

**REVIEW ON NUTRITIONAL AND PHARMACOLOGICAL POTENCIES OF *MORINGA OLEIFERA***

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Article Received on 22/10/2015

Article Revised on 13/11/2015

Article Accepted on 04/12/2015

**ABSTRACT**

*Moringa oleifera*, belongs to family *Moringaceae*. It is native to India, Pakistan, Afganistan and Bangladesh. It is also found in Thailand, Philippines, Taiwan and Africa. Moringa are being grown for differential purposes like Supplement, medicine, plant growth enhancer, green manure, biopesticides, biomass production and domestic livestock fodder. The present review focuses on the nutritional and pharmacological potencies of Moringa like anti-diabetic (hyperglycemic), anti-microbial, anti-fertility, anti-inflammatory, anti-cancer, anti-arthritis, hepatoprotective, etc. *M. oleifera* contains essential amino acids, carotenoids, and vitamins C in leaves rendering a quality nutraceutical property, supporting the idea of using this plant leaves as better nutritional supplement.

**KEYWORDS:** *Moringa oleifera*, Anti-hyperglycemic, Anti-arthritis, Nutrition, pharmacology.

**INTRODUCTION**

*Moringa oleifera* is one of the vegetables of the Brassica order and belongs to the family *Moringaceae*. The *Moringaceae* is a single genus family with 13 known species.<sup>[1]</sup> *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, the Pacific and Caribbean Islands and South America. *Moringa oleifera* is also known as Drumstick tree, Horseradish tree, Mlonge, Mulangay, Sajana, Benzolive, Kelor and Marango. Moringa is a type of local medicinal and vegetable Indian herb which has turned out to be familiar in the tropical and subtropical countries. *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.<sup>[2,3]</sup> *Moringa* leaves have been reported to be a rich source of  $\beta$ -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.<sup>[4,5]</sup> In the Philippines, it is known as 'mother's best friend' because of its utilization to increase woman's breast milk production and is sometimes prescribed for anemia.<sup>[5]</sup>

*Moringa oleifera* is a widely cultivated tree considered as a multi-purpose plant. It includes the use as functional food, cleaning water material, oil extraction for biofuel

production, and other applications. In a traditional way, it is used with medicinal purposes around the world due to empiric observations. These benefits have been associated with different plant metabolites present such as phenolic compounds, flavonoids, vitamins, minerals and protein.<sup>[6, 7]</sup> Nevertheless, the complete knowledge about what kind of metabolites are present in each organ, and their ecological and biological roles, are poorly elucidated. Some studies about macromolecular characterization have been made in the last years, including a protein with the ability to agglutinate, proteinase inhibitors, lectins, carbohydrates and lipid contents. Plant parts including leaves, stem, roots, seeds and flowers have been reported as source of different biochemical compounds with anti-carcinogenic, anti-inflammatory, anti-diabetic, antioxidant, and antimicrobial effects.<sup>[3,6,7,8,9]</sup> *Moringa oleifera* contains essential amino acids, carotenoids in leaves, and components with nutraceutical properties, supporting the idea of using this plant as a nutritional supplement or constituent in food preparation. Some nutritional evaluation has been carried out in leaves and stem. Studies have shown that conventional antinutritional factors like trypsin and amylase inhibitors, glucosinolates, cyanogenic glycosides, saponins and tannins were not detected, at least with the used methodology. However, a comprehensive study including the root system is still missing. Secondary metabolites from *M. oleifera* leaves have shown antimicrobial effects against various human pathogenic bacteria, including the genera *Shigella*, *Pseudomonas*, *Salmonella* and *Bacillus*. These secondary metabolites appear to be involved in plant defense mechanisms.<sup>[10, 11, 12]</sup> Recently, the presence of a

trypsin inhibitor has been reported in leaves. This indicates an important activity against serine proteinases. This inhibitor has been stable in a wide range of pH, detergents, reducing agents and high temperatures, which coincide with the high stability, reported for some proteins involved in plant defense.<sup>[13]</sup> Despite its potential applications, a comprehensive knowledge of *M. oleifera*, including its responses at the biochemical and biological levels, is still limited. Also, the biochemical implications on human health of the bioactive compounds present in this plant, their relation with the plant defense strategies against biotic and abiotic agents, as well as the physiological roles of proteins, enzymes

and secondary metabolites are not well understood when ecological interactions are considered.

