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THE STORY OF AN AMAZING TREE OF LIFE : "*MORINGA OLEIFERA*" –A REVIEW


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ABSTRACT

The *Moringa oleifera* is perhaps the most useful traditional medicinal plant in India. Each part of the "*Moringa oleifera*." tree has some medicinal property and is thus commercially exploitable. During the last five decades, apart from the chemistry of the *Moringa* compounds, considerable progress has been achieved regarding the biological activity and medicinal applications. It is now considered as a valuable source of unique natural products for development of medicines against various diseases and also for the development of industrial products. This review gives a bird's eye view mainly on the biological activities of some of the compounds isolated, pharmacological actions of the leaf extracts, clinical studies and plausible medicinal applications along with their safety evaluation. Nutritional and medicinal properties have the potential to end malnutrition, starvation, as well as prevent and heal many diseases and maladies world wide

KEYWORDS

Moringa oleifera, malnutrition, starvation and pharmacological **.**

RESEARCH PAPER

Introduction :

The medicinal plants are part and parcel of human society to combat diseases, from the dawn of civilization. The *Moringa oleifera* is well known in India and its neighbouring countries for more than 2000 years as one of the most versatile medicinal plants having a wide spectrum of biological activity. The tree is native to India but has been planted around the world and is naturalized in many locales. The *Moringa* goes by many names. In the Philippines, where the leaves of the moringa are cooked and fed to babies, it is called "mother's best friend" and "malunggay." Other names for it include the benzolive tree (Haiti), horseradish tree (Florida), Nébéday (Senegal) and very common drumstick tree (India).

There are about 13 species of moringa trees in the family Moringaceae. They are native to India, the Red Sea area and/or parts of Africa including Madagascar. Of these species, *Moringa oleifera* is the most widely known.Olson M.E (2010) In this the term 'moringa' refers to *M. Oleifera* English common name include moringa ,drumstick tree from the appearance of the long slender triangular seed-pods. Horseradish tree from taste of roots.

Chemical investigation on the products of the moringa tree was extensively undertaken in the middle of the twentieth century.

Moringa oleifera is one of the vegetables of the Brassica order and belongs to the family Moringaceae. *Moringa oleifera* come from Kingdom: Plantae, Division: Magnoliphyta, Class: Magnoliopsida, Order: Brassicales, Family: Moringaceae, Genus: Moringa, Species: M. oleifera (Fahey, 2005).The Moringaceae is a single genus family with 13 known species (Khawaja et al., 2010). *Moringa oleifera* is a small native tree of the sub-Himalayan regions of North West India, which is now indigenous to many regions in Africa, Arabia, South east Asia Islands and South America. Traditionally, besides being a daily used vegetable among people of these regions, the *Moringa* is also widely known and used for its health benefits.. Among commoners, it has earned its name as 'the miracle tree' due to its amazing healing abilities for various ailments and even some chronic diseases *Moringa oleifera* is an important food commodity which has had enormous attention as the 'natural nutrition of the tropics'. The leaves, fruit, flowers and immature pods of this tree are used as a highly nutritive vegetable in many countries, particularly in India, Pakistan, Philippines, Hawaii and many parts of Africa (D'souza and

Kulkarni, 1993; Anwar and Bhanger, 2003;

Anwar *et al.*, 2005). *Moringa* leaves have been reported to be a rich source of β-carotene, protein, vitamin C, calcium and potassium and act as a good source of natural antioxidants; and thus enhance the shelf-life of fat containing foods due to the presence of various types

of antioxidant compounds such as ascorbic acid, flavonoids, phenolics and carotenoids (Dillard and German, 2000; Siddhuraju and Becker, 2003). In the Philippines, it is known as 'mother's best friend' because of its utilization to increase woman's milk production and is sometimes prescribed for anemia (Estrella *et al.*, 2000; Siddhuraju and Becker, 2003).

