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REVIEW ARTICLE

ANTIOXIDATIVE PROPERTIES OF MORINGA OLEIFERA: A REVIEW

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ABSTRACT

The Free radicals play an important role in the pathogenesis of several human diseases, including cancer and Alzheimer's disease. Natural antioxidants present in food of plant origin protect against these radicals and are therefore important tools in obtaining and preserving good health. *Moringa oleifera* Lam. (drumstick tree, horseradish tree) is an indigenous tree from northwestern India and is often cultivated in hedges and home yards. The tree is valued mainly for the tender pods, which are esteemed as a vegetable. Flowers and young leaves are also eaten as vegetables. The present review is an attempt to popularize the antioxidant potential of *Moringa oleifera*.

INTRODUCTION

Moringa oleifera, the word "Moringa" probably came from dravidian language Tamil and commonly referred to as "Shojne" in Bengali, "Munga" in Hindi, "Munagakaya" in Telugu, "Shenano" in Rajasthani, "Shevaga" in Marathi, "Nuggekai" in Kannada. "Moringa" (from Tamil: Murungakai, Malayalam: Muringa, Konkani: Mashinga sanga), and Malunggáy in Filipino, is the most widely cultivated species of the genus *Moringa*, which is the only genus in the family Moringaceae. It is an exceptionally nutritious vegetable tree with a variety of potential uses. The tree itself is rather slender, with drooping branches that grow to approximately 10 m in height. In cultivation, it is often cut back annually to 1 meter or less and allowed to regrow so that pods and leaves remain within arm's reach. *Moringa oleifera* Lam. (drumstick tree, horseradish tree) is an indigenous tree from northwestern India and is often cultivated in hedges and home yards. The tree is valued mainly for the tender pods, which are esteemed as a vegetable (Ramachandran *et al.,* 1980). Flowers and young leaves are also eaten as vegetables. Among myriad of plants, *Moringa oleifera* Lam is one of the best known and most distributed species of Moringaceae family. *Moringa* is an important tropical crop that is used as human food, medicine and in oil production (Anwar *et al.,* 2007). Leaves of this plant are traditionally known for or reported to have various biological activities, including hypocholesterolemic agent (Ghasi *et al.,* 2000), regulation of thyroid hormone status (Tahiliani and Kar, 2000), antidiabetic agent (Makonnen *et al.,* 1997), gastric ulcers (Pal *et al.,* 1995), antitumor agent (Bharali *et al.,* 2003), antihyperglycemic (Anwar *et al.,* 2007) and hypotensive agent (Faizi *et al.,* 1995). The leaves as well as the flowers, roots, gums, fruits and seeds are extensively used for treating inflammation (Mahajan and Mehta, 2008), cardiovascular action, liver disease (Rao and Mishra, 1998) and hematological, hepatic and renal function (Mazumder *et al.,* 1999). It is generally known in the developing world as a vegetable, a medicinal plant and a source of vegetable oil (Bennet *et al.,* 2003).

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Free radical scavenging (antioxidant) activity

Free radicals play an important role in the pathogenesis of several human diseases, such as cancer, rheumatoid arthritis, and cardiovascular diseases (Hertog *et al.,* 1997). Natural antioxidants present in food of plant origin protect against these radicals and are therefore important tools in obtaining and preserving good health (Dell Agli *et al.,* 2004; Scoorbrate *et al.,* 2005). Strong epidemiological evidence suggests that regular consumption of fruits and vegetables, which are a rich source of the antioxidants, can reduce cancer and coronary heart diseases (Block at al., 1992; Middleton *et al.,* 2000). Active oxygen species and free radicals play an important role in the pathogenesis of several human diseases, such as rheumatoid arthritis, and cardiovascular diseases (Hertog *et al.,* 1997) including cancer. The antioxidant defence enzymes have been suggestive of playing an important role in maintaining physiological levels of oxygen and hydrogen peroxide and

eliminating peroxides generated from inadvertent exposure to xenobiotics and drugs. Any natural compound with antioxidant properties may help in maintaining health when continuously taken as components of dietary foods, spices or drugs (Singh, 2000). The majority of the diseases/disorders is mainly linked to oxidative stress due to free radicals. In the treatment of these diseases, antioxidant therapy has gained an immense importance. Antioxidants have been reported to prevent oxidative damage caused by free radical and may prevent the occurrence of disease, cancer and aging. It can interfere with the oxidation process by reacting with free radicals, chelating, catalytic metals, and also by acting as oxygen scavengers. Currently available synthetic antioxidants like butylated hydroxy anisole (BHA), butylated hydroxyl toluene (BHT), tertiary butylated hydroquinon and gallic acid esters, have been suspected to cause or prompt negative health effects. Hence, strong restrictions have been placed on their application and there is a trend to substitute them with naturally occurring antioxidants. Moreover, these synthetic antioxidants also show low solubility and moderate antioxidant activity (Mishra *et al.,* 2009).

