

## Antioxidant Activity of Medicinal Plants: A Review

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**ABSTRACT:** According to some studies, two-thirds of all species of plants have medicinal properties. The ability to provide antioxidants of medicinal plants is extremely significant. Antioxidants decrease the oxidative stress in cells so they are useful in the treatment of many human diseases, like cardiovascular diseases, diabetes, atherosclerosis, coronary artery disease, liver diseases, cataracts, nephrotoxicity, and neurodegenerative processes associated with aging, inflammatory diseases and cancer. Each part of the plant has unique therapeutic characteristics and contains several secondary metabolites that have crucial for the treatment of various diseases. The antioxidant activity of plant parts such as stems, roots, bark, leaves, fruits, and seeds of various prominent medicinal species are discussed in the present article. There are also synthetic antioxidants, butylated hydroxytoluene (BHT) and butylated hydroxyl anisole (BHA), which are currently utilized as food additives and prevent the oxidation of the body caused by free radicals. Similar antioxidant potential can be seen in many plant species. This review updates the knowledge on the antioxidant activity of several medicinal plants and herbs that aid in lowering the levels of oxidative stress. It promotes knowledge of some medicinal plants and herbs antioxidant properties, which are useful in preventing oxidative stress.

**Keywords:** Antioxidant, Alkaloids, Flavonoids, Oxidative stress.

### INTRODUCTION

Since from ancient times, herbal medications have been used to treat the symptoms of various diseases (Maqsood, 2010). In medicinal plants however, derives from their long use in folk medicines as well as their preventive properties, especially in developing countries. Despite the significant advancements in modern medicine over the past few decades, plants continue to play a significant role in healthcare. Large number of medicinal plants has been investigated for their antioxidant properties. Natural antioxidants either in the form of raw extracts or their chemical constituents are very effective to prevent the destructive processes caused by oxidative stress (Zengin *et al.*, 2011; Saeed *et al.*, 2012). Antioxidants are naturally occurring substances, in small quantities is having the capacity of preventing the oxidation of easily oxidizable materials. Brewer (2011), defined an antioxidant as a substance that can inhibit a specific oxidizing enzyme and reacts with oxidizing agents before causing harm to the other molecules, or that adsorbs oxidizing agents, it may be metal ions or even a material that can heal a system, such an iron-transporting protein.

**Need of Antioxidants-** Oxidation reaction depending upon the site of occurrences presents specific repercussions. If the site of occurrence is the food system, then food deteriorates. When oxidation occurs in a biological cell system, it causes damage or death to the

cell. The addition of antioxidants is required to control oxidative deterioration (Sehwag and Das 2014).

**Classification of Antioxidant.** There are five major types of antioxidants (Mukhopadhyay, 2000) given below:

- **Primary antioxidants or chain-breaking antioxidants-** Primary antioxidants actively inhibit oxidation reactions by scavenging Reactive Oxygen species (ROS)/ Reactive Nitrogen Species (RNS). These are the compounds, mainly phenolic substances that terminate the free radical chains in lipid oxidation and function as hydrogen and electron donors. In addition, primary antioxidants chelate transition metals acting as catalysts in lipid oxidation.

- **Oxygen scavengers-**

The substances which react with oxygen and can thus remove it in a closed system, e.g., ascorbic acid (vitamin C). They are useful for the preservation of colour and flavor and extension of shelf life, less shrinkage of product/ cell.

- **Secondary antioxidants -** Secondary antioxidants act indirectly through chelation of transition metal (iron) ions. The compounds function by decomposing the lipid hydroperoxides into stable end products.

- **Enzymatic antioxidants-** The enzyme function either by removing dissolved oxygen, e.g., glucose oxidase or by removing highly oxidative species, e.g., superoxide dismutase.

• **Chelating agents-** Synergistic substances greatly enhance the action of phenolic antioxidants. Most of these synergists exhibit little or no antioxidant activity, for example, citric acid, amino acid, and phospholipids such as cephalin.

**Commonly used Medicinal Antioxidants -** Some commonly used medicinal plants as a source of antioxidants are listed in the Table 1. It also gives information regarding botanical name, family, plant part used as an antioxidant source, medicinal uses.

