

Role of Medicinal Plants for Health Perspective: Special Reference to Antioxidant Potential

Anita Singh*, Shikha Singh and Sheo Mohan Prasad

Ranjan Plant Physiology and Biochemistry Lab, Department of Botany, University of Allahabad, Allahabad, India

*Corresponding author: Anita Singh, Department of Botany, University of Allahabad, Allahabad, UP, India, Tel: +919889452093; E-mail: anita.1710@gmail.com

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Abstract

Medicinal plants provide major source of molecules with medicinal properties due to presence of natural compounds. In these components, antioxidant substances are of particular interest. The oxidative stress that leads to progression of disorders such as: cardiovascular diseases, degenerative conditions, rheumatic disorders, metabolic syndrome, and in aging can be reduced with the help of antioxidant properties of medicinal plants and act as key-feature of modern multi-potent remedies.

Keywords Medicinal plant; Oxidative stress; Total phenolics; Antioxidants

Introduction

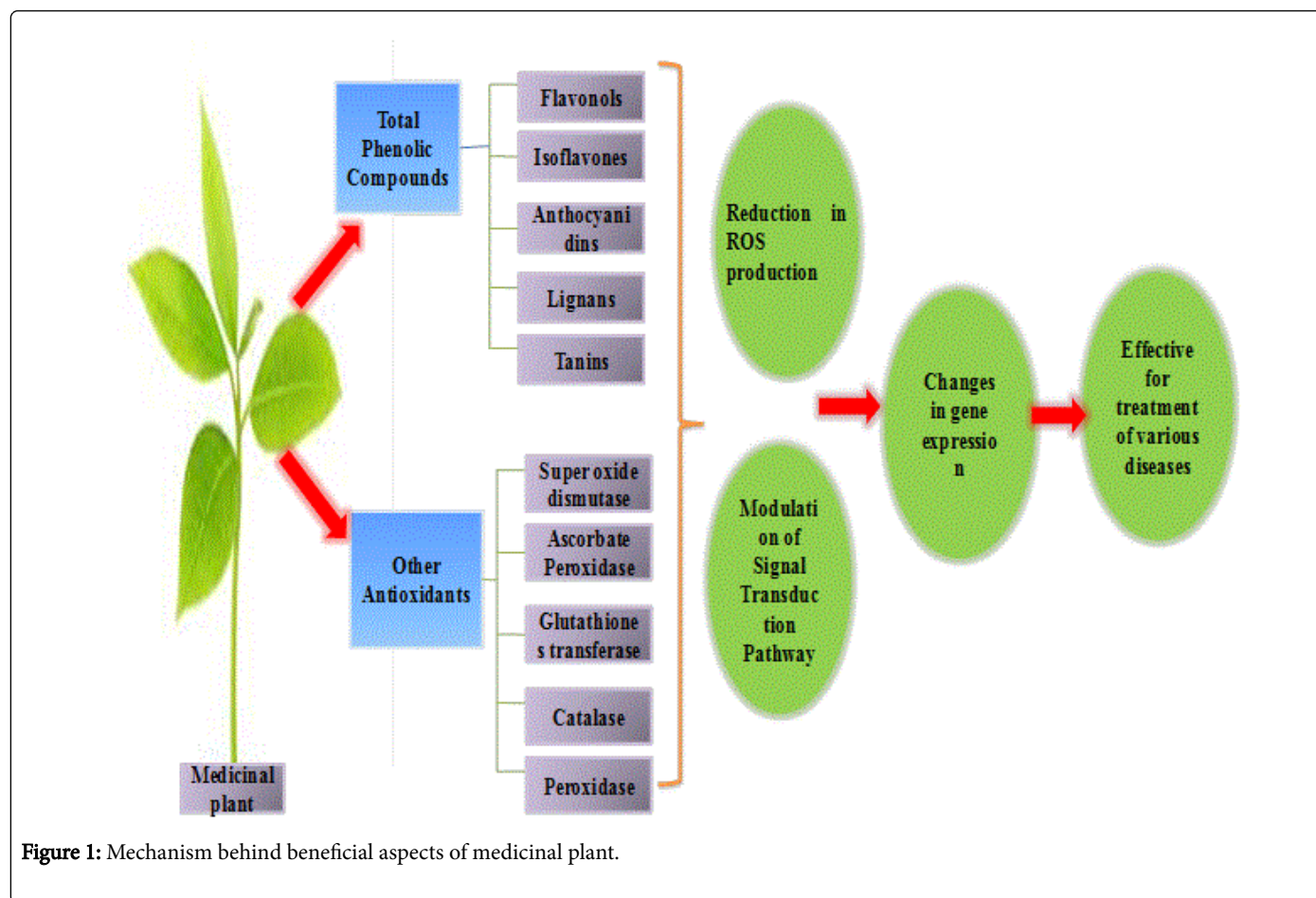
During ancient as well as in modern culture, medicinal plants play very important role in protection of human health. It has been reported that two-thirds of the world's plant species contain medicinal property [1]. These medicinal plants contain several components of therapeutic value so they can be used as drugs or formulations to treat various human diseases [2]. Due to more availability, cost affectivity and non-toxic nature, these drugs are good source of therapeutic agents [3]. World Health Organization (WHO) reported that 80% of the earth's population rely on traditional medicine for their primary health care needs, and most of this therapy involves the use of plant extracts and their active components [4]. The plant species contain medicinal property are *Acorus calamus*, *Aegle marmelos*, *Aloe vera*, *Andrographis paniculata*, *Carica papaya*, *Cassia fistula*, *Cyperus