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STUDIES ON ANTIOXIDANT ACTIVITY OF SOME MEDICINAL PLANTS

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ABSTRACT

A large number of different biologically active and therapeutic potential phytochemicals are drawn from the plant kingdom. The utilization of these natural compounds (secondary metabolites) for human aliments as well as animals begins from time immemorial. In the present paper six plants (*Achyranthes aspera, Acorus calamus, Curcuma zedoria, Eruca sativa, Verbascum thapsus* and *Vitex negundo*) are viewed for their chemical constituents, medicinal and antioxidant property. Free radicals or reactive oxygen species induce damage mainly to bio-membranes and DNA due to peroxidation mechanism, which ultimately leads to tissue damage resulting in a number of degenerative diseases. Antioxidants have been reported to prevent oxidative damage caused by free radicals and may prevent the body from various disorders. In recent years, the search for effective and more reliable non-toxic natural compounds with antioxidant activity has been intensified. The present review undertakes a brief account of research report on plants with antioxidant potential.

KEYWORDS: **Medicinal plants, Antioxidants, Phenolic compounds, Free radicals, Oxidative stress**

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INTRODUCTION

Plants are a natural source of wide variety of bioactive chemical constituents in a most efficient and convenient way. Medicinal plants, as a source of remedies, are widely used as alternative therapeutic tools for the prevention of many detrimental diseases. Medicinal plant parts are commonly rich in phenolic compounds, such as flavonoids, phenols, stilbenes, tannins, coumarins, lignans, lignins, etc. These chemical compounds have multiple biological effects including antimicrobial and antioxidant activity[1,2,3]. Pathological conditions such as ischemia, asthma, arthritis, inflammation, neurodegenertion, Parkinson's diseases, mongolism, dementia etc. are caused by accumulation of free radicals. Natural antioxidants have become the target of a great number of research studies in finding the sources of potentially safe and more effective antioxidants[4]. Herbal drugs are considered as free radical scavengers for their therapeutic activities[5]. Antioxidants are generally applied to prevent lipid peroxidation in the food industries[6,7].Reactive oxygen species (ROS) are class of highly reactive molecules derived from the oxygen metabolism. Reactive oxygen species are an inevitable by-product of cellular respiration which cause oxidation of lipids, nucleic acids and proteins, hence ROS damage is an underlying cause of many diseases[8-12]. These free radicals exist in the body during an imbalance between ROS and antioxidants. Many medicinal plants contain valuable antioxidants such as Vitamin C, Vitamin E, polyphenols etc. Natural antioxidants increase the antioxidant potential of the plasma and reduce the risk of certain diseases related to heart, skin etc.There are many synthetic antioxidants but they are known to cause many side effects[13], hence there is a need for more potent and less toxic antioxidants. It has been found that plants rich in polyphenolic compounds such as flavonoids possess antioxidant properties [14]. Cells have refined antioxidant regulatory systems to maintain proper balance of ROS; however, disruption in homeostasis leads to oxidative stress and tissue injury[15,16]. Studies have revealed that metals including iron, copper, chromium, lead, mercury, nickel and vanadium generate reactive oxygen species[17]. Antioxidants are widely employed in dietary supplements and have been investigated for the prevention of certain diseases such as cancer, coronary heart disease and even altitude sickness. However, initial studies suggested that antioxidant supplements might promote health. Based on solubility, anti-oxidants are of two types- Hydrophilic and Hydrophobic antioxidants. Hydrophilic antioxidants are soluble in water and generally react with oxidants in the cell cytoplasm and blood plasma, whereas hydrophobic antioxidants are soluble in lipids and protect cell membranes from lipid peroxidation[18].Antioxidants mediate oxidative damage caused by ROS, and research has focused on the role of antioxidants for the treatment and prevention of deadly disease. Antioxidants, including polyphenols, sulfur and selenium containing compounds, enzymatic antioxidants such as superoxide dismutase (SOD) and glutathione peroxidise, and micronutrients such as vitamins C and E, have been extensively studied, and numerous investigations have demonstrated their antioxidant potential[19-26].It has been established that oxidative stress is among the major causative factors in the induction of ageing and immunosuppression, and many chronic and degenerative diseases[27]. Free radicals are constantly generated in the body, resulting in extensive damage to tissues and bio-molecules leading to various pathological conditions. Natural antioxidants protect the human body from these free radicals and retard the progress of many chronic diseases as well as the lipid oxidative rancidity in foods[28]. Recent findings have revealed the inherent potential of plant products as antioxidants against various diseases induced by free radicals[29]. So the medicinal plants with antioxidant properties are employed as an alternative source of medicine to palliate the diseases associated with oxidative stress[30,31].