Further, there is a great amount of research being put in for the discovery of new compounds from natural systems for the prevention and cure of diseases. The emphasis is always given to the native species of plants for such research. *Moringa* being a tropical tree, has been and being widely investigated in tropical countries such as India. Ayurveda has also advocated the medicinal uses of *M. oleifera* and there are a variety of ayurvedic preparations that use *M. oleifera* powder and extracts in some way or other. Most of the plant parts of *M. oleifera* have been shown to posses antioxidant activities by different researchers. Sidduraju and Becker (2003) have examined water, aqueous methanol, and aqueous ethanol extracts of freeze-dried leaves of *Moringa oleifera* Lam. from different agroclimatic regions for radical scavenging capacities and antioxidant activities and showed that all leaf extracts were capable of scavenging peroxyl and superoxyl radicals. Similar scavenging activities for different solvent extracts of each collection were found for the stable 1,1-diphenyl 2-picrylhydrazyl ($DPPH^{\bullet}$) radical. Among the three different Moringa samples, both methanol and ethanol extracts of Indian origins showed the highest antioxidant activities, 65.1 and 66.8%, respectively, in the β-carotene−linoleic acid system. Nonetheless, increasing concentration of all the extracts had signed ($P < 0.05$) increased, reducing power, which may in part be responsible for their antioxidant activity. The major bioactive compounds of phenolics were found to be flavonoid groups such as quercetin and kaempferol.

Ashok Kumar and Pari (2004) studied the hepatoprotective effect of an ethanolic extract of *M. oleifera* leaves on liver damage induced by antitubercular drugs such as isoniazid (INH), rifampicin (RMP), and pyrazinamide (PZA) in rats. Oral administration of the extract showed a significant protective action made evident by its effect on the levels of glutamic oxaloacetic transaminase (aspartate aminotransferase), glutamic pyruvic transaminase (alanine aminotransferase), alkaline phosphatase, and bilirubin in the serum; lipids, and lipid peroxidation levels in liver. The results showed that treatment with *M. oleifera* extracts or silymarin (as a reference) enhanced the recovery from hepatic damage induced by antitubercular drugs which can be attributed to its antioxidant activity.

Siddiqui et al (2005) investigated the antioxidant activity of different solvent extracts of *Moringa oleifera* leaves by using accelerated aging of sunflower oil. Methanolic and acetone (80 and 100%) extracts of *M. oleifera* leaves were added at the concentration of 0.06% (wt/wt) into the refined, bleached and deodorized sunflower oil. 80% methanolic extract showed maximum amount of antioxidant activity. The antioxidant activity of *M. oleifera* leaves was attributed to the presence of high amount of flavonoids, polyphenolics and tocopherol contents. Santos et al (2005) discovered that seed flour from *Moringa oleifera* can be widely used as a natural coagulant for water treatment in developing countries. Extracts obtained by water soaking of *M. oleifera* intact seeds were investigated for the presence of lectin, trypsin inhibitor, tannin as well as antioxidant activity. The antioxidant component reduced 1,1-diphenyl-2-picrylhydrazyl radical (DPPH) slower than catechin but was thermostable. Reddy et al. (2005) highlighted the use of natural antioxidants for their role in preventing the auto oxidation of fats, oils and fat containing food products. They studied three plant foods viz., amla (*Emblica officianalis*), drumstick leaves (*Moringa oleifera*) and raisins (*Vitis vinifera*) as sources of natural antioxidants. All the three extracts exhibited a high percentage of antioxidant activity evaluated using β-carotene–linoleic acid in *in vitro* system, compared to synthetic antioxidants. Biscuits prepared by the addition of such natural extracts of raisins and drumstick leaves received higher ($P \leqslant 0.05$) panel scores during storage period of 6 weeks, than control, butylated hydroxyl anisole and amla. Extracts from drumstick leaves and amla were more effective in controlling lipid oxidation during storage (Reddy *et al.,* 2005).

