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## A Review on Antioxidant Potential of Herbs Bearing Phenolic Active Constituents



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### ABSTRACT

Antioxidants are the class of drugs that generally inhibit the process of oxidation. Most of the diseases are directly or indirectly related to oxidative stress because most of the reactive free radicals produced in these diseases are having high reactivity. These may damage the macromolecules such as DNA (Deoxyribonucleic acid), lipids, proteins and also affects various enzymes which may leads to cancer, aging, heart diseases, rheumatoid arthritis, atherosclerosis *etc.*, The herbs which are having active constituents of phenolic compounds tend to possess antioxidant activity as they donate electrons and thus helps in scavenging the free radicals. These types of herbs are having variable quantity of antioxidants and that can be protective against various chronic diseases related to oxidative stress. It has been postulated that the herbs possessing phenolic active constituents may contribute to the beneficial effects on health. This review gives exposure to knowledge about antioxidant potential of the herbs having phenolic active constituents which are medicinally important.



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## INTRODUCTION

Edible and nonedible plants are the common source of phenolic compounds and they possess various biological activities such as anticancer, antiemetic and mainly the antioxidant activity. The necessity of extracts of herbs which are having high content of phenolics is more in the food industry as they inhibit the oxidative degradation of lipids so that the nutritional value and quality of the food can be improved. The vital role of the phenolic constituents of herbs as antioxidants in prevention of coronary heart disease, cancer and also in aliment of health is highly appreciated. Phenolics such as flavonoids and other phenolics have been advised to play a vital defending role in the evolution of heart disease and cancer. Administration of mixture of phenolic compounds extracted from red wine has been exhibited to upgrade the antioxidant properties of plasma in humans. The antioxidant properties of phenolic compounds is because of their redox potential, they concede them to acts as hydrogen donors, singlet oxygen quenchers and as reducing agents and also they possess metal chelation properties *etc.*, Phenolic compounds are present in a variety of plant materials, some of plants or trees through which some phenolics have been isolated and analysed from are silver birch leaves, bark of birch, white birch, spruce and pine. Pycnogenol is apparently the most investigated phenolic tree extract. It may scavenge free radicals such as superoxide anions and hydroxyl radicals and may also useful in the treatment of age-related diseases and atherosclerosis.[1]

Oxidative stress is found to occur when there is an imbalance between the reactive oxygen species and reactive nitrogen species, which may lead damage to the components of the cell such as lipids, proteins, nucleic acids and carbohydrates and it further lead to cancer, atherosclerosis, aging, hair loss, inflammation, immunosuppression, diabetes and neurodegenerative disorders. When there is disturbance in superoxide dismutase, catalase and glutathione peroxidase there generates oxidative stress which may cause oxidative damage to the biomolecules. Phenolic compounds are known for their antimicrobial, anti-inflammatory, and antioxidant properties. They act as free radical scavengers and their antioxidant potential depends on the substituent present and extent of structure conjugation.[2]

Herbal medicine has been shown that it is one of the most vital fields of traditional medicine and it is used for varied medical conditions. The trend of collation of phytochemicals of plants and it's pharmacological properties is increasing. The advanced studies suggested that antioxidants obtained from natural sources like medicinal plants conserve from free radicals

and have broad spectrum of pharmacological activities including antimicrobial, antiallergic, antimutagenic, anticarcinogenic and antioxidant free radical scavenging activity. A large number of plants having active compounds like polyphenols can be used to treat the diseases where the reactive oxygen species and free radicals are having the vital role. Secondary plant metabolites like polyphenolic compounds may found in number of plants species and they concluded variety of functions to act against the free radicals and they were also found to inhibit various oxidizing enzymes.[3]

Plant extracts have shown various favorable effects on our health because of its multiplicity of free radicals scavenging molecules, some of which are carotenoids, anthocyanins, vitamins and phenolics. Typical phenolics having antioxidant properties are vital in adsorbing and neutralizing the free radicals and they are especially flavonoids and phenolic acids. These compounds possess some potential biological activities like antioxidant, antiviral, antibacterial, anti-inflammatory and anticancer activities. Tannins are the special group of plant phenolics, they are having an endothelium-dependent vasorelaxant and anti-ischemic activities. Previously, various studies shown that it was crucial to accomplice the biological activities with the total contents of phenolics. So, it need to report more details on antioxidants and phenolic compounds possessing biological activities which are isolated from a different plants or on screened extracts of the plants in which phenolic compounds are present.[4]

