

A Review on Moringa Oleifera: A Miracle Tree

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ABSTRACT

Moringa oleifera, commonly known as the "miracle tree," is a highly nutritious plant native to South Asia, recognized for its diverse applications in traditional medicine and nutrition. This review highlights the taxonomic classification, nutritional composition, and therapeutic uses of *M. oleifera*. The plant is rich in essential nutrients, including proteins, vitamins, and minerals, and contains potent antioxidants such as flavonoids and phenolics. Moringa has been extensively studied for its health benefits, including anti-hyperglycemic, anti-inflammatory, anti-cancer, and antimicrobial properties. Traditional Ayurvedic texts document its use for various ailments, reinforcing its significance in herbal medicine. The growing body of scientific evidence supports Moringa's role as a valuable dietary supplement and therapeutic agent, underscoring its potential in promoting health and managing chronic diseases.

INTRODUCTION

Moringa oleifera (*M. oleifera*), the "miracle tree", thrives globally in almost all tropical and subtropical regions, but it is believed to be native to Afghanistan, Bangladesh, India, and Pakistan. (1,2). It is also known as the drumstick tree based on the appearance of its immature seed pods, the horse radish tree based on the taste of ground root preparations, and the ben oil tree from seed-derived oils (3).

The Moringa family comprises 13 species (*M. oleifera*, *M. arborea*, *M. rivae*, *M. ruspoliana*, *M. drouhardii*, *M. hildebrandtii*, *M. concanensis*, *M. borziana*, *M. longituba*, *M. pygmaea*, *M. ovalifolia*, *M. peregrina*, *M. stenopetala*), of which *M. oleifera* has become well known for its use in nutrition, biogas production, fertilizer, etc., (4,5).

In the last few decades there has been an exponential growth in the field of herbal medicine (6). Herbal drugs constitute a major share of all the officially recognized systems of health in India viz. Ayurveda, Yoga, Unani, Siddha, Homeopathy and Naturopathy, except allopathy. More than 70% of India's 1.1 billion populations still use these non-allopathic systems of medicine (7).

Seeds, leaves, oil, sap, bark, roots, and flowers are widely used in traditional medicine (8). Nearly all parts of the tree are used for their essential nutrients. *M. oleifera* leaves have a high content of beta-carotene, minerals, calcium, and potassium (9). Moringa leaves have been characterized to contain a desirable nutritional balance, containing vitamins, minerals, amino acids, and fatty acids (8).

The powdered leaves are used to make many beverages, of which "Zija" is the most popular in India (10). The bark of the tree is considered very useful in the treatment of different

disorders such as ulcers (11), toothache (12), and hypertension [13]. Roots, however, are found to have a role in the treatment of toothache [12], helminthiasis [14] and paralysis [15]. Moringa has commonly been found to be used in various health care products including body and hair moisturisers and conditioners.



Figure 1: Figure Of Moringa Oleifera (16)

Table 1: Phytoconstituents of Moringa and their relevant therapeutic effects

Plant Part	Compound	Class	Therapeutic Activity	References
Leaves	Rutin (555.6 µg/g)	Flavonoid	Found to have maximum affinity and interaction towards BRAC-1 gene.	[17,18]
Leaves	Kaempferol (197.6 g/g)	Flavonoid	Oxidative damage protective activity	[19]
Leaves	Gallicacid (1.034mg/g)	Phenol	Anti-inflammatory, anti-neoplastic, antioxidant	[20,21]
Seeds	Myricetin (5.804mg/g)	Flavonoid	Potential prevention of diabetes mellitus and other diabetic complications	[20]
Seeds	Myristic acid	Fatty acids	Anxiolytic effect, used in membrane localization of the enzyme.	[21,22]
Flower	D-mannose	Carbohydrate	Treatment of deficiency caused by genetic defects and acute urinary tract infections	[23]
Stem	β-sitosterol	Phytosterol	Antioxidant, cardiovascular, immunomodulatory.	[24]

Taxonomic Classification

Kingdom - Plantae
Sub kingdom - Tracheobionta
Super Division – Spermatophyta
Division – Magnoliophyta
Class – Magnoliopsida
Subclass - Dilleniidae
Order - Capparales
Family – Moringaceae
Genus – Moringa