Bajpai et al. (2005) identified promising sources of antioxidants from some food and medicinal plants. The leaves, bark and fruits of *Terminalia arjuna*, *Terminalia bellerica*, *Terminalia chebula* and *Terminalia muelleri*, the leaves and fruits of *Phyllanthus emblica*, and the seeds of *Syzygium cumini* were found to have high total phenolic contents (72.0–167.2 mg/g) and high antioxidant activity (69.6–90.6%). Leaves of *Eucalyptus globulus* were a rich source of rutin, *Moringa oleifera* for kaempferol, aerial parts of *Centella asiatica* for quercetin, fruits of *T. bellerica* and *T. chebula* for gallic acid, and bark of *T. arjuna*, leaves and fruits of *T. bellerica* and bark, leaves and fruits of *T. muelleri* for ellagic acid (Bajpai *et al.,* 2005). Iqbal and Bhanger (2006) studied antioxidant activity of methanolic extracts from *Moringa oleifera* leaves, as a function of the seasons and agroclimatic locations in the linoleic acid system and scavenging power of superoxide anion radical. Significant differences were observed in the antioxidant activity of the extracts from different locations and seasons. Overall, antioxidant efficacy was greater in December or March depending upon location, and least in June. Antioxidant potential of *M. oleifera* leaves from Pakistan was quite comparable or higher than literature values for *M. oleifera* from other countries and some other potent antioxidants. Kumar et al. (2007) studied methanolic pod extract of *Moringa oleifera* (Moringaceae) for antioxidant activity. The pod exhibited significant antioxidant activity on DPPH free radical, superoxide radical, hydrogen peroxide and nitric oxide production. The highest free radical scavenging of the pod extract was observed at concentrations of 2500 μg/ml. Chumark et al. (2008) studied *Moringa oleifera* leaf extract for the antioxidant, hypolipidaemic and antiatherosclerotic activities. It

was found that in scavenging DPPH radicals the extract and the Trolox® had IC_{50} of 78.15 ± 0.92 and 2.14 ± 0.12 µg/ml respectively. The results indicate that this plant possesses antioxidant, hypolipidaemic and antiatherosclerotic activities and has therapeutic potential for the prevention of cardiovascular diseases. Sreelatha and Padma (2009) investigated *Moringa oleifera* leaf extracts in two stages of maturity using standard in vitro models for antioxidant activity. The aqueous extract of *Moringa oleifera* exhibited strong scavenging effect on 2, 2-diphenyl-2-picryl hydrazyl (DPPH) free radical, superoxide, nitric oxide radical and inhibition of lipid per oxidation. The free radical scavenging effect of *Moringa oleifera* leaf extract was comparable with that of the reference antioxidants. Sultana et al (2009) investigated effects of four extracting solvents [absolute ethanol, absolute methanol, aqueous ethanol (ethanol: water, 80:20 v/v) and aqueous methanol (methanol: water, 80:20 v/v)] and two extraction techniques (shaking and reflux) on the antioxidant activity of extracts of barks of *Azadirachta indica*, *Acacia nilotica, Eugenia jambolana*, *Terminalia arjuna*, leaves and roots of *Moringa oleifera*, fruit of *Ficus religiosa*, and leaves of *Aloe barbadensis.* The tested plant materials contained appreciable amounts of total phenolic contents (0.31-16.5 g GAE /100g DW), total flavonoid (2.63-8.66 g CE/100g DW); reducing power at 10 mg/mL extract concentration (1.36-2.91), $DPPH^{\cdot}$ Scavenging capacity (37.2-86.6%), and percent inhibition of linoleic acid (66.0-90.6%). Higher extract yields, phenolic contents and antioxidant activity were obtained using aqueous organic solvents, as compared to the respective absolute organic solvents.

Singh et al. (2009) investigated the aqueous extract of leaf, fruit and seed of *Moringa oleifera* for their ability to inhibit the oxidative DNA damage, antioxidant and anti-quorum sensing potentials. It was found that these extracts could significantly inhibit the $OH^{\cdot}$-dependent damage of pUC18 plasmid DNA and also inhibit synergistically with trolox. HPLC and MS/MS analysis showed the presence of gallic acid, chlorogenic acid, ellagic acid, ferulic acid, kaempferol, quercetin and vanillin. The leaf extract was with comparatively higher total phenolics content (105.04 mg gallic acid equivalents (GAE)/g), total flavonoids content (31.28 mg quercetin equivalents (QE)/g), and ascorbic acid content (106.95 mg/100 g) and showed better antioxidant activity (85.77%), anti-radical power (74.3), reducing power (1.1 ascorbic acid equivalents (ASE)/ml), inhibition of lipid peroxidation, protein oxidation, $OH^{\cdot}$-induced deoxyribose degradation, and scavenging power of superoxide anion and nitric oxide radicals.