PLANTS WITH MEDICINAL AND ANTIOXIDANT PROPERTIES

Achyranthes aspera
***Common names*:** Prickly chaff flower, Devil's horsewhip, Chirchira, Onga
***Family*:** Amaranthaceae
***Part used*:** Dried whole plant, Roots, Leaves, Flowers and Seeds

CHEMICAL CONSTITUENTS

Preliminary chemical examination of the seeds of *Achyranthes aspera* revealed the presence of α-L-rhamnopyranosyl-(14)-(β- Dglucopyranosyluronicacid)-(13)-oleanolic acid, α-L rhamnopyranosyl-(14)-(β-Dglucopyranosyluronicacid)-(13)-oleanolic acid-28-O-β-D- glucopyranoside and α- Lrhamnopyranosyl-(14)-(β-Dglucopyranosyluronic acid)-(13)-oleanolic acid-28-O-β-Dglucopyranosyl-(14)-β-Dglucopyranoside[32].
Hariharan & Rangaswami[33] and Ali[34] reported the isolation & identification of Saponins A and B in the seeds of *Achyranthes aspera*. Hence Saponin A was identified as D-Glucuronic Acid and Saponin B was identified as β-Dgalactopyranosyl ester of D-Glucuronic Acid. Along with these constituents certain other constituents were also isolated such as oleanolic acid, amino acids and hentriacontane. Chemical constituents like 10-tricosanone, 10-octacosanone & 4-tritriacontanone also found in the seeds[35]. Danial[36] also reported the presence of many polysaccharides, ecdysterone(harmone), achyranthine, betaine(Alkaliods), vanillic acid, syringic acid, p-coumaric acid(phenolic acids), saponin A, saponin B (saponins), protein and carbohydrates in *A. aspera*.

MEDICINAL AND ANTIOXIDANT PROPERTIES

The plant is widely used in indigenous system of medicine such as anti-bacterial, anti-viral, anti-cancer, antioxidant, anti-inflammatory and anti-arthritic activity, anti-fertility, anti-plasmodic and anti-tumor activities[37-42]. Tahiliani and Kar[43] investigated various extracts of the leaves for antioxidant activities. Gayathri[44] also reported antioxidant activity in leaves and roots. Malarvili and Gomathi[45] reported antioxidant activity in

seeds of many plants. *Achyranthes aspera* is well known for the presence of phytoactive chemical constituents. Phytoactive constituents present in seed powder reduce the rate of lipid peroxidation and enhance free radical scavenging activity. DNA protection potential of *A. aspera* has also been reported[46]. Presence of phenolic compounds in *A. aspera* suggests this plant as potential source of antioxidant compounds[47].

Acorus calamus
***Common Name*:** Sweet Flag, Vacha, Bacch, Bajai, Gora-bach, Vasa Bach
Family **:** Acoraceae
Part used **:** Leaves, root (rhizome) and stem

CHEMICAL CONSTITUENTS

A. calamus (as various extracts of the rhizome) contains constituents such as alkaloids, flavonoids, gums, lectins, mucilage, phenols, quinone, saponins, sugars, tannins, and steroids[48]. The oil of *A. calamus* rhizomes has been analyzed by various workers for their chemical constituents and was found to contain varying concentrations of a-asarone, b-asarone, c-asarone, calamene, calamenenol, calameone, a-pinene, b-pinene, camphene, p-cymene, eugenyl acetate, eugenol, isoeugenol, methyl isoeugenol, calamol, azulene, eugenol methyl ether, dipentene, methyleugenol, asaronaldehyde, terpinolene, 1,8-cineole, camphor, a-caryophyllene, and hydrocarbons 12-14[49-61]. Among these essential oil constituents, the most characteristic component is β-asarone [[Z]-1,2,4-trimethoxy-5-prop-1-enylbenzene][62].

MEDICINAL AND ANTIOXIDANT PROPERTIES

Acous calamus is a potential larvicide. With exposure to an alcoholic extract of the roots, larvicidal action was reported on the housefly, flesh fly and culex[63,64]. The rhizome extract of *A. calamus* has been found to possess an antibacterial activity. β-asarones in *A. calamus* rhizomes were demonstrated to possess antibacterial activity[65]. β-asarone compound fraction obtained from the crude methanolic rhizome extract has been reported to possess the antifungal activity against the yeast strain of *Candida albicans, Cryptococcus neoformans, Saccharomyces cerevisae*[66] and also against *Aspergillus niger*[67]. The *Acorus calamus* extract exhibited a remarkable increased and decreased levels of certain parameters due to exposure to noise-stress which ultimately proves its antioxidant activity[68]. *A. calamus* has been found to render the protection against γ-radiation induced oxidative stress[69]. Another study has revealed that *A. calamus* extract helps preventing the development of ferric chloride-induced epileptogenesis in rats by modulating antioxidant enzymes[70].