**Table 1: Plants with botanical names, family, their parts use as source for antioxidant activity with their medicinal uses.**

Sr. No.	Botanical Name	Family	Plant Part used as antioxidants	Medicinal Uses	References
1.	<i>Acalypha indica</i>	Euphorbiaceae	Whole plant	Antioxidants, anti-cancer activity (Joy <i>et al.</i> , 2010)	(Badami and Channabasavaraj 2007)
2.	<i>Achyranthes aspera</i>	Amaranthaceae	Leaves	Facilitating delivery, boils, bronchitis, cold, cough, colic, debility, dropsy, dog bite, dysentery, ear complications, headache, leukoderma, pneumonia, renal complications, scorpion bite, snake bite and skin diseases etc (Jain, 1991).	(Kumar <i>et al.</i> , 2008)
3.	<i>Albizia amara</i>	Mimosaceae	Leaves	Treating bronchitis, bronchial asthma, and muscle pain (Farnsworth and Bunyaphatsara 1992)	(Kumar <i>et al.</i> , 2008)
4.	<i>Annona squamosa</i>	Annonaceae	Leaf	Haematinic, cooling, sedative, stimulant, expectorant, Matu rant, tonic. They are useful in anaemia, burning sensation. (Ma <i>et al.</i> , 2017)	(Kaleen <i>et al.</i> , 2006)
5.	<i>Asparagus racemosus</i>	Liliaceae	roots	Diabetes, HIV/AIDS, lactation promotes fertility dysentery, inflammations, tumour, bronchitis, nervous disorder, hyperacidity, certain infectious diseases, neuropathy, conjunctivitis, spasm, chronic fevers, and rheumatism (Noorul <i>et al.</i> , 2016).	(Velavan <i>et al.</i> , 2007)
6.	<i>Azadirachta indica</i>	Meliaceae	leaves, flowers, seeds, roots and bark	Psoriasis, acne, eczema, leprosy, dandruff, wrinkles rashes, viral diseases like chicken-pox, wart and smallpox, healing of wounds and cuts, sprains, headaches, fevers, intestinal helminthiasis, constipation, respiratory disorders. (Kharwar <i>et al.</i> , 2020; Hashmat <i>et al.</i> , 2012).	(Wolinsky <i>et al.</i> , 1996; Zhang <i>et al.</i> , 2010)
7.	<i>Bacopa monnieri</i>	Scrophulariaceae	Leaves	Fever, inflammation, pain, asthma, epilepsy, and memory decline (Russo and Borrelli 2005)	(Simpson <i>et al.</i> , 2015)
8.	<i>Benincasa hispida</i>	Cucurbitaceae	Dried ripe peels	Diabetes mellitus, urinary infection, haemorrhages from internal organs, insanity, epilepsy, and other nervous disorders in Ayurveda (Ramesh <i>et al.</i> , 1989).	(Rana <i>et al.</i> , 2012)
9.	<i>Bryophyllum calycinum</i>	Crassulaceae	Whole plant	Burns, bowels, Insects bites, Dysentery, diarrhoea, tuberculosis, ulcers, wounds (Nadkarni, 1976)	(Badami and Channabasavaraj 2007)
10.	<i>Coffea arabica</i>	Rubiaceae	seeds	Anti-cancerous, anti-inflammatory,	(Liang and Kitts 2014)