#### Nutritional value

Moringa leaves are being used to combat malnutrition, especially in infants and nursing mothers. Three non-governmental organizations in particular- Trees for Life, Church World service and Educational Concerns for Hunger Organization have advocated Moringa as natural nutrition for the tropics, *M. oleifera* leaves have essential amino acids, including the sulfur-containing amino acids in higher levels than those recommended by the Food and agriculture Organization (FAO) and patterns similar to those of soybean seeds.<sup>[14]</sup>

#### Moringa (drumstick) pods and leaves (Nutritive value per 100 g).

	Pods,raw	Leaf,raw
<b>Energy</b>	<b>37 Kcal (2%)</b>	<b>64 Kcal (3%)</b>
<b>Carbohydrates</b>	8.53 g (6.5%)	8.28% (6%)
<b>Protein</b>	2.10 g (4%)	9.40 g (17%)
<b>Total Fat</b>	0.20 g (1%)	1.40% (7%)
<b>Cholesterol</b>	0 mg (0%)	0 mg (0%)
<b>Dietary Fiber</b>	3.2 g (8%)	2.0 g (5%)
<b>Folates</b>	44 µg (11%)	40 µg (10%)
<b>Niacin</b>	0.680 mg (4%)	2.220 mg (14%)
<b>Pyridoxine</b>	0.120 mg (9%)	1.200 mg (92%)
<b>Riboflavin</b>	0.074 mg (6%)	0.660 mg (51%)
<b>Thiamin</b>	0.053 mg (4.5%)	0.257 mg (21.5%)
<b>Vitamin A</b>	74 IU (2.5%)	7564 IU (252%)
<b>Vitamin C</b>	141mg (235%)	51.7 mg (86%)
<b>Sodium</b>	42 mg (3%)	9 mg (0.5%)
<b>Potassium</b>	461 mg (10%)	337 mg (7%)
<b>Minerals</b>		
<b>Calcium</b>	30 mg (3%)	185 mg (18.5%)
<b>Iron</b>	0.36 mg (4.5%)	4.00 mg (50%)
<b>Magnesium</b>	45 mg (11%)	147 mg (37%)
<b>Phosphorus</b>	50 mg (9%)	112 mg (20%)
<b>Selenium</b>	8.2 µg (15%)	0.9 µg (1.5%)
<b>Zinc</b>	0.45 mg (4%)	0.60 mg (5%)

Percentages of daily-recommended values are marked in brackets.  
(Source: USDA National Nutrient data base)

The growth and metabolic functions of all plants and animals are largely dependent on the availability of micronutrients, nutrition and vitamins required in varying quantities. The essential ingredients, required for both plants and animals to perform the metabolic and growth functions, include vitamins (A, B, C and E) and minerals like iron (Fe), iodine (I), zinc (Zn), and selenium (Se). Nutrition deficiency, especially of vitamin A, Fe and I, has been reported in about 2 billion people worldwide especially in developing countries. In Tanzania, 45% children under the age of five and in Pakistan, 38% children between the ages of six months and five years are found iron deficient. Moringa 17 leaves, fresh pods and roots contain high nutrients essential for both humans and livestock, so its leaves are being used as feed for animals, chicken and fish and also for humans while the humans are traditionally using

young fresh pods, kernels and roots used as pickles, sauces, juices and vegetables and for medicinal purposes.<sup>[2,3]</sup> Moringa is a miracle tree with a great indigenous source of highly digestible proteins, Ca, Fe and Vitamin C. It contains all the essential nutritional elements that are vital for livestock and human beings.<sup>[6]</sup> It has been demonstrated that the dry leaves of *M. oleifera* contain 7 times more vitamin C than orange, 10 times vitamin A than carrot, 17 times calcium than milk, 15 times potassium than bananas, 25 times iron than spinach and 9 times proteins than yogurt.<sup>[34]</sup> In addition, it contains vitamin B, chromium, copper, magnesium, manganese, phosphorus and zinc.<sup>[35]</sup> Thurber and Fahey (2009) reported moringa leaves as rich protein source, which can be used by doctors, nutritionists and community health cautious persons to solve worldwide malnutrition or under nutrition problems. Seshadri and

