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ANTIOXIDANT POTENTIAL OF SOME TRADITIONALLY USED MEDICINAL PLANTS: A REVIEW

Heena Department of Botany, Maharshi Dayanand University Rohtak

email Id: heenasaroj4@gmail.com

ABSTARCT:

Antioxidants are the chemical compounds that can slow down or completely inhibit the oxidation of other molecules. Though various ROS such as hydrogen peroxide, Nitric oxide radical and Hydroxyl radical are continuously produced inside the living cells which act as signalling molecules in various biochemical reactions occurring inside the living cells, but an excess of these reactive oxygen species may disrupt the normal functioning of the biomolecules. Thus, a balance between the production and scavenging of these free radicals should be maintained inside the sub-cellular organs. For this purpose living organisms have developed a highly sophisticated defence mechanism of antioxidants. But several times, these endogenously produced antioxidants are not sufficient to maintain this balance, which may lead to oxidative stress of surrounding tissues. To counteract such an imbalance, herbal antioxidants may prove a panacea. They can act as dietary supplements and/or can be used for treatment of various diseases associated with oxidative stress.

Key words: Antioxidants, plant extracts, ROS, phytochemicals, DPPH assay, oxidative stress.

INTRODUCTION:

Plants are of special importance for their value as a source of natural antioxidants (Tiwari *et al.*, 2009). According to their functional definition, Antioxidants can be defined as the chemical compounds that can delay or

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inhibit the oxidation of other molecules, by using a range of mechanism. Oxygen is absolutely essential for aerobic respiration in living organisms but a paradox of metabolism is that while on one side, most living organisms requires oxygen to meet their body needs, on the other hand oxygen is highly reactive molecule that may damage the living surrounding cells by forming ROS (Reactive Oxygen Species) (Davies,1995). Reactive oxygen species is a common term which encompasses all highly reactive, oxygen containing molecules including free radicals. Examples of ROS includes Hydroxyl radical, Nitric oxide radical, Singlet oxygen hypochlorite radical, hydrogen peroxide etc. These free radicals are constantly produced in the sub-cellular organelles of living cells (Halliwell and Gutteridge, 1990). These are actually the part of biochemical reactions and act as signalling molecules, but an overproduction of these molecules and/or lack of control on them can lead to adverse effects on living cells, as they can impair the structure of biomolecules such as DNA, proteins and lipids. Our body maintains a balance between these highly activity oxygen species and a complex system of overlapping antioxidants, which scavenge these excess free radicals. Under normal conditions, about 1% of ROS escapes daily from the control of these naturally occurring anti-oxidant defence system and contribute to the oxidative stress of surrounding tissues (Gutteridge, 1993). In humans, oxidative stress believed to contribute in a range of diseases such as cardiovascular diseases, Parkinson's disease (Wood *et al.*, 2006), human aging, Rheumatoid arthritis (Hitchon and Gabalawy, 2004) and Alzheimer disease (Nunomura *et al.*, 2006). Therefore, dietary antioxidants are required to counteract these excess free radicals as the endogenous antioxidants are sometimes not sufficient to maintain a balance. Medicinal plants, which possess good antioxidant potential, are the good supplements for the treatment of diseases associated with oxidative stresses. They do so with the least side effects as compared to synthetic antioxidants, which are commercially available in market such as Butylated hydroxytoluene (BHT) and Butylated

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hydroxyanisole (BHA), which are suspected to have carcinogenic effects. The main antioxidant components in plants are mainly Polyphenols (phenolic acids, flavonoids, anthocyanins, lignins and stilbenes), Vitamins (Ascorbic acid and tocopherol) and Carotenoids (Xanthophylls and Carotenoids) (Baiano *et al.*, 2015 and Manach *et al.*, 2004).

Objective - Various attempts have been carried out by the researchers of diverse geographical locations in order to evaluate the antioxidant potential of a variety of plant species, so that the new horizons of supplementary antioxidant products can be explored. Thus, an effort to provide a quick and easy compilation of such researches has been done in the present review paper.