rotundus*, *Dalbergia sisoo*, *Emblca officinalis*, *Magnifera indica*, *Acacia auriculiformis*, *Moringao lifera*, *Salvia officinalis*, *Momordica charantia*, *Rheum ribes* L., *Plumbago zeylanica*, *Ocimum sanctum*, *Solanum nigrum*, *Syzygium cumini* and *Azadirachta indica*. Mathur et al. [5] have estimated phenolic component and antioxidant properties of *W. coagulans* and reported that due to presence of alkaloid, steroids, tannins, carbohydrate, protein they can be used for the treatment of diabetes mellitus. Rakotoarivelo et al. [6] have reported that bark and leaves of *Litchi chinensis* and *Psidium guajava* is used for the treatment of Diarrhea, dysentery, stomach-ache. The presence of active phytochemicals such as steroids, reducing sugars, triterpenoids, sugars, alkaloids, phenolic compounds, flavonoids, catechins, saponins, tannins, anthroquinons and amino acids in the flowers of *Calotropis gigantea*, *Caesalpinia pulcherrima*, *Cassia auriculata*, *Azadirachta indica*, and *Catharanthus roseus*, make them effective for the treatment of infectious diseases [7]. Due to presence of flavonoids, ascorbic acid, beta-carotene and beta-tocopherol, *Aloe vera* is used for the treatment of skin diseases and taken as health drink. It is also found effective in treating wrinkles, stretch marks and pigmentations. A gel prepared with the extract of *Aloe vera* leaves can be applied for the treatment of spontaneous atopic dermatitis like skin lesions due to reduction of interleukin, IL5 and IL10 levels [8]. The gel has antifungal and

antibacterial properties. Joshi et al. [4] have studied antimicrobial properties of different medicinal plants: *Ocimum sanctum* (Tulsi), *Eugenia caryophyllata* (Clove), *Achyranthes bidentata* (Datiwan) and *Azadirachta indica* (Neem) and reported that among them *Eugenia caryophyllata* (Clove) was found to be the most effective against *Solmonella typhi* due to presence of eugenol, acetyleugenol, chavicol, acetyl salicylate and humulenes.

