recently it was investigated by Sharma *et al.*, 2017 and Zhao *et al.* 2018 that Mentha contains various medicinal uses like anti-tumour, anti-inflammatory, anti-diabetes, anti-nociceptive activity etc. *Zingiber officinale* used as medicinal purposes and has been used in nausea and vomiting, and can be nutritionally used for cooking (Hanway *et al.*, 2018). Generally, alkaloid from the plant

has a conspicuous influence upon the central nerve of human even if taking a small quantity alkaloid, very strong action is shown (Table 2 and Fig. 3, Tyler, 1999).

Table 2 : Actions of alkaloid compounds

Action	Alkaloid compound
Analgesic, anesthesia	Morphine
Mydriasis	Atropine
Mitosis	Pilocarpine
Blood-pressure increase	Ephedrine
Blood-pressure reduction	Reserpine
Bronchial expansion	Lobeline
Stimulus	Strychnine
Anti-microbial	Berberine
Anti-leukemia	Vinblastine

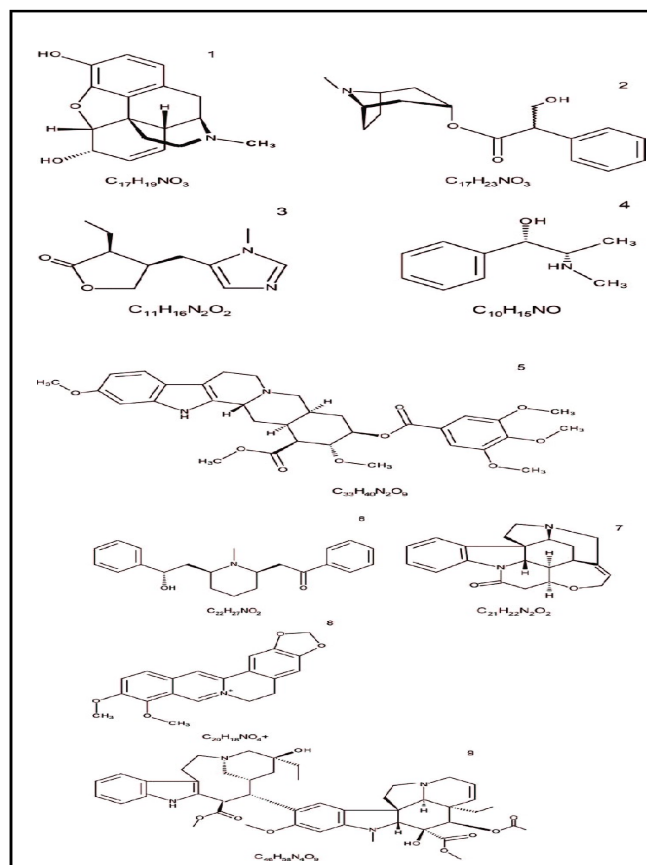


Fig. 3: Diagram of alkaloid compounds. (1) Morphine, (2) atropine, (3) pilocarpine, (4) ephedrine, (5) reserpine, (6) lobeline, (7) strychnine, (8) berberine and (9) vinblastine

Type of phytoconstituents:**Phenolics :**

Phenolic compounds are essential for the growth and reproduction of plants and are produced as a response for defending injured plants against pathogens. They are universally distributed in plants and have been the subject of a great number of chemical, biological, agricultural, and medical studies. Recent interest in phenolics is because of their potential protective role against many diseases e.g coronary heart disease, stroke, and cancers. They form a varied group that includes the widely distributed hydroxybenzoic and hydroxycinnamic acids. Plant phenolic compounds are diverse in structure but are characterized by hydroxylated aromatic rings (e.g. flavan-3-ols). They are categorized as secondary metabolites. Many plant phenolic compounds are polymerised into larger molecules such as the proanthocyanidins and lignins. Furthermore, phenolic acids are present in food plants as esters or glycosides conjugated with other natural compounds such as flavonoids, alcohols, hydroxyfatty acids, sterols, and glucosides (Ray Sahelian, 2016 and Karin Fester, 2010).