Curcuma zedoria
***Common names*:** Zedoary, White Turmeric, Kachur, Jungli Haldi
Family **:** Zinziberaceae
Part used: Rhizome

Chemical constituents
Curcuma zedoaria is a good source of essential oils, starch, curcumin, arabin and gum[71]. Makabe[72] isolated more than 10 sesquiterpenes from the rhizome of *C. zedoaria* and were able to structurally characterize 15 more compounds, namely furanodiene, furanodienone, zedorone, curzerenone, curzeone, germacrone, 13-hydroxygermacrone, dihydrocurdione, curcumenone and zedoaronediol. Some scientific studies on the extracts and essential oils of several *Curcuma* species, especially *C. zedoria*, have identified curcuminoids and sesquiterpenoids as the major components[73] and these secondary metabolites have been identified as the major groups of antioxidants in the plants.

MEDICINAL AND ANTIOXIDANT PROPERTIES

Curcuma zedoaria has been used as a substitute for *Curcuma longa* and has recently been reported to show anti-allergic activity as well[74]. *Curcuma zedoaria* rhizome extracts which contain Curcumin as main component, have been used to treat stomach diseases, blood stagnation, hepato protection, diarrhoea, coryza, dermatosis disorders and rheumatism and promoting menstruation as a traditional medicine. Antimicrobial, anti-inflammatory anti-hepatotoxic, neuroprotective activity and cytotoxic effects against human ovarian cancer cells are all considered as abilities of Curcumin productions from *C. zedoaria* and furthermore, zedoary natural products are used as spices, rhizomes are also used in food industry as condiment and dye[75]. The essential oil isolated from the rhizome of *C. zedoaria* has been characterized and possess cytotoxic and antioxidant activities[76,77]. Kumar[78] also reported the anticancer and antioxidant activity of *C. zedoaria* and *C. amada* rhizome extact.

Eruca sativa
Common names: Rocket salad, Rucola, Rugula, Colewort, Arugula, Taramira
Family **:** Brassicaceae
Part used **:** Leaves, Seeds, Flowers

CHEMICAL CONSTITUENTS

Phytochemical screening of *Eruca sativa* plant extracts shows the presence of alkaloids, flavonoids, saponins, tannins, phenols, carbohydrates, steroids, and proteins[79]. Three novel quercetin triglucoside, in addition to their acylated sinapoyl derivatives, have been analysed and identified from leaves by Weckerle[80]. Later it was observed that the percentage of the aglycone kaempferol and its glycosides in the edible parts of *E. sativa* was more than that of quercetin[81]. Bennett[82] reported that all rocket species tissues, except roots, contained significant amount of poly-glycosylated flavonoids, with/without hydroxyl-cinnamoyl acylation. Further analysis of seed oil fatty acid profile yielded six major fatty acids such as palmitic acid 2.80%, stearic acid 30.8%, oleic acid 17.8%, linoleic acid 1.44%, linolenic acid 6.78%, erucic acid 47.0%[83].

MEDICINAL AND ANTIOXIDANT PROPERTIES

Eruca sativa seed extract contains important secondary metabolites such as flavonoids, alkaloids, tannins, phenols, saponins, ascorbic acid and these bioactive compounds are used as remedies of many diseases and frequently required in traditional medicines. Essential oil component especially erucic acids are responsible for antibacterial activity, which could be used for the preparation of drugs required for human and animal health[84]. Ancient Egyptians and Romans both have considered the leaves to be used as aphrodisiac, antiscorbutic, stimulant and rubefacient[85]. In terms of antioxidant compounds, *E. sativa* extracts are a good source of vitamins, like vitamin C, carotenoids, and polyphenols, which play a very important role among natural antioxidants[86]. The presence of higher total flavonoid content in the leaves reveals higher nutritional value, as flavonoids possess strong antioxidant activity and thus inhibit oxidative stress[87].It was examined that *Eruca sativa* seeds exhibits anti-diabetic effect by reducing oxidative stress experimented in rats [88]. Furthermore, ethanolic extract of *Eruca sativa* possesses significant anti-secretary, cytoprotective, and antiulcer properties against gastric lesions experimentally induced in rats by elevating mucus synthesis and endogenous prostaglandins through its potent antioxidant activity[89].