Beneficial aspect of medicinal plants

The literature reveals that due to presence of flavonoids, terpenoid, alkaloids, diterpenes, tannins, glycosides and other phenolic compounds, these medicinal plants possess strong antioxidant activity and may help to protect the cells against the oxidative damage caused by free-radicals [1]. These free radicals and reactive Oxygen Species (ROS) such as superoxide anion, hydroxyl radical and hydrogen peroxide play a crucial role in the development of various ailments such as arthritis, asthma, dementia, mongolism, carcinoma and Parkinson's disease. The free radicals in the human body are generated through aerobic respiration or from exogenous sources [9]. These free radicals are damaging at their higher concentration. They react with various biological molecules namely lipid, proteins and deoxyribonucleic acids resulting in imbalance between oxidants and antioxidants. Due to presence of several antioxidant and metabolites the medicinal plants scavenges these free radicals and provide protection to human health against several diseases.

These medicinal plant species have significantly high phenolic content and a large amount of flavonoids, flavonols as well as antioxidant activity as compared to synthetic antioxidants that have side effect and have been reported to be carcinogenic. In the modern word it has been realized the herbal drugs strengthens the body system specifically and selectively without side effects. The importance of traditional herbal medicinal system has now gained vital importance in developed countries. So, based upon this, medicinal plants, which possess good antioxidant potential, are the best supplements for the treatment of diseases associated with oxidative stress. A mechanism to its importance in reducing disease attack and other disorder is shown in Figure 1.



An overview of methods applied for estimating antioxidant potential of medicinal plant

The antioxidant components such as total phenolics (TP) content, total flavonoids, phenolic acids, lignans, catechins and tannins present in medicinal plants are estimated by following methods.

The antioxidant properties can be estimated by 1,1-diphenyl-2-picrylhydrazine (DPPH) radical scavenging assay [10], ferric reducing antioxidant power (FRAP) [11], oxygen radical absorbance capacity (ORAC) assay [12], nitro blue tetrazolium (NBT) reduction assay [13], or by using 2,2-azino-bis(3-ethylbenzthiazoline-6-sulphonic acid) (ABTS) radical scavenging method [14]. Some important methods are discussed in detail:

DPPH (1,1-diphenyl-2-picrylhydrazine) methods: It was first discussed by Blois [15] and further modified by several workers. DPPH is one of the stable free radicals that can react with compounds which donate hydrogen atoms. The mechanism behind this assay is the scavenging of DPPH through the addition of an antioxidant that results in the decolorization of the DPPH solution. Thereafter, total antioxidant activity is measured by the decrease in absorbance at 515 nm.

ABTS (2,2-azino-bis(3-ethylbenzthiazoline-6-sulphonic acid) method: The ABTS radical scavenging method was developed by several workers and later modified by Baltrusaitis et al. [14]. Along with the DPPH method, the ABTS radical scavenging method is also used extensively for measuring antioxidant potential of plant samples. The reaction mechanism behind this assay method is the generation of the ABTS

radical cation by the oxidation of ABTS with potassium persulfate, and its reduction in the presence of hydrogen-donating antioxidants which is measured spectrophotometrically at 734 nm. This decolorization assay measures the total antioxidant capacity in both lipophilic and hydrophilic substances.

NBT assay: With this assay superoxide anion scavenging activity is measured as described by Beauchamp and Fridovich [16]. In this case scavenging potential for superoxide radicals is estimated spectrophotometrically by nitroblue tetrazolium (NBT) reduction process through a hypoxanthine / xanthine oxidase-generating system. The scavenging activity of superoxide is expressed as percent inhibition over the value of blank, in which buffer is used in place of the extract. It determines the antioxidant potential of medicinal plants.

Folin-Ciocalteu method: As the total phenolic content is a major component present in medicinal plants, so the Folin-Ciocalteu reagent assay plays an important role in its estimation [17]. During this process the sample (0.2 ml) is mixed with 0.5 ml of the Folin-Ciocalteu reagent that is diluted with deionized water (7 ml). A saturated sodium carbonate solution is added in this and the mixed solution is allowed to stand for another 120 min and measured at 725 nm. A standard curve is prepared by using gallic acid and the total phenolic content is expressed as mM gallic acid equivalents (GAE) per l of sample (mM/l).