Alkaloids:

Alkaloids often have pronounced bioactivities and are therefore thought to play an important role in the interaction of plants with their environment. Throughout human history they have been used as remedies, poisons and psychoactive drugs (Karin Fester, 2010). They are basic, nitrogen-containing organic constituents that occur mainly in plants. The nitrogen in the alkaloid molecule is derived from amino acid metabolism. Since the amino acid skeleton is often largely retained in the alkaloid structure, alkaloids originating from the same amino acid show similar structural features. Many alkaloids, though poisons, have physiological effects that render them valuable as medicines. According to The Columbia Encyclopedia (2015), Cinchonine and quinine are derived from cinchona, coniine is found in poison hemlock, and reserpine is an extract of rauwolfia roots. Also curarine, found in the deadly extract curare, is a powerful muscle relaxant; atropine is used to dilate the pupils of the eyes; and physostigmine is a specific for certain muscular diseases. Narcotic alkaloids used in medicine include morphine and codeine for the relief of pain and cocaine as a local anesthetic. Other common alkaloids include quinine, caffeine, nicotine, strychnine, serotonin, and LSD. Aconitine is the alkaloid of aconite.

Saponins :

They are phytochemicals found in most vegetables, beans and herbs. The best known sources of saponins are peas, soybeans, and some herbs with names indicating foaming properties such as soapwort, saoproot, soapbark and soapberry. They have a bitter taste. Saponins are glucosides with foaming characteristics. The foaming ability of saponins is caused by the combination of a hydrophobic (fat-soluble) saponin and a hydrophilic (water-soluble) sugar part. Some saponins are toxic and are known as saponotoxin. Saponins are having many health benefits. Many studies have showed the beneficial effects on blood cholesterol levels, cancer, bone health and stimulation of the immune system. Saponins from Yucca and Quillaja are used in some beverages, such as beer, to produce stable foam. The detergent properties of saponins have led to their use in shampoos, facial cleansers and cosmetic creams (<http://www.phytochemicals.info/>).

Glycosides:

They are compounds containing a carbohydrate and a non-carbohydrate residue in the same molecule. The carbohydrate residue is attached by an acetal linkage at carbon atom 1 to a non-carbohydrate residue or a glycone. The non-sugar component is known as the aglycone. The sugar component is called the glycone (Manpreet Kaur, 2015).

Tannin:

The term tannin refers to the use of wood tannins from oak in tanning animal hides into leather; hence the words "tan" and "tanning" for the treatment of leather. It is an astringent, plant polyphenolic compound. The tannin compounds are widely distributed in many species of plants, where they play a role in protection from predation, and perhaps also as pesticides, and in plant growth regulation. The astringency from the tannins is what causes the dry and puckery feeling in the mouth following the consumption of unripened fruit or red wine. Likewise, the destruction or modification of tannins with time plays an important role in the ripening of fruit and the aging of wine.

Anthraquinones:

These are a class of aromatic compounds. Some naturally occurring anthraquinones have been identified which include emodin, physcion, cascarin, catenarin and

rhein. A large body of literature has demonstrated that the naturally occurring anthraquinones possess a broad spectrum of bioactivities, such as cathartic, anticancer, anti-inflammatory, antimicrobial, diuretic, vasorelaxing, and phytoestrogen activities, suggesting their possible clinical application in many diseases. Despite the advances that have been made in understanding the chemistry and biology of the anthraquinones in recent years, research into their mechanisms of action and therapeutic potential in autoimmune disorders is still at an early stage (Shih-Chang *et al.*, 2015).

Steroids:

Plant steroids are types of natural organic compounds found in plants. There are different types of plant steroids which play an important role in various biological activities of plants for example growth, development, cell division, and resistance to damage from environmental stresses like cold weather. Some plant steroids are also useful for their effects when consumed by human beings because their presence decreases the amount of cholesterol in the bloodstream. Plant steroids should not be confused with anabolic steroids used to increase muscle mass, which are a synthetic substance that imitates the effects of human androgenizing hormones such as testosterone. Different steroids have different properties that vary according to the number of double bonds in the carbon rings and the composition of the attached functional groups. The most biologically prominent plant steroid is brassinolide, which is important to the development of plant cells and promoting the plant's growth. It is part of a larger class of plant steroids called brassinosteroids. Brassinolide is synthesized from campesterol, another plant steroid that is part of a group of similar steroid compounds called phytosterols. Other examples of phytosterols, also commonly called plant sterols, include beta-sitosterol and brassicasterol.