Verbascum thapsus

***Common names*:** Great or Common Mullein, Velvet Dock, Velvet Plant

***Family* :** Scrophulariaceae

***Part used* :** Leaves, stems, roots and flowers

CHEMICAL CONSTITUENTS

A group of unusual macrocyclic spermine alkaloids have been reported in members of the family Scrophulariaceae[90,91]. Chemical constituents of *V. thapsus* include polysaccharides; iridoid glycosides including harpagoside, harpagide and aucubin (mainly in the leaf); flavonoids including 3'- methylquercitin, hesperidin and verbascoside; saponins and volatile oils[92-95], vitamin C[96,97] and elements[98]. In *V. thapsus* flower, four saponins of fairly similar structure have been identified and named thapsuins A, B and hydroxythapsuins A and B[99]. 6-hydroxyluteolin 7-glucoside, 3'-methylquercetin and 7, 4'-dihydroxyflavone 4'-rhamnoside.16. Phytosterols (β-sitosterol and ergosterol peroxide) and oleanolic acid have also been reported in *V. thapsus* flower[100].

MEDICINAL AND ANTIOXIDANT PROPERTIES

V. thapsus shows antiviral activity against influenza in chicken embryos[101]. Dried leaves of *V. thapsus* are smoked for mental relaxation while tea made from the leaves is used to treat colds and dysentery. The product obtained from decoction of dried leaves and flowers is used to treat sore throats, bronchitis and abdominal pain, and can act as an expectorant and sedative[102]. The leaves and flowers possess antispasmodic properties and generally used as an expectorant for bronchitis, tuberculosis and other respiratory ailments. Flavonoids and saponins in the leaves may be responsible for their antimicrobial activity. Activity of flavonoids is probably due to their ability to complex with extracellular and soluble proteins and also with bacterial cell walls. Lipophilic flavonoids are known to disrupt microbial membranes[104].

Vitex negundo

***Common names*:** Indrani, Nilanirgundi, Nilapushpa, Nirgundi, Renuka, Mewri

***Family* :** Verbenaceae

***Part used*:** Roots, Leaves and seeds

CHEMICAL CONSTITUENTS

Leaves of *V. negundo* contain an alkaloid nishindine, flavonoids such as flavones, luteolin-7- glucoside, casticin, iridoid glycosides, an essential oil and other constituents like vitamin C, carotene, gluco-nonital, benzoic acid, β-sitosterol and C-glycoside. Hydrocarbons, β-sitosterol, benzoic acid and phthalic acid, antiinflammatory diterpene, flavonoids, artemetin and triterpenoids have been reported in the seeds[105,106]. Krishna[107] isolated β-amyrin, epifriedelinol and oleanolic acid from the heartwood of *V. Negundo*. Chopra[108] isolated fatty acids, β-sitosterol, vanillic acid, *p*-hydroxybenzoic acid and luteolin from bark, stem bark also yields leucoanthocyanidins. Essential oil of fresh leaves, flowers and dried fruits is rich in chemical constituents like δ-guaiene; guaia-3,7-dienecaryophyllene epoxide; ethyl-hexadecenoate; α-selinene; germacren-4-ol; caryophyllene epoxide; (E)-nerolidol; β-selinene; α-cedrene; germacrene D; hexadecanoic acid; p-cymene and valencene[109].

MEDICINAL AND ANTIOXIDANT PROPERTIES

The plant is reported to have valuable properties like expectorant, carminative, digestive, anodyne, antiseptic, alterant, antipyretic, diuretic, depurative, rejuvenating, ophthalmic, vulnerary and tonic[110]. The leaves of *V. negundo* are antibacterial, antitumor, astringent, febrifuge, sedative, tonic and vermifuge. Decoction of leaves may enhance eyesight[111,112]. Tondon & Gupta[113] reported anti-oxidant effect of Vitexin which is a recently reported compound. *V. negundo* exhibited a potent scavenging activity for (2, 2′-azino-bis 3-ethyl benzothiazoline-6-sulfuric acid) ABTS radical cations in a concentration dependent manner, showing a direct role in trapping oxidative species[114,115]. Mahalakshmi[116] analysed the antioxidant and therapeutic potential of *V. negundo* flavonoids in modulating solenoid-induced cataract and found it to be effective.

CONCLUSION

From the above discussion, it has been revealed that free radical contributes to the etiology of various ailments. Antioxidants play vital role in preventing the risk of so many diseases by interacting with free radicals. A number of active constituents including phenolic compounds, such as flavonoids, phenolic acids, tannins, lignins, and alkaloids, vitamins etc.

serve as useful antioxidants. The present investigation suggests that medicinal plants which possess considerable antioxidant potential are the best supplements for the diseases associated with oxidative stress. The literature review presented in this paper strongly approved the medicinal properties of all the mentioned plant species. The finding that these medicinal plants possess antioxidant and therapeutic properties implies that making these plants as an integral part of daily consumption may prevent various diseases.

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CONFLICT OF INTEREST

The authors hereby declare that there is no conflict of interest.

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