Nambiar (2003) reported 40139 µg/100g total carotenoides on fresh weight basis in moringa leaves out of which 47.8% or 19210 µg/100g was β-carotene. Moreover, it was also found that moringa contains ascorbic acid were at 6.6 mg/g on dry weight basis, Fe 0.26mg/g, Ca 22.4 mg/g, P 6.3 mg/g, oxallic acid 11.2 mg/g and fiber at 0.9 g/100 g. Some studies revealed that

moringa has the potential to combat vitamin A and other micronutrient deficiencies.<sup>[36]</sup>

#### Pharmacological Properties

*Moringa oleifera* also has numerous medicinal uses, which have long been recognized in the Ayurvedic and Unani systems of medicine.<sup>[37]</sup>

#### TRADITIONAL MEDICINAL USES OF MORINGA

LEAVES	FLOWERS	PODS	SEEDS
General Tonic	General Tonic		Tonic
Anti-inflammatory	Anti-inflammatory	Anti-inflammatory	Anti-inflammatory
Anti-cancer	Anti-cancer	Anti-cancer	
Diuretic	Diuretic		Treats Bladder problems
Antibacterial	Antibacterial		Antibacterial
Anti-helminthic	Anti-helminthic	Anti-helminthic	
Antipyretic	Antibiotic		Antipyretic
Analgesic			
Laxative			Laxative
Anti anemic			Treat scurvy
Increase milk production			
Anti- diarrheia			
Anti hypersensitive			
Anti diabetic			
Hepatoprotector			
Relaxant sedative			

Phytochemicals are, in the strictest sense of the word, chemicals produced by plants. Commonly, though, the word refers to only those chemicals which may have an impact on health, or on flavor, texture, smell, or color of the plants, but are not required by humans as essential nutrients. An examination of the phytochemicals of *Moringa* species affords the opportunity to examine a range of fairly unique compounds. In particular, this plant family is rich in compounds containing the simple sugar, rhamnose, and it is rich in a fairly unique group of compounds called glucosinolates and isothiocyanates.<sup>[15,16]</sup> For example, specific components of *Moringa* preparations that have been reported to have hypo-tensive, anticancer, and antibacterial activity include 4-(4'-*O*-acetyl- $\alpha$ -L-rhamnopyranosyloxy)benzyl isothiocy-anate, 4-( $\alpha$ -L-rhamnopyranosyloxy)benzyl isothiocy-anate, niazimicin, pterygospermin, benzyl isothiocyanate, and 4-( $\alpha$ -L-rhamnopyranosyloxy) benzyl glucosinolate. While these compounds are relatively unique to the *Moringa* family, it is also rich in a number of vitamins and minerals as well as other more commonly recognized phytochemicals such as the carotenoids (including β-carotene or pro-vitamin A).

The benefits for the treatment or prevention of disease or infection that may accrue from either dietary or topical administration of *Moringa* preparations (e.g. extracts, decoctions, poultices, creams, oils, emollients, salves, powders, porridges) are not quite so well known. Although the oral history here is also voluminous, it has been subject to much less intense scientific scrutiny, and it is useful to review the claims that have been made and

to assess the quality of evidence available for the more well-documented claims. The readers of this review are encouraged to examine two recent papers that do an excellent job of contrasting the dilemma of balancing evidence from complementary and alternative medicine (e.g. traditional medicine, tribal lore, oral histories and anecdotes) with the burden of proof required in order to make sound scientific judgments on the efficacy of these traditional cures.<sup>[17,18]</sup> Clearly much more research is justified, but just as clearly this will be a very fruitful field of endeavor for both basic and applied researchers over the next decade. Widespread claims of the medicinal effectiveness of various *Moringa* tree preparations have encouraged the author and his colleagues at The Johns Hopkins University to further investigate some of these possibilities. A plethora of traditional medicine references attest to its curative power, and scientific validation of these popular uses is developing to support at least some of the claims. *Moringa* preparations have been cited in the scientific literature as having antibiotic, antitrypanosomal, hypotensive, antispasmodic, antiulcer, anti-inflammatory, hypo-cholesterolemic, and hypoglycemic activities, as well as having considerable efficacy in water purification by flocculation, sedimentation, antibiosis and even reduction of Schistosome cercariae titer.