Commonly used herbal Antioxidants:

Murraya Koenigii: (Family – Rutaceae)

The plant may attain a height of 4-6 meters and is distributed in all over the India, from tarai region of utter Pradesh to hills of Uttaranchal and West Bengal and from central India to Indian peninsula. It is well known for its aromatic leaves, which imparts a special flavour to Indian curries, hence also named as "curry leaves". The plant produces small, white flowers, which produces shiny black drupes on self-pollination. The leaves of *Murraya Koenigii* are traditionally been claimed to be effective in treating of diarrhoea, dysentry, and in checking vomiting (Gupta *et al.*, 2009)

Pharmacological antioxidant activity- Gupta *et al.*, 2009, evaluated the leaves extracts of *Murraya Koenigii* in four different solvents by using DPPH free radical scavenging activity for determination of antioxidant potential of the plant. In their findings, the acetone, alcohol, and aqueous extracts have shown potent DPPH scavenging activity with an IC_{50} value of 4.72µg/ml, 4.10µg/ml and 4.46µg/ml respectively, hence, alcoholic extract was found to be most potent among others. Similarly, Tomar *et al.*, 2014, observed that ethanolic

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extract of *Murraya Koenigii* possess highest antioxidant activity (88.31% scavenging) than chloroform and petroleum ether extracts, which showed the % inhibition of 45.17% and 33..986% respectively. Such finding suggests the potential of this plant as a source of antioxidant compounds that can be used as a diet supplement as well as in pharmaceutical industries. The plant is also reported to have antifungal, antibacterial, anticarcinogenic, anti-lipid peroxidative, hypoglycaemic and anti- hypertensive activities (Iyer and Uma, 2008)

***Capsicum annuum*: (Family- Solanaceae)**

The plant is a perennial herb, reaching up to the height of 1m. Fruits (non pulpy berries) are slender in shape, curved, upto 11cm long and are known for their mild to extreme pungent taste. Ripened fruits may be green, yellow or red in color. Flowers are whitish in color and usually borne singly. Chilli peppers are used worldwide for its pungent flavour and aroma. It is also believed to be anti-diabetes, anti-ulcer, anti-arthritis, anti-coagulant, immuno-modulatory in action (Parvez, 2017).

Pharmacological antioxidant activity- Sharma *et al.,* 2017, observed the significant antioxidant activity of green chilli (*Capsicum annuum*) and yellow lantern chilli (*Capsicum chinense*). The free radical scavenging activity of samples was determined by using the DPPH scavenging assay. The ethanolic extracts of both the species observed to have strong antioxidant activity than aqueous and ethyl acetate extracts. The IC_{50} value of ethanolic extracts of capsicum and green chilli were found to be 0.07mg/ml and 0.05mg/ml respectively. High free radical scavenging activity of green chilli can be explained by the presence of high phenolic content (Siddhuraju *et al.,* 2002).

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Momordica charantia: **(family- Cucurbitaceae)**

The plant is a tendril-bearing vine and may reach up to a height of 5m. The stem is well-branched, slender, slightly five-angled and ridged. The fruits are narrower in shape with pointed ends, surface covered with jagged, triangular 'teeth' and ridged with green colouration. The taste is bitter. It is hollow in cross-section with a relatively thin layer of flesh surrounding a central seed cavity filled with large flat seed and pith. The flowers are unisexual and actinomorphic. Seeds are sculptured on both faces.

Pharmacological antioxidant activity- The plant is known for its anti-diabetic properties (Lotlikar *et al.*, 1966 and Virdia *et al.*, 2003), antimicrobial properties (Sankaranarayanan and jolly, 1993), in lowering blood fat level, in curing ulcers, and in treating malaria (Garau *et al.*, 2003 and Agharkar *et al.*, 1953). Also, there are certain evidences provided by various researchers to show the antioxidant activity of *Momordica charantia* fruits. Krishnendu and Nandini, 2016, determined the antioxidant activity of the methanolic, petroleum ether and acetonic plant extracts and observed the IC_{50} value 50.95µg/ml, 50.36µg/ml and 49.76µg/ml respectively. In an another study, the bitter gourd was observed to be 82.5% as effective as ascorbic acid in inhibiting the free radical DPPH as compared to *Cucurbita pepo*, which was 12.9% effective. The results showed that *Momordica charantia* was significantly higher in antioxidant activity as compared to that of *Cucurbita pepo* (Hamissou *et al.*, 2013).