Some studies suggested the evidence that consumption of plant foods on daily basis is accomplished with less risk of human diseases occurrence. The antioxidant activity is commonly considered in fruits and vegetables but the recent studies suggested that the antioxidant activity can be measured in other plant categories like medicinal plants and herbs. In the region of Peruvian Amazon, some small proportion of edible and medical plants has been estimated for the antioxidant properties. They aimed to determine the correlation of biological activities with respect to phenolic content.[5]

The vital role of the phenolic compounds present in the plants is to prevent photodamage to the leaves and acts as antioxidant. Some of phytomolecules like curcumin, epicatechin, magnalol, ziyuglycoside I, Gallic acid, asiaticoside, ginsenoside, aloin, hydroxychavicol, hydroxycinnamic acids, and hydroxybenzoic acids scavenge the free radicals present in the cells of the skin and also protect from trans-epidermal water loss bearing a sun protection

factor of about 15 or more which leads to prevention of wrinkles formation and keep the skin young and healthy.[6]

Vegetables and herbal infusions are considered as main clusters of antioxidants. Aqueous herbal extracts can be given as decoctions on daily basis, hence there is more attraction towards herbal medicine. Herbal extracts of Lamiaceae family have found wider use in traditional practice and popular medicines and their therapeutic effects are mainly due to polyphenol components, such as phenolic acids and flavonoids as they possess antioxidant activities.[7]

Ginger has been reported with high antioxidant activity and better medicinal potential as they contain phenolics. In halia bara ginger, level of total phenolics and flavonoids are reported as high corresponding to high antioxidant activity. Ginger consists of different varieties of antioxidants such as polyphenols, terpenoids,  $\beta$ -carotene and rutin.[8]

The parts of the medicinal plants such as roots, leaves, branches/stems, barks, flowers and fruits are having the high content of flavonoids, phenolic acids, coumarins, stilbenes, tannins, lignans and lignins. There are several studies on many herbs with medicinal values for their antioxidant activities. In recent, ayurveda has been reviewed in detail regarding their antioxidant efficacies. There are so many methods available to determine the antioxidant efficacy of plant extracts, such as ferric reducing antioxidant power (FRAP) assay, oxygen radical absorbance capacity (ORAC) assay, ABTS [2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid)] assay, DPPH (2,2-diphenyl-1-picryl-hydrazyl-hydrate) assay *etc.*,[9]

In the present review, an attempt has been made to summarize the antioxidant potential of some herbs which are medicinally important. Some of such herbs or medicinal plants reviewed are;

In 2009, Rachh PR, Patel SR, Hirpara HV, Rupareliya MT, Rachh MR, Bhargava AS, Patel NM, Modi DC investigated the leaves of *Gymnema sylvestre* as it consists of lupeol, stigmasterol, resin,  $\beta$ -amyrin,  $\alpha$  and  $\beta$  chlorophyll, tartaric acid, gymnemic acid, mixture of triterpene saponins, alkaloids, choline, betain, anthraquinone derivatives. The leaves of the plant possess antiallergic, antiviral, diuretic, hypolipidemic activity and are also used in dental caries, hypoglycemic and in the treatment of obesity. So that study was aimed to perform *in-vitro* antioxidant activity from the leaf extract. This extract exhibited antioxidant activity by the inhibition of DPPH (2,2-diphenyl-1-picryl-hydrazyl-hydrate) radical, hydrogen

peroxide radical, superoxide anion radical and all of this was because of flavonoids, tannins, triterpenoids and phenols present in the extract and they concluded that further studies are needed to determine the *in-vivo* antioxidant potential.[10]