Health promoting activity of medicinal plants based upon their antioxidant and other phenolic compounds

Medicinal plants have been used to treat human diseases for thousands of years. The importance of medicinal plants and traditional health systems in solving the health care problems of the world is gaining increasing attention. Because of this resurgence of interest, the research on plants of medicinal importance is growing phenomenally at the international level. Additions to this, people are becoming increasingly interested in medicinal plants because of their strong antioxidant activities, good therapeutic performance and low toxicity, wide distributions and medicinal functions. The oxidative stress, defined as “the imbalance between oxidants and antioxidants in favor of the oxidants potentially leading to damage” has been suggested to be the cause of aging and various disease in humans. Reactive oxygen species (ROS) are an entire class of highly reactive molecules often generated as byproducts of biological reactions or from the metabolism of oxygen that includes superoxide radicals, hydroxyl radicals, and hydrogen peroxide. Mammalian cells possess elaborate defense mechanisms for radical detoxification. The key metabolic steps includes enzymatic antioxidants such as superoxide dismutase (SOD), catalase (CAT), and glutathione peroxidase (GPX) and some non-enzymatic molecules which destroy toxic peroxides [18]. The ROS are concerned for many diseases including diabetes mellitus, atherosclerosis, inflammatory disease, carcinogenesis and aging. In treatments of these diseases, antioxidant therapy has gained much importance. Antioxidants have been reported to prevent oxidative damage caused by ROS and may also prevent the occurrence of diseases such as cancer and aging. Several studies have shown that these medicinal plants had a wide range of antioxidant capacities and phenolic compounds were a major contributor to the antioxidant activity of these plants and make them promising sources of natural antioxidants and other bioactive compounds in food and pharmaceutical industries [19,20] as shown in Table 1. During the last 3 decades, studies on antioxidant-based drugs / formulations for the

prevention and treatment of complex diseases like atherosclerosis, stroke, diabetes, Alzheimer’s disease, and cancer have appeared remarkably due to increased interest in their potential of being used as a rich and natural source of antioxidants [21]. Recently Asnake et al. [22] reported that medicinal plants (antimalarial plants) used by Sidama people of Boricha District, Sidama Zone, South Region of Ethiopia to treat malaria. They conducted an ethnobotanical survey from September 2011 to February 2012 and collected the data through semi-structured interview and field, and market observations. A total of 42 antimalarial plants belonging to 27 families were recorded in the study area. The plants *Ocimum lamiifolium*, *Ocimum urticifolium* of family Lamiaceae contributed the highest antimalarial property followed by *Vernonia amygdalina*, *Vernonia auriculifera* of family Asteraceae [22].

Conclusion

Various medicinal plants have antioxidant activity, high phenolic content and a large amount of flavonoids and flavonols. They are used around the world as therapeutic agents. The present informative note suggests that medicinal plants that possess antioxidant potential are the best supplements for the diseases associated with oxidative stress. However, *in vivo* studies of the all the medicinal plants are required. Before they are applied in the food processing industry or used as preventive medicine, their systematic investigation should be done to identify their antioxidant potential.

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Plant name	Family	Parts used	Phytochemicals present	Diseases / disorders treated	References
<i>Achyranthes aspera</i>	Amaranthaceae	Root, leaf	Alkaloids, saponine, sapogenine, glucosides, ecdysterone	Asthma, bleeding, debility, bronchitis, cold, cough, colic, dropsy, dog bite, dysentery	[4]
<i>Aloe barbadensis</i>	Liliaceae	Leaf	Phenolic compounds	Skin problems, poorly healing wounds, leg ulcers, burns due to excessive heat, sun exposure	[8]
<i>Allium sativum L.</i>	Alliaceae	Bulb	Phenol, tannin	Used for hardening of the arteries (atherosclerosis) and high blood pressure	[23]
<i>Azadirachta indica</i>	Meliaceae	Leaf, bark	Alkaloids, phenolic, tannin compounds, flavonoids	Antihelmenthic, antifungal, antidiabetic, antibacterial, antiviral, contraceptive and sedative	[4]
<i>Bacopa monneriri</i>	Scrophulariaceae	Leaf, root	Triterpenoid saponins, alkaloids, Brahmin and herpestine	Anxiety, epilepsy, bronchitis, asthma, irritable bowel syndrome, gastric ulcers	[24]
<i>Cimicifuga foetida L.</i>	Ranunculaceae	Root, rhizome	Terpene, glycosides, cimicifugenins, cimigenols	Erythematousus, diarrhea, hemorrhoids, Parkinson's syndrome, purulent infection	[25]