				bacterial, anti-diabetic and antiatherosclerotic (Khalid <i>et al.</i> , 2020)	
11.	<i>Cassia auriculata</i>	Cesalpiniaceae	Leaves	skin diseases, dandruff, bone fracture and also some of them dropped the juice of fresh macerated leaves into ears in case of scorpion bite (Natarajan and Paulsen 1999; Ratnam and Raju 2008)	(Kumar <i>et al.</i> , 2008)
12.	<i>Cassia fistula</i>	Cesalpiniaceae	Leaves, stem, Fruits	Laxative, in constipation management relieving pain, edema, and reducing skin irritation as result of swelling. Additionally, extracts of the stem bark and fruits are used in eliminating toxins from the blood (Jung <i>et al.</i> , 2017)	(Kumar <i>et al.</i> , 2008)
13.	<i>Cicer arietinum</i>	Fabaceae	Whole plant	Astringent, dyspepsia, constipation and snakebite (Roy and Sarkar 2022)	(Badami and Channabasavaraj 2007)
14.	<i>Cocculus hirsutus</i>	Menispermaceae	Arial parts	Curing various skin diseases like, itching, wounds etc. (Jain, 1968)	(Panda <i>et al.</i> , 2011; Logesh <i>et al.</i> , 2020)
15.	<i>Coleus aromaticus</i>	Lamiaceae	Whole plant	antibacterial, antifungal properties, antitumor and antimutagenic (Prudent <i>et al.</i> , 1995)	(Badami and Channabasavaraj 2007)
16.	<i>Cucumis sativas</i>	Cucurbitaceae	Fruits	analgesic, anti-inflammatory, antioxidant, anticancer, antimicrobial, diuretic, hepatoprotective, and immunomodulatory activities (Upadhyay <i>et al.</i> , 2007)	(Heidari <i>et al.</i> , 2012; Teti <i>et al.</i> , 2021)
17.	<i>Curcuma longa</i>	Zingiberaceae	Rhizome	Anti-inflammatory, antifungal, antibacterial, in Anaemia, Eye disorders, bronchitis, dysentery, fever, cough, diabetes, leprosy, jondice (Kantori, 1992) antioxidant, anticarcinogenic, antimutagenic, anticoagulant, antifertility, antidiabeti, antiprotozoal, antiviral, antifibrotic, antivenom, antiulcer, hypotensive and hypocholesteremic activities (Gadekar <i>et al.</i> , 2020)	(Menon and Sudheer 2007)
18.	<i>Cyperus rotundus</i>	Cyperaceae	Rhizome	Fever and arthritis (Halliwell <i>et al.</i> , 1992)	(Nagulendran <i>et al.</i> , 2007)
19.	<i>Datura stramonium</i>	Solanaceae	Leaves	Antinociceptive, antioxidant, hypolipidemic, anti-rheumatoid and hypoglycemic properties, cure Asthma (Tariq <i>et al.</i> , 1989; Khan and Yadaba 2010)	(Kumar <i>et al.</i> , 2008)
20.	<i>Glycyrrhiza glabra</i>	Fabaceae	Roots	Improve immunity, respiratory health, metabolic and female reproductive functions (Jafari <i>et al.</i> , 2021).	(Naik and Satav 2003)
21.	<i>Momordica charantia</i>	Cucurbitaceae	Leaves	Boosts body stamina and prevents chronic fatigue controlling eye disorders and enhances eyesight (Leatherdale <i>et al.</i> , 1981; Ahmad <i>et al.</i> , 1999).	(Leelaprakash <i>et al.</i> , 2011)