Nutritive properties:

The Moringa has lot of minerals that are essential for growth and development among which, calcium is considered as one of the important minerals for human growth. While 8 ounces of milk can provide 300–400 mg, Moringa leaves can provide 1000 mg and Moringa powder can provide more than 4000 mg. Moringa powder can be used as a substitute for iron tablets, hence as a treatment for anemia. Beef has only 2 mg of iron while Moringa leaf powder has 28 mg of iron. It has been reported that Moringa contains more iron than spinach . A good dietary in take of zinc is essential for proper growth of sperm cells and is also necessary for the synthesis of DNA and RNA. *M. Oleifera* leaves show around 25.5–31.03 mg of zinc/kg, which is the daily requirement of zinc in the diet . Every part of *M. oleifera* is a storehouse of important nutrients and anti nutrients. The leaves of *M. oleifera* are rich in minerals like calcium, potassium, zinc, magnesium, iron and copper (J.N. Kasolo, G.S. Bimenya, L. Ojok (2010) . Vitamins like beta-carotene of vitamin A, vitamin B such as folic acid, pyridoxine and nicotinic acid, vitamin C, D and E also present in *M. Oleifera* (M. Mbikay 2012),. Phytochemicals such as tannins, sterols, terpenoids, flavonoids, saponins,anthraquinones, alkaloids and reducing sugar present along with anti-cancerous agents like glucosinolates, isothiocyanates, gly-coside compounds and glycerol-1-9-octadecanoate . Moringa leaves also have a low calorific value and can be used in the diet of the obese. The pods are fibrous and are valuable to treat digestive problems and thwart colon cancer (D.I. Sanchez-Machado, 2012). A research shows that immature pods and flowers shows similar amounts of palmitic ,linolenic,linoleic and oleic acids. *Moringa oleifera* is rich in compounds containing the simple sugar, rhamnose and a fairly unique group ofcompounds called glucosinolates and isothiocyanates (Fahey *et al.*, 2001; Bennett *et al.*, 2003). The stem bark has been reported to contain two alkaloids, namely moringine and moringinine (Kerharo, 1969). Vanillin, β -

sitosterol , β-sitostenone, 4-hydroxymellin and octacosanoic acid have been isolated from the stem of *M. oleifera* (Faizi *et al.*, 1994a). Purified, whole-gum exudate from *M. oleifera* has been found to contain L-arabinose, -galactose, -glucuronic acid, and L-rhamnose, -mannose and -xylose, while a homogeneous, degraded-gum polysaccharide consisting of L-galactose, -glucuronic acid and L-mannose has been obtained on mild hydrolysis of the whole gum with acid (Bhattacharya *et al.*, 1982). Flowers contain nine amino acids, sucrose, D-glucose, traces of alkaloids, wax, quercetin and kaempferat; the ash is rich in potassium and calcium (Ruckmani *et al.*, 1998). They have also been reported to contain some flavonoid pigments such as alkaloids, kaempherol, rhamnetin, isoquercitrin and kaempferitrin (Faizi *et al.*, 1994a; Siddhuraju and Becker, 2003). Antihypertensive compounds thiocarbamate and isothiocyanate glycosides have been isolated from the acetate phase of the ethanol extract of *Moringa* pods (Faizi *et al.*, 1998). The cytokinins have been shown to be present in the fruit (Nagar *et al.*, 1982). A new *O*-ethyl-4-(α-L-rhamnosyloxy) benzyl carbamate .

Vitamin & Mineral Content of Moringa

All values are per 100 grams of edible portion.