Zingiber officinale**: (Family – Zingiberaceae)**

The plant is an aromatic herb with a small, erect stem. The edible portion is an underground rhizome. The rhizome is much branched somewhat resembling the palm of a hand with fingers. Fibrous roots are emitted from these nodes. Leaves are simple, alternate in phyllotaxy, glaborous, up to 15cm long. Flowers are bisexual and densely arranged. Fruit is an oblong capsule with numerous seeds.

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The plant is primarily reported in treating the digestive disorders, dyspepsia, nausea, diarrhoea and vomiting (Ansari *et al.*, 2016).

Pharmacological antioxidant activity- Free radical scavenging activity of *Z. officinale* by DPPH method has been reported by Amir *et al.*, 2011. The IC_{50} values of plant extract and standard ascorbic acid were observed to be 24.97µg/ml and 7.79µg/ml respectively. In an another study, the DPPH free radical scavenging activity of dried ginger estimated to be 83.87 ± 0.50% (El-Ghorab *et al.*, 2010). These findings suggest that *Zingiber officinale* could be served as a potential source of antioxidant supplement products. The plant is also used as a remedy for Alzheimer (Mathew and Subramanian, 2014), asthma, nervous diseases, hepatotoxicity (Mukherjee *et al.*, 2015), diabetes (Islam and Choi, 2008), inflammation (Iwami *et al.*, 2011), hypercholesterolaemia and helminthiasis(Iqbal *et al.*, 2006).

***Curcuma longa*: (family – Zingiberaceae)**

The plant is a Perennial herb attaining a height of about 1m and is native to southern India and Indonesia. The flowers are zygomorphic, hermaphrodite and yellow-orange in color. The leaves are simple, with long petioles. The leaves arise from the underground branching rhizomes. Dried powder of rhizome, (vernacularly known as '*haldi'*) is a commonly used spice in India that imparts characteristic yellow color to curry. The rhizome consist a yellow coloured Lipophilic polyphenol substance known as 'curcumin' (diferuloylmethane), which is believed to consist medical properties such as treating in dermatological diseases, infection, wound healing, stress and cough. Such uses of turmeric power are traditionally well known in Indian societies. Recently, efforts have been done to evaluate the antioxidant, anti- inflammatory, anti-cancer and anti-aging effects of *curcuma longa* by various researchers (Kocaadam and Sanlier, 2017).

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Pharmacological antioxidant activity – Nahak and sahu, 2011, compared the antioxidant activity of five *Curcuma species* namely, *C. longa, C. zedoaria , C. angustifolia, C. aromatica and C. amada*. In their findings, the highest antioxidant activity was shown by *C. longa* (74.61 ± 0.02%), which may be due to the presence of high concentration of phytochemicals such as phenols, flavonoids and anthocyanins in this species (Aderogba *et al.*, 2004).

***Foeniculum vulgare*: (Family – Apiaceae)**

The plant is a native of southern Europe and the Mediterranean region. Currently, it is cultivated worldwide including Egypt, South Africa, Iran, India, Ukraine, Greece, Italy, Australia, and southern America for spice and medicinal purposes. The plant has a thick root-system, erect and much branched stem which may reach up to a height of 1m. The family is characterized by the umbelliferous inflorescence. The fruit is a dry seed 4-10mm long. Many cultures in the Indian subcontinent use fennel seeds in their dishes. It is considered as one of the most important spice in Gujarati dishes and in rituals of Kashmiri pandit (Grieve,1931). Fennel seeds are traditionally used as anti-inflammatory, antispasmodic, analgesic and carminative agent (Crellin *et al.*, 1989). It is also found helpful in the treatment of glaucoma (Agarwal *et al.*, 2008) and in hypertension (Bardai *et al.*, 2001).