22.	<i>Moringa oleifera</i>	Moringaceae	Stem bark	Anti-inflammatory, antihypertensive, antioxidant, hepatoprotective, anti-diabetic, anticancer, analgesic activity, cholesterol-lowering activity, cardiac and circulatory stimulant (Nweze and Nawfor 2014; Rani <i>et al.</i> , 2018).	(Kumbhare <i>et al.</i> , 2012)
23.	<i>Morus alba</i>	Moraceae	Whole plant	Analgesics, anthelmintics, antibacterial agents, anti-rheumatic agents, diuretics, antihypertensive agents, hypoglycemic agents, laxatives, tonics, and sedatives (Warrier <i>et al.</i> , 1997)	(Badami and Channabasavaraj 2007)
24.	<i>Opuntia dilenii</i>	Cactaceae	Whole plant	Anti-inflammatory, cures atherosclerosis, coronary heart diseases, and stroke (Otin <i>et al.</i> , 2016).	(Badami and Channabasavaraj 2007)
25.	<i>Origanum dictamnus</i>	Labiatae	Leaves and flowers	Wounds and skin diseases (Avola <i>et al.</i> , 2020).	(Kouri and Bardouki 2007)
26.	<i>Pavonia procumbens</i>	Malvaceae	Whole plant	Antibacterial and antifungal (Nakhare and Garg 1992)	(Badami and Channabasavaraj 2007)
27.	<i>Phyllanthus emblica</i>	Phyllanthaceae	Fruit	Hepatoprotective, nephroprotective, anti-diabetic, immunostimulant, anti-cancer, anti-pyretic, antitussive, dermo protective, pancreas disorder, anti-aging, eye disorder (Bhandari and Kamdod 2012)	(Kumar <i>et al.</i> , 2021)
28.	<i>Piper retrofractum</i>	Piperaceae	Fruit	Digestive disorders and hemorrhoids and respiratory disorders (Jadid <i>et al.</i> , 2017)	(Leelaprakash <i>et al.</i> , 2011)
29.	<i>Sauropus androgynus</i>	Phyllanthaceae	Leaves	Restore uterus and abdomen to the original size after giving birth and for relieving fatigue (Handayani <i>et al.</i> , 2001)	(Badami and Channabasavaraj 2007)
30.	<i>Sonchus asper</i>	Asteraceae	Whole plant	Cough, bronchitis and asthma gastrointestinal infection, inflammation, diabetes and cardiac dysfunction (Koche <i>et al.</i> , 2008; (Sabeen and Ahmad 2009).	(Khan <i>et al.</i> , 2012)
31.	<i>Terminalia arjuna</i>	Combretaceae	Stem bark	Heart Tonic, healing fractures (Dharmasena <i>et al.</i> , 2021)	(Kumar <i>et al.</i> , 2021)
32.	<i>Terminalia bellirica</i>	Combretaceae	Fruit	Antidiabetic, Anti diarrhoeal, Antifertility, Antiandrogenic, Antifungal, Anti-helminthic, Antihypertensive, Antimicrobial, Anti-HIV-1, Antioxidant, Antipyretic, Antisalmonella, Antisecretory etc. (Khan and Gilani 2008, 2010; Valli and Shankar 2013)	(Kumar <i>et al.</i> , 2021)
33.	<i>Terminalia chebula</i>	Combretaceae	Fruit	Antioxidant, antidiabetic, antibacterial, antiviral, antifungal, anticancer, antiulcer, antimutagenic, wound healing activities, cardiovascular diseases,	(Kumar <i>et al.</i> , 2021)

				cancer, paralysis, leprosy, ulcers, gout, arthritis, etc. (Kannan <i>et al.</i> , 2009)	
34.	<i>Tribulus terrestris</i>	Zygophyllaceae	Seeds	Diuretic, aphrodisiac, anticancer, Antiuro lithic, cardio tonic, analgesic, immunomodulatory, anti-diabetic, absorption enhancing, hypolipidemic, nervous system tonic, hepatoprotective, antiinflammatory, antibacterial, antispasmodic, anthelmintic, parricidal, and anti-cariogenic activities (Sivapalan, 2016)	(Kumar <i>et al.</i> , 2021)
35.	<i>Trigonella foenum graecum</i>	Leguminosae	Leaves, seeds	Menstrual Cramps, Antidibetics, Lactation, infertility, asthma (Neelakantan <i>et al.</i> , 2014; Pattanittum <i>et al.</i> , 2016; Emtiazy <i>et al.</i> , 2018; Foong <i>et al.</i> , 2020)	(Liang and Kitts 2014)
36.	<i>Withania somnifera</i>	Solanaceae	Tuberous roots	Antihelmantic, anti-pyretic, anti-cancer, anti-tuberculosis and anti-ulcer (Dhar <i>et al.</i> , 2012).	(Udayakumar <i>et al.</i> , 2011)
37.	<i>Zingiber officinale</i>	Zingiberaceae	Rhizome	Antimicrobial, anticancer, antioxidant, antidiabetic, nephroprotective, hepato-protective, larvicidal, analgesic, anti-inflammatory and immunomodulatory activities (Lin <i>et al.</i> , 2010; Mishra and Nighantu 2002).	(Jewell, 2003)
38.	<i>Zizipus oenoplia</i>	Rhamnaceae	Whole plant	Ulcer, Stomach ache, obesity, asthma and it has an astringent, digestive, antiseptic, hepatoprotective, wound healing and diuretic property (Rao <i>et al.</i> , 2012; Pullaiah <i>et al.</i> , 2002)	(Badami and Channabasavaraj 2007)