	Fresh Leaves	Dried Leaves
Carotene (Vit. A)*	6.78 mg	18.9 mg
Thiamin (B1)	0.06 mg	2.64 mg
Riboflavin (B2)	0.05 mg	20.5 mg
Niacin (B3)	0.8 mg	8.2 mg
Vitamin C	220 mg	17.3 mg
Calcium	440 mg	2,003 mg
Calories	92 cal	205 cal
Carbohydrates	12.5 g	38.2 g
Copper	0.07 mg	0.57 mg
Fat	1.70 g	2.3 g
Fiber	0.90 g	19.2 g
Iron	0.85 mg	28.2 mg
Magnesium	42 mg	368 mg
Phosphorus	70 mg	204 mg
Potassium	259 mg	1,324 mg

Protein	6.70 g	27.1g
Zinc	0.16 mg	3.29 mg

Medicinal Properties :

Moringa oleifera is often referred as a plant and can be used to cure more than 250 diseases. Moringa has long been used in herbal medicine by Indians and South Africans. The presence of phytochemicals makes it a good medicinal agent.

Antitumor and anticancer activities :

Cancer is a common disease and one in seven deaths is attributed due to improper medication. There are no specific reasons for cancer to develop. Cancer treatments like surgery, chemotheraphy and radiations are expensive and have side effects. Makonnen *et al.* (1997) found *Moringa* leaves to be a potential source for antitumor activity. *O*-Ethyl- 4-(α-L-rhamnosyloxy) benzyl carbamate together with 4(α-L-rhamnosyloxy)-benzyl isothiocyanate , niazimicin and 3-*O*-(6′-*O*-oleoyl-β-D-glucopyranosyl)- β-sitosterol have been tested for their potential antitumor promoting activity using an *in vitro* assay which showed significant inhibitory effects on Epstein– Barr virus-early antigen. Niazimicin has been proposed to be a potent chemo -preventive agent in chemical carcinogenesis (Guevara *et al.*, 1999). The seed extracts have also been found to be effective on hepatic carcinogen metabolizing enzymes, antioxidant parameters and skin papillomagenesis in mice (Bharali *et al.*, 2003). A seed ointment had a similar effect to neomycin against *Staphylococcus aureus pyodermia* in mice (Caceres and Lopez, 1991). It has been found that niaziminin , a thiocarbamate from the leaves of *M. oleifera*, exhibits inhibition of tumor-promoter-induced Epstein–Barr virus activation. On the other hand, among the isothiocyanates, naturally occurring 4-[(4′-*O*-acetyl-α-i-rhamnosyloxy) benzyl] , significantly inhibited tumor-promoter induced Epstein–Barr virus activation, suggesting that the isothiocyano group is a critical structural factor for activity (Murakami *et al.*, 1998). *Moringa oleifera* can be used as an anticancer agent as it is natural ,reliable and safe,at fixed concentration. Further more,research papers suggest that the anti-proliferative effect of cancer may be due to ability to induce reactive oxygen species induced in the cells.

Antibacterial and antifungal activities

Moringa roots have antibacterial activity (Rao *et al.*, 1996) and are reported to be rich in antimicrobial agents. These are reported to contain an active antibiotic principle, pterygospermin , which has powerful antibacterial and fungicidal

effects (Ruckmani *et al.*, 1998). A similar compound is found to be responsible for the antibacterial and fungicidal effects of its flowers (Das *et al.*, 1957). The root extract also possesses antimicrobial activity attributed to the presence of 4-α-L-rhamnosyloxy benzyl isothiocyanate (Eilert *et al.*, 1981). The aglycone of deoxy-niazimicine (N-benzyl, S-ethyl thioformate) isolated from the chloroform fraction of an ethanol extract of the root bark was found to be responsible for the antibacterial and antifungal activities (Nikkon *et al.*, 2003). The bark extract has been shown to possess antifungal activity (Bhatnagar *et al* 1961). In a study by Singh et al. (2012), the antimicrobial activity of *Moringa oleifera* examined using the main model Kirby-bauer disc diffusion method in which 50% of ethanolic moringa leaf extract was used. The results showed that the 50% ethanolic extract successfully displayed anti-bacterial activity however only little. Even at higher concentration ,the extract displayed mild inhibitory activity and no activity at all against pseudomonas. *Moringa oleifera* leaf extract indicated potential as a treatment for certain bacterial infections.The antibacterial activity of Moringa extract was observed to be greater against gram –positive species.