In 2000, Martinez G, Delgado R, Pérez G, Garrido G, Núñez sellés AJ, León OShave reported antioxidant, antispasmodic, analgesic, antipyretic and some other pharmacological activities of *Mangifera indica*. The antioxidant activity was because of the presence of flavonoids and they carried out *the in-vitro* antioxidant activity by phospholipid peroxidation, deoxyribose assay, hypochlorous acid assay, Thiobarbituric acid-reactive substance (TBARS) assay methods. The major active constituent of *Mangifera indica* is mangiferin, which is having varieties of pharmacological activities such as immunomodulatory, antitumour, anti-HIV. The study concluded that the antioxidant activity of *Mangifera indica* is due to its active constituent mangiferin.[11]

In 2010, Priya CL, Kumar G, Karthik L, Rao KV selected to study *Achyranthes aspera* because of its traditional use in the treatment of some diseases. However, it's root was already showed antioxidant activity. In this study, *Achyranthes aspera* was tested for antioxidant activity in its stem part. There may be several phenolic compounds in plants such as phenolic acids, flavonoids, isoflavonoids, lignins, tannins *etc.*, which can be isolated and used as natural antioxidants. They have collected plants from Seshachalam forest area in Chittoor district of Andhra Pradesh. The dried powder of *Achyranthes aspera* was screened and reported the presence of saponins, alkaloids, carbohydrates, oils, fats, tannins and phenolic compounds and there is absence of proteins and flavonoids. They have measured the total phenolic content of methanol and aqueous extract and showed that the methanolic extract possesses high phenolic content than aqueous extract and they carried out antioxidant activity by DPPH (2,2-diphenyl-1-picryl-hydrazyl-hydrate) radical scavenging assay and reported that methanolic extract possesses high antioxidant activity than aqueous extract.[12]

In 2011, Ganapathy PS, Ramachandra YL, Sai SP group studied *Holarrhena antidysenterica* as it is an important medicinal plant for treating hematuria, spermatorrhoea, epilepsy, asthma, piles, diarrhea, leprosy, bronchitis, eczema, fever and jaundice *etc.*, They reported that the bark was having antidiarrheal and astringent activities. The leaves were reported to treat scabies and further, it was also having anti-inflammatory, analgesic and antibacterial properties. This study was aimed to determine the natural antioxidant potential and evaluated *in-vitro* antioxidant activities of the herb in methanol extract. They determined the total

phenolic content of the methanolic extract of the herb *H. antidysenterica* and it was found to be 41.32 mg of tannic acid equivalents per gram of extract.[13]

In 2011, Yu YG, He QT, Yuan K, Xiao XL, Li XF, Liu DM, Wu H have investigated the herb called *Bombax malabaricum* as it is used to treat catarrhal affection, diarrhea, chronic inflammation, fever and other inflammatory conditions and also used as a diuretic. They extracted *Bombax malabaricum* with various solvents such as 50% ethanol, water, 80% acetone and tested for the *in-vitro* antioxidant activity and they established the relationship between the antioxidant activity, total flavonoid content and total phenolic content. Overall the present study designed was demonstrated the potential antioxidant activities from the flowers of *Bombax malabaricum*. [14]

In 2011, Devi SA, Ganjewala D analysed one of the Indian traditional medicinal plant belongs to the family of Araceae that is *Acorus calamus* for its antioxidant activity. It's rhizomes, leaves and its essential oils exhibited many vital biological properties, some of which are anticellular, antimicrobial, allelopathic, immunosuppressive and anti-inflammatory activities. The water extract of the leaves of *Acorus calamus* has shown it's anti-inflammatory activity on keratinocyte HACaT (Cultured human keratinocyte) cells. Phenolic compounds possess antioxidant properties because it is having the ability to scavenge the radicals. They were measured the quantity of phenolics in the rhizomes and leaves and investigated for their antioxidant activities. They prepared the extract of *Acorus calamus* in methanol and they determined the total phenolic content, flavonoids and proanthocyanidin. Total phenolic content was measured by Folin-ciocalteu method.