Essential oil:

An oil is "essential" in the sense that it contains the "essence of" the plant's fragrance—the characteristic fragrance of the plant from which it is derived. The term essential used here does not mean indispensable as with the terms essential amino acid or essential fatty acid which are so called since they are nutritionally required by a given living organism. They are also known as volatile oils, ethereal oils or simply as the oil of the plant from

which they were extracted such as oil of clove. Essential oils are generally extracted by distillation, often by using steam distillation. Other processes include expression, solvent extraction, absolute oil extraction, resin tapping, and cold pressing. They are used in perfumes, cosmetics, soaps and other products, for flavouring food and drink, and for adding scents to incense and household cleaning products https://en.wikipedia.org/wiki/Essential_oil.

Scope of medicinal plants:

Undoubtedly, medicinal phytochemicals are important natural resources for future drug discoveries and only a small percentage of the phytochemical properties of medicinal plants have been investigated. This sector has traditionally occupied an important position in the socio-cultural, spiritual and medicinal arena of rural and tribal lives of India. The demand for traditional herbal drugs is also increasing rapidly mainly because of the harmful effects of synthetic chemical drugs and also because of an expansion of pharmacies manufacturing natural drug formulations. The growing demand is putting a heavy strain on the existing resources. In China, Nepal and India, they are important revenue generating resources and providing income to economically marginalized and indigenous people. Medicinal plants can also contribute to address the chronic problem of global poverty and hunger. There has been a tremendous upsurge in the demand for phyto-pharmaceutical raw medicinal herbs and vegetable drugs of Indian origin from the Western nations. There is also an increase in domestic demand for raw material used for perfumeries, pharmacies and bio-pesticidal units. Increasing interest by multinational pharmaceutical companies and domestic manufacturers of herbal based medicines is contributing significant economic growth of the global medicinal plants sector. The global market potential of Aloe Vera used to treat burns and added to skin creams and cosmetics was estimated in the billions of dollars. MAP-based industries create employment opportunities in poor, job-starved states, thereby increasing the cash earnings of local people. Export opportunities of natural products are tremendous, as the world market is looking towards natural sources for the purposes of therapeutic use as well as nutritional dietary supplements. Demand for medicinal plant is increasing in both developing and developed countries, and the bulk of the material trade is still from wild harvested sources on forest land and only a very small number of species

are cultivated. Indeed, it is an important call for coordination and collaboration between the World Health Organization (WHO), the Food and Drug Administration (FDA), European Medicines Agency (EMA), the biotech companies, pharmaceutical industry, and several other regulatory agencies globally to provide clear guidelines for the discovery and development of herbal drugs to utilize the vast potential of traditional medicine for development of drugs for different diseases.

Conclusion:

The growing demand for MAPs makes them remunerative alternative crops to the traditional ones for smallholders in the tropics. Being underexploited species with promising potential, the MAPs require research attention on a wide array of topics ranging from propagation methods to harvesting and processing techniques and germplasm collection and genetic improvement to quality control and market trends. They still have unknown and uncountable potential, though there is a long history for use since prehistoric times. In accord to a period, the role of medicinal and aromatic plants is changing continuously and the role expands such as cure of disease to prevention of disease. The accumulated massive knowledge, information, and materials should be shared in the whole world and go down to generation to generation. The blessings of medicinal and aromatic plants are treasures that belong to all lives. Moreover, there is a need to clarify their role in the treatment of present diseases and how they can be used to produce or synthesis more effective drugs. Full effort must be given to explore and evaluate potential molecular characterization of the medicinal compounds with the help of databases and interdisciplinary group efforts.

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17th
Year
★★★★★ of Excellence ★★★★★