Nowadays, natural antioxidants produced from plant sources have attracted considerable public attention compared to synthetic antioxidants which shows their adverse side effects such as toxicity and carcinogenicity (Saad *et al.*, 2007). *Piper retrofractum* Vahl. known as Javanese chili is widely distributed and cultivated in tropical regions including Indonesia for its medicinal properties. Indonesian people use *P. retrofractum* fruit as a traditional beverage, mixed with another source of medicinal plant (Jadid *et al.*, 2017). It has been mentioned that the antioxidant activity of plants might be due to their phytochemicals like phenolic compounds (Duh *et al.*, 1999). The study of Sravanthi *et al.* (2023) focusing on the, despite of plants medical use, phytochemicals have additionally been used in food supplements, cosmetics, and fragrance so, the antioxidants gain centre of attraction in research. The relative lipid peroxidation inhibition activity was carried out with some selected medicinal plants like *Albizia amara* (Mimosaceae), *Achyranthes aspera* (Amaranthaceae), *Cassia fistula* (Caesalpinaceae), *Cassia auriculata* (Caesalpinaceae) and *Datura*

*stramonium* (Solanaceae). The total alkaloid and flavonoid contents with antioxidant activity were also determined. Plant species are identified as having high levels of antioxidant activity (Kumar *et al.*, 2008). *Terminalia arjuna* Roxb., *Terminalia chebula* Retz., *Terminalia bellirica* Roxb., *Phyllanthus emblica* Linn. and *Curcuma longa* Linn. species showed remarkable antioxidant activities (Priyanka *et al.*, 2017). According to Dwivedi *et al.* (2020) the flowers of *Carica papaya*, medicinal plant used to treat various diseases like dengue, inflammation, Malaria and skin diseases also having large quantity of tannins and flavonoids are found in n-hexane extract possess good antioxidant activity. The extracts from a number of medicinal plants which are known to have some biologically active principles are used in ayurvedic preparations and these extracts were prepared in bulk for commercial purposes. The present study will enrich the knowledge about the sources of antioxidant potentially important medicinal plant like *Curcuma longa*, Coffee bean extract (*Coffea arabica*), *Tribulus terrestris*, *Bacopa monnieri* and fenugreek (*Trigonella foenum graecum*) employing



various *in vitro* assay methods, such as scavenging activity of DPPH, superoxide radical, inhibition of microsomal lipid peroxidation and reducing power (Sathisha *et al.*, 2010). The extracts of *Acalypha indica*, *Cicer arietinum*, *Morus alba*, *Opuntia dillenii*, *Pavonia procumbens*, *Sauropus androgynus*, and *Zizupus oenopila* showed potent antioxidant activity against ABTS free radicals (Patel *et al.*, 2013). Potent activity was observed for the extracts of *Bryophyllum calycinum* against DPPH free radicals and for the extracts of *Opuntia dillenii* and *Coleus aromaticus* in the lipid peroxidation assay (Badami and Channabasavaraj 2007). The levels of antioxidant capacity of medicinal plant species are variable and depending upon the quantity of secondary metabolites such as tannins, flavonoids, carotenoids phenolic acids, stilbenes, coumarins, lignans, organosulfur compounds, and vitamins (Flieger *et al.*, 2021).

## CONCLUSIONS

Plants like *Piper retrofractum*, *Albizia amara*, *Cassia fistula*, *Terminalia arjuna*, *T. Chebula*, *Azadirachta indica*, *Zingiber officinale*, *Tribulus terrestris*, *Trigonella foenum graecum*, *Opuntia dillenii* and *Phyllanthus emblica* etc. are the potent source of antioxidants and are easily available in the surrounding. Various parts of these plants, leaves, fruits, flower, stem, root/ rhizome are used as great source of antioxidants. The increasing external influences of the promoting unchecked production of free radicals are reduced by such raw herbal antioxidants. Endogenous antioxidants are those produced by the body independently and some antioxidants, known as exogenous antioxidants, are received from external sources and satisfy the body's dietary requirements. Antioxidants have been shown to possess toxicity and pro-oxidant action which is useful for more research and development. If we take these medicinal plants as part of our diets, antioxidants may enable us to keep our free radical levels low and, as a result, maintain our bodies working normally. This study will advance our understanding of the sources of antioxidants.

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**Conflict of Interest.** None.

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