The total phenolic content was found to be 34.4( $\pm$ 0.8)mg gallic acid equivalent/g in leaf extract and 27.( $\pm$ 0.05)mg gallic acid equivalent/g in rhizome extract. The flavonoids content was found to be 22.0( $\pm$ 0.86) mg quercetin equivalent/g in leaf extract and 11.1( $\pm$ 0.7)mg quercetin equivalent/g in rhizome extract. The proanthocyanidin content was found to be 15.9( $\pm$ 3.0)mg catechin equivalent/g in leaf extract and 9.7( $\pm$ 1.45)mg catechin equivalent/g in rhizome extract. They were determined antioxidant activity by DPPH (2,2-diphenyl-1-picrylhydrazyl-hydrate) radical scavenging assay, superoxide anion radical scavenging activity. They have estimated the antioxidant activity of *Acorus calamus* leaves and rhizomes, leaves extract showed strong antioxidant activity at all different concentrations used except one *i.e.*, at 10 $\mu$ g/mL. The rhizomes extract of 100 $\mu$ g/mL concentration showed highest activity of 80% and the leaf extract of 40 $\mu$ g/mL concentration showed 84% activity. They showed



correlation between phenolic content and biological activity. Based on correlation analysis, there was strong correlation between DPPH (2,2-diphenyl-1-picryl-hydrazyl-hydrate) radical scavenging activity and total phenolic content of rhizome extract and moderate correlation with leaf extract. There was strong correlation of superoxide anion radical scavenging activity with phenolic content of both rhizome and leaf extracts.[15]

In 2012, Rameshkumar A, Sivasudha T investigated the antioxidant activity of *Mollugo nudaulis* by *in-vitro* method and screened for phytochemical constituents in the methanolic and aqueous extract of *Mollugo nudaulis*. They carried out *in vitro* antioxidant activity by DPPH (2,2-diphenyl-1-picryl-hydrazyl-hydrate) and ABTS[2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid)] assay and they quantified the total phenolic content by Folin-Ciocalteu and Aluminium chloride methods. They were showed the presence of flavonoids, steroids, reducing sugars, alkaloids in both aqueous and methanolic extracts. The total phenolic content in both methanolic and aqueous extracts of leaves were found to be  $47.01 \pm 0.8$  and  $46.4 \pm 0.05$  mg/100g respectively. The total flavonoid content in both methanolic and aqueous extract of leaves were found to be  $41.3 \pm 0.04$  and  $36.2 \pm 0.01$  mg/100g respectively. The total phenolics, flavonoids content and *in vitro* antioxidant activity was higher in methanolic extract when compared with aqueous extract. The investigations were reported that the *Mollugo nudicaulis* when extracted with the methanol exhibited the potential antioxidant activity.[16]

In 2012, Selles C, Dib ME, Allali H, Tabti B extracted the aerial parts of *Anacyclus pyrethrum* and analysed for total phenolic content and evaluated antioxidant activity by DPPH (2,2-diphenyl-1-picryl-hydrazyl-hydrate) radical scavenging assay, FRAP (Ferric reducing antioxidant power) assay. By using spectrophotometric methods they determined the total phenolics and flavonoids in the extract and it was found to be 310.78 mg gallic acid equivalent/g of extract.[17]

In 2012, Suresh J, Ahuja J, Paramakrishnan N, Sebastian Mestimated total flavonoids, total phenolic and various phytochemical constituents present in the *Artemisia abrotanum*. They used aluminium chloride colorimetric assay to determine the flavonoids content and folin-Ciocalteu assay to determine total phenolic content. They were studied and reported the presence of terpenoids, tannins, phenols, alkaloids, sterols, flavonoids in the ethanolic extract of aerial parts of *Artemisia abrotanum*. This extract had  $9.35 \pm 0.008$  mg gallic acid equivalent/g of phenolic content and  $11.0 \pm 0.025$  mg rutin equivalent/g of flavonoids content.