Anti-diabetic properties

Diabetes is one of disorder where the patients suffer from non-production of insulin, which is a hormone that maintains the blood glucose level at the required normal value. Moringa has been shown to cure both Type 1 and Type 2diabetes. Type 1. Type 2 diabetes is one associated with insulin resistance. Type 2 diabetes might also be due to Beta cell dysfunction, which fails to sense glu-cose levels, hence reduces the signaling to insulin, resulting in high blood glucose levels (M.E Cerf). Several studies have shown that,moringa can act as an anti-diabetic agent. A study has shown that the aqueous extracts of *M. oleifera* can cure streptozotocin-induced Type 1 diabetes and also insulin resistant Type 2 diabetes in rats.(S.M.Divi) In another study, the researchers fed the STZ-induced diabetes rats with Moringa seed powder and noticed that the fasting blood glucose dropped A.L.AL-(Malki,HA.EL.Rabey). Also, when the ratswere treated with about 500 mg of moringa seed powder/kg bodyweight, the antioxidant enzymes increased in the serum. This shows that the antioxidants present in moringa can bring down the ROS caused in the Beta-cells due to the STZ induction .STZ causes ATP dephosphorylation reactions and helps xanthineoxidase in the formation of superoxides and reactive oxygenspecies

(ROS) in Beta cells. In hyperglycemic patients, the beta cells get destructed . Therefore, high glucose entersthe mitochondria and releases reactive oxygen species. Since beta cells have low number of antioxidants, this in turn causes apoptosis of the beta cells . This reduces insulin secretion leading to hyperglycemia and in turn diabetes mellitus Type-2.The flavonoids like quercitin and phenolics have been attribute antioxidants that bring about a scavenging effect on ROS. It can be hypothesized that the flavonoids in Moringa scavenge the ROS released from mitochondria, thereby protecting the beta cells and in turn keeping hyperglycemia under control.

Conclusion :

From this present investigation it is clear that the research on *Moringa oleifera* is yet to gain importance in India .It is very essential that such wonder tree full of nutrients should be exploited for a variety of purpose. In conclusion, it is proven in numerous cases that the *Moringa oleifera* tree possesses a wide range of medicinal and therapeutic properties. For instance, in this paper, it views the general nutrition contents of the Moringa several remedial properties including anti-fibrotic,anti-inflammatory, anti-microbial, anti-hyperglycemic,antioxidant,anti –tumour and anti cancer properties. Further studies for the mechanism of action and constituents of the Moringa plant may provide incredible capabilities to develop pharmacological products. The further studies should emphasis on probable mode of action of the isolates and possible structural-activity relationship as the chemical constituents of *Moringa oleifera* are very well investigated and represented . In conclusion, *Moringa oleifera* has numerous applications in medicinal field as well as in commercial field applications Moringa seeds are used to extract oil called the Ben oil. This oil is rich in oleic acid, tocopherols and sterols. It can also withstand oxidative rancidity. The oil can be used in cooking gas a substitute for olive oil, as perfumes and also for lubri-cation . The pods can absorb organic pollutants and pesticides. Moringa seeds also have great coagulant properties and can precipitate organics and mineral particulates out of asolution . Chemical coagulants such as aluminum sul-fate (Alum) and ferric sulfate or polymers removes suspended particles in waste water by neutralizing the electrical chargesof particles in the water to form flocs making particles fil-terable. *M. oleifera* seed is a natural coagulant, containing acationic protein that can clarify turbid water. This property of *M. oleifera* seeds is attracting much research as other coag-ulants such as alum, activated carbon and ferric chloride are

expensive and rare.Moringa seeds can be used in cosmetics and are source of biodiesel, while the seedcakes can be used as a green manure or a fertilizer. The tree as a native of India can become a great source of income for the nation .The demand for snacks in the market is huge, hence moringa fortification in snacks to eradicate malnutrition.

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