Pharmacological antioxidant activity – Fennel seeds are found to have an excellent free – radical scavenging activity with IC_{50} of 2.1mg dry seed weight. Extract equivalent to 0.5µg seeds is enough to protect DNA against H_2O_2 induced oxidation (Dua *et al.*, 2013). The preliminary phytochemical study showed the presence of saponins, flavonoids, glycosides, sterols, coumarins and triterpenes (Tanira *e al.*, 1996). Phenolic compounds isolated from the dry fruits of *Foeniculum vulgare* are considered to be responsible for the antioxidant

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activity it possesses while the volatile oil compounds make it an excellent flavouring agent (Rather *et al.*, 2016).

***Ocimum sanctum*: (Family – Lamiaceae)**

The traditional medical practitioners in India have been widely using *Ocimum sanc*tum (commonly known as 'Tulsi') since ancient times. It is grown throughout in India, from Himalayas to the Indian peninsula. Eugenol (71%) and methyl eugenol(20%) are the two prominent volatile oil possessed by the *Ocimum sanc*tum. The oil also contains the carvacrol and sesquiterpine hydrocarbon caryophyllene (Shah *et al.*, 1988). In indigenous system of medicines, the plant is believed to treat a range of disorders in human beings such as fever and common cold, cough, respiratory disorders (asthma and bronchitis), cardiac diseases, and mouth infections (Rindhe, 2018).

Pharmacological antioxidant activity - The *In vitro* DPPH free radicals scavenging activity of methanolic plant extract of *Ocimum sanctum* was observed to be slightly lower than that of standard ascorbic acid. The plant extract showed the percent inhibition of 80.19% when compared to ascorbic acid (89.60%) as a reference compound (Rindhe, 2018). Chattopadhyay (1993) reported the role of ethanolic extract of *Ocimum sanctum* in lowering the blood glucose level in diabetic rats. In an another study, There was an increased activity of two antioxidant enzymes of liver (SOD and Catalase) was observed after treatment with an aqueous extract of *Ocimum sanctum*, which shows the antioxidant potential of the plant (Panda and Kar, 1998).

***Acacia nilotica* (family – Fabaceae)**

Acacia nilotica is a native to Egypt and is widely distributed in tropical and subtropical regions of India. The various plant parts contain tannin (leaves and fruits), steric acid, kaempferol-3-glucoside, isoquercetin, leucocyanidin (flowers) and Arabic acid combined with calcium, magnesium and potassium

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(pods) (Rana, 2018). The literature studies observed a wide spectrum of biological activities of *Acacia nilotica* including antitumor (Lam and Ng, 2010), antifungal (Lopes *et al.*, 2009), antioxidant potential (Rajbir *et al.*, 2010), vasoconstrictor, antimutagenic (Menna *et al.*, 2006), antihypertensive, antidiabetic (Karau *et al.*, 2013) and wound healing (Tung *et al.*, 2009).

Pharmacological antioxidant activity –Algfri *et al.*, 2015 used the DPPH method to determine the antioxidant potential of leaf extract of *Acacia nilotica* by using methanol as a solvent. The percent inhibition by the extract was found to be concentration dependent with an IC_{50} value of the extract 6.28±0.30 µg/ml. The plant is also a rich source of polyphenols. Although, the role of these polyphenols in the plant itself is not well understood, but for human kind they can be of prime strategies for developing antioxidant supplements (Singh *et al.*, 2009).