The results of the study suggested that this plant was having great content of flavonoids and polyphenols. Therefore it could be considered for the antioxidant, anticancer, immunomodulatory and antimicrobial categories.[18]

In 2012, Shahriar M, Akhter S, Hossain MI, Hague MA, Bhuiyan MA evaluated *Terminalia arjuna* for antioxidant activity by *in-vitro* method from the extract of this bark with various solvents such as methanol, ethanol, petroleum ether. The methanolic extract had shown highest DPPH (2,2-diphenyl-1-picryl-hydrazyl-hydrate) radical scavenging activity followed by ethanol extract and petroleum ether. By using spectrophotometric methods the flavonoids content, phenolic content and antioxidant activities were determined. There was good correlation between total phenolic content and antioxidant potential and there found a correlation coefficient of about 0.891. So that they concluded *Terminalia arjuna* was a natural source of antioxidant.[19]

In 2013, Tang EL, Rajarajeswaran J, Fung SY, Kanthimathi MS extracted leaves, roots and stems of *Coriandrum sativum* using dichloromethane, methanol, ethyl acetate, hexane and water. They measured the antioxidant activity by using DPPH radical scavenging assay and FRAP (Ferric reducing antioxidant power) method and they were also measured the total phenolic content. *Coriandrum sativum* roots extracted in ethyl acetate reported that they had highest phenolic content. FRAP (Ferric reducing antioxidant power) assay and DPPH (2,2-diphenyl-1-picryl-hydrazyl-hydrate) radical scavenging activity showed that they also possess greater antiproliferative activity. They concluded that *Coriandrum sativum* had shown potential antioxidant activity in treating oxidative stress-related diseases. There was a strong correlation found between FRAP (Ferric reducing antioxidant power) values and phenolic content of the root whereas weak correlation was found between DPPH (2,2-diphenyl-1-picryl-hydrazyl-hydrate) radical scavenging activity and total phenolic content of the root.[20]

In 2013, Jegadeesware P, Daffodil E, Mohan V studied on *Aristolochia bracteata*, which is a traditional medicine used in the treatment of dysentery, lung inflammation, cancer, snake bites, skin diseases, rheumatism, analgesic, purgative, anthelmintic, anti-inflammatory and antipyretic. It was screened for antioxidant activity by DPPH (2,2-diphenyl-1-picryl-hydrazyl-hydrate) radical scavenging assay, superoxide anion radical scavenging activity, ABTS [2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid)] assay, hydroxyl radical scavenging activity. *Aristolochia bracteata* is extracted with petroleum ether, ethyl acetate,



benzene, methanol and ethanol and it was shown that all these extracts possess potent DPPH (2,2-diphenyl-1-picryl-hydrazyl-hydrate) radical scavenging activity, which depends on the concentration of extracts. They reported total phenolic content and flavonoids content in methanol extract as 1.32g/100g and 3.48g/100g respectively.[21]

In 2014, Kazemi Malone extracted essential oil by hydrodistillation of *Carum copticum* and it was characterized by GC-MS (Gas chromatography-Mass spectrometry). The major components of the essential oil were thymol (45.6 %),  $\gamma$ -terpinene (20.0 %), p-cymene (11.03 %), carvacrol (2.87%). The essential oil was subjected for antioxidant activity and it was showed that potential nitric oxide scavenging activity and blocked the expression of nitric oxide synthase. It was also showed that thymol possesses highest inhibition of nitric oxide radical formation *i.e.*,  $85.12 \pm 0.43$ .[22]

## CONCLUSION

This review reveals fact that these herbs are having potential antioxidant activity as they possess free radicals scavenging activity. These free radicals are generated in the body mainly due to oxidative stress which leads to damage of the cells, proteins and DNA. This contributes to aging, diabetes, cancer and neurodegenerative diseases. The dietary antioxidants may help in the maintenance of sufficient antioxidant status and hence, they may prevent the body from various radicals such as reactive oxygen species, reactive nitrogen species etc., These herbs are having definite quantity of phenolic compounds and exhibit antioxidant activity. Most of the herbs extracted with methanol possessing a potential antioxidant activity than with any other solvents. There is a correlation between total phenolic content and antioxidant activity of the extracts of herbs. From the reviews of the plants studied we can conclude that the antioxidant activities of the herbs are due to presence of the total phenolic active constituents.

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