<i>Camellia sinensis</i> L.	Theaceae	Leaves	Glycosides, phenol, saponin	Asthma, angina, artery and coronary disease, pectoris, peripheral vascular disease	[23]
<i>Emblica officinalis</i>	Euphorbiaceae	Fruit	Alkaloids, glucosides, tannins, resin, saponine	Antipyretic, analgesic, antitussive, antianemia, antiatherogenic, adaptogenic, cardioprotective, gastroprotective, antidiarrheal and neuroprotective properties	[26]
<i>Evolvulus alsinoides</i>	Convolvulaceae	Leaf, root	Flavonois, alkaloids, glucosides, terpenoids	Alzheimer, anxiety and blood impurity	[27]
<i>Hemides musindicus</i>	Asclepiadaceae	Leaf	Flavonoids, Glycosides, tannins, sterols	Asthma, diarrhoea, respiratory conditions, cough, cold, bleeding disorders, skin diseases, gout	[28]
<i>Ocimum sanctum</i>	Labiatae	Leaf	Glycosides, phenol, saponin	Bronchitis asthma, malaria, diarrhoea, dysentery, skin diseases, arthritis, chronic fever, insect bite, etc.	[23]
<i>Polygonum multiflorum</i>	Polygonaceae	Stem	Stilbene, glycoside	Improve immunity, enhance red blood cell production, reduce cholesterol levels and blood pressure, and reduces the risk of cardiovascular diseases.	[29]
<i>Piper cubeba</i>	Piperaceae	Seed	Phenol, flavonoids	Chronic bronchitis, cystitis, leucorrhoea, arthritis, prostrate infection	[23]
<i>Prunus persica</i> (Linn)	Rosaceae	Seed, root	Amygdalin, prunasin, sorbitol, kaempferol, quercetin, prunetin, ascorbic acid, citric acid, carotene	Gastritis, whooping cough, coughs and bronchitis. The root bark is used in the treatment of dropsy and jaundice	[30]
<i>Salvia miltiorrhiza</i>	Lamiaceae	Root	Rosmarinic, lithospermic and salvianolic acids, diterpenoids and tanshinones	It dilates the coronary arteries and peripheral blood vessels, reducing excessive platelet aggregation, reducing risk of heart attack	[31]
<i>Semecarpus anacardium</i>	Anacardiaceae	Fruit	Biflavonoids, bhwilwanols, phenolic compounds, sterols	Used as CNS stimulant, hypoglycemic, anticarcinogenic and hair growth promoter and also used for arthritis, tumors	[23]
<i>Sanguisorba officinalis</i>	Rosaceae	Leaf	Triterpenes, flavonoids, arabinose, rhamnose	used in peptic ulcers, haematuria, menorrhagia, dysentery, diarrhoea, haemorrhoids and burns	[32]
<i>Trigonella foenum-graecum</i>	Leguminosae	Leaf	Alkaloids, flavonoids, glycosides	bronchitis, fever, sore throat, skin irritation, diabetes, ulcers, and in the treatment of cancer.	[23]
<i>Tussilago farfara</i> L.	Asteraceae	Leaf	Sesquiterpenes, triterpenes, flavonoids, phenylpropanoids	Used for dry cough, throat irritation and in respiratory disorders	[33]

Table 1: Total phenolics and antioxidant potential of medicinal plants used in the treatment of various diseases / disorders.

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