Conclusion

The results suggest that the different parts of *M. oleifera* have capabilities of scavenging free radicals. we have investigated the potential of antioxidant activity of leaves of *Moringa oleifera*from Central Indian region of Jabalpur. The DPPH scavenging was shown by ethyl acetate extract of the leaf. Upon purification through gel filtration, thin layer chromatography and subsequent LC ESI MS, phenolic compounds, i.e. catechin and related compounds were identified. Leaves of *Moringa oleifera*could be the potential source of antioxidants (Nigam *et al.,* 2016). We have studied the whole plant thoroughly, and came to a conclusion that apart from pod (entire pod that includes fruit and seed both) which is a regularized and customary food in India, leaves of *M. oleifera* can also be used as a food. The food prepared from leaves of *M. oleifera* will also serve as a good natural antioxidant and help in preventing many diseases.

REFERENCES

Anwar F. and Rashid U. 2007. Physico-chemical characteristics of *Moringa oleifera*seeds and seed oil from a wild provenance of Pakistan. Pakistan Journal Bot. 39(5): 1443-1453.

Ashok Kumar N. and Pari L. 2003. Antioxidant action of *Moringa oleifera*Lam. (drumstick) against anti tubercular drug induced lipid peroxidation in rats. *J. Med. Food,* 6(3):255-9.

Bajpai M., Pande A., Tiwari S.K. 2005. Phenolic contents and antioxidant activity of some food and medicinal plants. Int. J. Food Sci. Nutr. 56: 287-291.

Bennett R.N., Mellon F.A., Foidl N., Pratt J.H., DuPont M.S., Perkins L. and Kroon P.A. 2003. Profiling glucosinolates and phenolics in vegetative and reproductive tissues of the multi-purpose trees *Moringa oleifera*L. (Horseradish tree) and *Moringa stenopetala* L. J. of Agric. and Food Chem. 51: 3546-3553.

Bharali R., Tabassum J. and Azad M.R.H. 2003. Chemomodulatory effect of *Moringa oleifera*, Lam, on hepatic carcinogen metabolizing enzymes, antioxidant parameters and skin papillomagenesis in mice. *Asian Pacific J. of Cancer Prevention,* 4: 131-139.

Block G., Patterson B. and Subar A. 1992. Fruits, vegetables and cancer prevention: A review of the epidermiological evidence. Nutr. Cancer, 2: 129.

Chumark, P., Khunawat, P., Sanvarinda, Y., Phornchirasilp, S., Morales, N. P., Phivthong-Ngam, L., Ratanachamnong, P., Srisawat, S. and Pongrapeeporn, K. U. 2008. The in vitro and ex vivo antioxidant properties, hypolipidaemic and antiatherosclerotic activities of water extract of *Moringa oleifera*Lam. leaves. *Journal Ethnopharmacol.,* 116, 439–446.

Dell Agli M, Busciala A, Bosisio E. 2004. Vascular effects of wine polyphenols. Cardiovasc. *Research*, 63:593–602.

Faizi S., Siddiqui B.S., Saleem R., Siddiqui S., Aftab K. and Gilani A.M. 1995. Fully acetylated carbamate and hypotensive thiocarbamate glycosides from *Moringa oleifera*. Phytochemistry, 38: 957-963.

Ghasi S., Nwobodo E. and Ofili J.O. 2000. Hypocholesterolemic effects of crude extract of leaf of *Moringa oleifera*Lam in high-fat diet fed Wistar rats. *J. of Ethnopharmacol.,* 69(1): 21-25.

Hertog, M.G.L., Sweetnam, P.M., Fehily, A.M., Elwood, P.C. and Kromhout D. 1997. Antioxidant flavonols and ischemic heart disease in a Welsh population of men: the Caerphilly study. American Journal of Clinical Nutrition, 65: 1489–1494.

Iqbal S. and Bhanger M. I. 2006. Effect of season and production location on antioxidant activity of *Moringa oleifera*leaves grown in Pakistan. J. Food Compost. Anal. 19, 544–551.10.1016/j.jfca.2005.05.001

Kumar, S., Kumar, D., Singh, N. and Vasisht, B.D. 2007. In vitro free radicals scavenging and antioxidant Activity of *Moringa oleifera*pods. Journal of Herbal Medicine and Toxicology 1 (2) 17-22 ISSN : 0973-4643.