**I. Antimicrobial:** *Moringa oleifera* shown invitro antimicrobial activity against bacteria such as; *E.coli*, *Bacillus cereus*, *Staphylococcus aureus*, *Bacillus subtilis*, *S faecalis*, *S epidermidis*, *shigella shinga* and

*Pseudomonas aeruginosa*. Yeast, dermatophytes and helminthes were tested by disc diffusion technique.<sup>[19]</sup> Antifungal activity in both broth dilution and agar plate methods against *Trichophyton rubrum*, *T. mentagraphytes*, *Trichophyton mentagraphytes*, *Epidrmophyton xoccosum*, *Microsporum canis*, *Fusarium solani* and *Rhizopus solani*. Benzyl isothiocyanate, Benzyl glucosinolate and Pterygospermin are the phyto-constituents responsible for antimicrobial activity.<sup>[14]</sup>

**II. Anti-diabetic:** Aqueous extract of *Moringa oleifera* leaves were studied for antidiabetic activity and it has found that 200mg kg<sup>-1</sup> decreased blood glucose level(BGL) of normal animals by 26.7 and 29.9% during FBG(Fasting blood glucose) and OGTT(Oral glucose tolerance test) and post prandial glucose(PPG) of normal and streptozotocin(STZ) induced sub, mild and severely diabetic rats.<sup>[20]</sup> It also found anti-diabetic activity on glucose tolerance in Goto-Kakizaki and wistar rats.<sup>[21]</sup> Methanolic extract of *Moringa oleifera* exhibited significant antidiabetic activity.<sup>[22]</sup>

**III. Anti-inflammatory:** Hydroalcoholic extract of seeds and flower shown anti-inflammatory activity in invivo studies on male Wistar rat.<sup>[23, 24]</sup> High anti-inflammatory doses of indomethacin have been found to interfere with the synthesis of proteoglycans by chondrocytes, transmembrane ion fluxes, and cell binding. It also has the ability to unmask T-cell suppressor activity that may lead to a reduction in the rheumatoid factor.<sup>[25]</sup>

**IV. Anti-oxidant:** The extracts of *Moringa oleifera* both mature and tender leaves have potent antioxidant activity against free radicals, prevent oxidative damage to major biomolecules and afford significant protection against oxidative damage.<sup>[26]</sup> Methanolic extracts from *Moringa oleifera* leaves exhibit antioxidant activity.<sup>[27]</sup> Bajpai et al reported that this antioxidant activity of *Moringa oleifera* is due to presence of kaemferol.<sup>[19]</sup>

**V. Anti-cancer:** The biochemical basis of the chemopreventive potency of *Moringa oleifera*, Lam extract represents a promising chemopreventive strategy as a bifunctional inducer, along with the enhancement of antioxidant system enzymes which affords protection against cellular damage and inhibits tumor promotion.<sup>[28]</sup>

**VI. Hepatoprotective:** Ethanolic extract of leaves and alcoholic extract of seeds of *Moringa oleifera* has shown hepatoprotective activity in pyrizinamide, isoniazid induced liver damage and diclofenac induced toxicity in rat.<sup>[19]</sup>

**VII. Anti-asthmatic:** Alcoholic extract of *Moringa oleifera* seed kernel on various models of bronchial asthma has shown appreciable decrease in severity of symptoms of asthma and also simultaneous improvement in respiratory functions and as useful drug for bronchial

asthma and it was found that seed kernels have potential anti-asthmatic activity that may be due to its bronchodilator.<sup>[29, 30]</sup>

**VIII. Diuretic:** Hot water infusion of seed, root, flower, leaves and bark of *Moringa oleifera* shows increased urine output in rats.<sup>[19]</sup>

**IX. Wound healing:** Aqueous extract of leaves of *M. oleifera* was investigated and rationalized for its wound healing activity and it was concluded that the aqueous extract of moringa leaves has significant wound healing property. The healing of wounds in case of rats treated with ethyl extract was found to be quicker than the control, which was also comparable with standard.<sup>[31, 32]</sup>

**X. Antiulcer activity:** The effect of aqueous extract of *Moringa oleifera* leaf was found reduction of characteristics lesions induced by indomethacin compared to untreated control group in dose dependent manner.<sup>[33]</sup>

#### Future Prospects

From the above mentioned nutritional value proves that *Moringa oleifera* leaves are a better nutraceutical. Its Pharmacological properties justifies it a true Miracle tree. More research are being continued on humans so that a drug with multifarious effects will be available in the future market. Since it has high nutritional and pharmacological properties, developing countries could easily fight against the problems of malnutrition, diseases, hunger and poverty. For future prospective, moringa can be included in routine diet to get its maximum benefits and to avoid several nutritional deficiencies as well as improve the immunity.

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