***Citrus limon*: (Family – Rutaceae)**

The plant is a native to South Asia, mainly to North-eastern India, and is well known for its antioxidant potential (Mokbel *et al.*, 2006). The fruits are consumed as fresh or juice as a flavouring agent in various dishes. Various phytochemicals such as Vitamin A, C and E, flavonoids, coumarins, carotenoids, limonoids, tannins and other mineral elements have been reported to present inside the citrus fruits (Zhou, 2012). These phytoconstituents have been known to show antioxidant, anti-inflammatory, anti-carcinogenic, anti-mutagenic and anti-aging effects on human health (Rajendran *et al.*, 2014 and Zhang *et al.*, 2015).The fruits are found to be effective in treatment of various diseases such as vascular diseases and cancers (So *et al.*, 1996, Miyagi *et al.*, 2000, Vanamala *et al.*, 2006).

Pharmacological antioxidant activity- Hajimahmoodi *et al.*, 2014 analysed the interrelation between phenolic compounds and ascorbic acid content with

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antioxidant capacity of the *Citrus limon* fruits and observed a significant positive correlation between them. In an another study, Moosavy *et al.*, 2017, determined the total phenolic content and %Inhibition of lemon peel extract which was found to be 81.82 ±8.02 mg GAE and 55.09% respectively. Another encouraging study to demonstrate the antioxidant potential of lemon peel was carried out by Suja *et al.*, 2017. In their research they compared the antioxidant capacity of *C. limon* and *C. sinensis.* They observed that the ethanolic extract of *C. limon* peel shows the reducing power of 30% as compared to *C.sinensis*, whose reducing power observed to be 46%. Hence both the plants have a good reducing power and can be used as a source for antioxidant supplements. Also, the ethanolic extracts were found to show the highest antioxidant activity as compared to acetonic, chloroform and aqueous extracts.

***Artemisia vulgaris*: (Family – Asteraceae)**

The plant is widespread in semi-arid and arid areas of North Africa, Spain, The Middle East and Northwest of Himalayas (Wang, 2004). In Ayurveda, *Artemisia vulgaris* has been considered as a source of snake bite - antidote (Issar 1975). The plant is used locally as a remedy for the scabies, gastric and headache (Ghimire and Bastakoti, 2009). Medicinally, the various species of herb are known for their neuroprotective (Bora and Sharma, 2010), antifungal (Kordali *et al.*, 2005), anti-malarial (Irshad *et al.*, 2011), antimicrobial (Juteau *et al.*, 2003), anti-depressant(Mahmoudi *et al.*,2009) and hepatoprotective (Gilani and Janbaz,1995) properties. The plant contains the essential oils, flavonoids, Polyphenolic compounds, steroids, glycosides and tannins, which are responsible for a range of biological activities that plant possesses (Neelamma *et al.*, 2016).

Pharmacological antioxidant activity –Temraz and Walid (2014) evaluated the leaves extract of *Artemisia vulgaris* by using various methods. The extract is

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observed to exhibit the IC_{50} value of 11.4µg/ml for DPPH (Close to those of standard rutin, 10µg/ml). The reducing power of the extract depends on the amount of extract. In another study, the methanolic leaves extract of *Artemisia vulgaris* is observed to have significant antioxidant potential and anti-inflammatory activities by Neelamma *et al.*, 2017. The aqueous and chloroform extracts of *Artemisia vulgaris* leaves are also observed to have anti-hypertensive activity but have no significant effects on cardiovascular hemodynamics under basal conditions (Tigno *et al.*, 2000).

Conclusion:

In the present work, *Murraya Koenigii, Capsicum annum, Momordica charantia, Zingiber officinale, Citrus limon, Acacia nilotica, Ocimum sanctum, Curcuma longa, Foeniculum vulgare and Artemisia vulgaris* are reviewed for their antioxidant potential. The studies carried out by various researchers revealed the presence of various phytochemicals in these plants which may be responsible for a range of biochemical activities such as anti-bacterial, antifungal, anti-diabetic, antioxidant, anti-hepatotoxicity and anti-carcinogenic activities which plants possesses. The present review clearly shows that different plant species vary in their antioxidant capacity. The antioxidant activity consist by these plant species could be used as exogenous supplements to maintain the adequate antioxidant status inside the human body, which could be of significant interest for the researchers in the development of new drugs.

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