Mahajan S.G. and Mehta A.A. 2008. Effect of *Moringa oleifera*Lam. seed extract on ovalbumin-induced airway inflammation in guinea pigs. Inhalation Toxicol., 20: 897–909.

Makonnen E., Hunde A. and Damecha G. 1997. Hypoglycaemic effect of *Moringa stenopetala* aqueous extract in rabbits. Phytotherapy Res., 11: 147-148.

Mazumder U.K. and Gupta M. 1999. Evaluation of hematological and hepatorenal functions of methanolic extract of *Moringa oleifera*Lam. root treated mice. *Ind. J. of Exp. Biol.,* 37(6): 612-614.

Middleton F.A. and Strick P.L. 2000. Basal ganglia and cerebellar loops: Motor and cognitive circuits. Brain Res. Rev. 31:236–250.

Mishra D., Gupta R., Pant S., Kushwah P. and Satish H.T. 2009. Flora SJS, 2009. Co-administration of Monoisoamyl Dimercaptosuccinic acid and *Moringa oleifera* seed powder protects arsenic induced oxidative stress and metal distribution in mice. Toxicol. Mech. and Meth., 19(2): 169-182.

Nigam, R., Ayachi, A. and Verma, K.S. 2016. The antioxidant potential of phenolic compounds from the leaves of *Moringa oleifera* collected from jabalpur (india). European Journal of Biomedical and Pharmaceutical sciences, 3(3):532-536.

Pal S.K., Mukherjee P.K. and Saha B.P. 1995. Studies on the antiulcer activity of *Moringa oleifera* leaf extract on gastric ulcer models in rats. Phytotherapy Res. 9: 463-465.

Ramachandran C., Peter K.V. and Gopalakrishnan P.K. 1980. Drumstick (*Moringa oleifera*): A multipurpose Indian vegetable. Economic Botany, 34(3):276-283.

Rao K.S. and Mishra S.H. 1996. Drumstick polysaccharide as pharmaceutical adjuvant. *Ind. J. of Nat. Products,* 9(1): 3-6.

Reddy, V., Urooj, A. and Kumar, A. 2005. Evaluation of antioxidant activity of some plant extracts and their application in biscuits. Food Chemistry 90: 317-321

Santos, A.F., Argolo, A.C., Coelho, L.C. and Paiva, P.M. 2005. Detection of water soluble lectin and antioxidant component from *Moringa oleifera* seeds. Water Research. 39(6):975:980.

Siddhuraju P. and Becker K. 2003. Antioxidant properties of various solvent extracts of total phenolic constituents from three different agroclimatic origins of drumstick tree (*Moringa oleifera* Lam) leaves. Journal Agric Food Chemical.51: 2144–2155.

Siddiqui, A., Anwar, F., Manzoor, M. and Fatima A. 2005. Antioxidant activity of different solvent extracts of *Moringa oleifera* leaves under accelerated storage of sunflower oil. *Asian Journal Plant Science,* 4: 630-635.

Singh, B.N., Singh, B.R., Singh, R.L., Prakash, D., Dhakarey, R., Upadhyay, G, et al. 2009. Oxidative DNA damage protective activity, antioxidant and anti-quorum sensing potentials of *Moringa oleifera*. Food and Chemical Toxicology 47: 1109-1116

Scorbrattee M.A., Neergheen V.S., Luximon-Ramma A., Aruoma O.L. and Bahorun T. 2005. Phenolics as potential antioxidant therapeutic agents: mechanism and actions. *Mut. Res.,* 579:200–213.

Sreelatha, S. and Padma P. R. 2009. Antioxidant activity and total phenolic content of *Moringa oleifera* leaves in two stages of maturity. Plant Foods Human Nutrition. 64, 303–311.

Sultana, B., Anwar, F. and Ashraf M. 2009. Effect of extraction solvent/technique on the antioxidant activity of selected medicinal plant extracts. Molecules 2009, 14, 2167-2180; doi:10.3390/molecules14062167.

Tahiliani, P. and Kar, A. 2000. Role of *Moringa oleifera* leaf extract in the regulation of thyroid hormone status in adult male and female rats. *Pharmacol. Res.,* 41(3):319-323.

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