Species – Oleifera

Botanical Description

Synonyms Latin - Moringa oleifera

Sanskrit - Subhanjana

Hindi - Saguna, Sainjna

Gujarati - Suragavo

Tamil - Morigkai

Telugu - Mulaga, Munaga

Malayalam - Murinna, Sigru

Punjabi - Sainjna, Soanjna

Unani - Sahajan

Ayurvedic - Akshiva, Haritashaaka, Raktaka, Tikshnagandhaa

Arabian - Rawag French - Moringe à graine ailée, Morungue

Spanish - Ángela, Ben, Moringa

Portuguese - Moringa, Moringueiro

Chinese - La ken

English - Drumstick tree, Horseradish tree, Ben tree

Chemical Analysis of Moringa oleifera

Moringa oleifera leaves contained 27.2% protein, 5.9% moisture, 17.1% fat, and 38.6% carbohydrates [25]. Moringa oleifera seeds contained 34.80% ether extract, 31.65% protein, 7.54% fiber, 8.90% moisture, and 6.53% ash contents [26].

Table 2: Chemical compositions and gross energy (GE; on dry matter basis) of different fractions of Moringa oleifera (27)

Parts/Fractions	Dry matter g/kg						GE MJ/KG
	Crude protein	Lipid	Ash	NDF	ADF	ADL	
Leaves	264	ND	88.7	151	92	11	19.35
Twigs	72	ND	93.0	564	515	83	18.52
Stems	62	ND	69.0	684	609	110	18.95
Shells	99	22	22.7	842	805	452	21.62
Kernels	367	417	31.8	48	39	14	26.68
Meal (fat-free kernels)	614	Nil	56.5	82	67	25	19.39
Extracted kernels	353	538	23.0	61	50	18	31.21
Extracted meal	703	Nil	45.0	145	120	44	20.30

ND: not determined; **NDF:** neutral detergent fiber; **ADF:** acid detergent fiber; **ADL:** acid detergent ligning.

Table 3: Uses of Moringa oleifera listed in Ayurvedic medicinal textbook

Name of Ayurvedic Text	Form of Plant Used	Treatment	References
Charaka Samhita (1000 BC- 4th Cent. AD)	Powder decoction	Used for treatment of worms and headache, Ascites, oedema Hiccough and asthma, deafness, tinnitus in the ear, worm's manifestation	[28]
Ashtanga Hridaya (7th Cent. AD)	Oil	Earache, deafness, and tinnitus in the ear	[29]
Kashyapa Samhita (6–7th Cent AD)	Decoction Oil	Puerperal disorder, sleeplessness Edema	[30]
Sharangadhara Samhita (13 Cent. AD)	Decoction	Conjunctivitis	[31]
Yogaratakara (17th Cent. A.D.)	Decoction	Enlargement of spleen, wormedema, Ascites, fever, abscess.	[32]

Nutritional Composition

Moringa was found to contain many essential nutrients, for instance, vitamins, amino acids, beta – carotene, antioxidant, anti-inflammatory nutrients and 3 and 6 omega fatty acids [33]. Nutrition content of a plant plays an essential function in medicinal, nutritional, and therapeutic properties [34].

It is believed that Moringa leave to consist high source of vitamin C, beta-carotene, potassium as well as protein. It works as an effective source of natural antioxidants. Due to the presence of several sorts of antioxidant compounds such as flavonoids, carotenoids and phenolics (35).

It is rare for a single plant to contain many essential nutrients and furthermore in high quantities. However, the Moringa on its own was reported to have a higher content of different nutrients compared to those found individually in several different types of food and vegetables (36) (figure 2). In addition, the Moringa was found to have a group of unique compounds containing sugar and rhamnose, which are uncommon sugar-modified glucosinolates (38).



Figure 2: Nutrient Chart of Moringa Oleifera (37)

USES OF MORINGA OLEIFERA

Anti Hyperglycemic Activity of Moringa

Diabetes Mellitus (DM) is a chronic metabolic disorder. F hyperglycemia and glucose tolerance impairment (39). Moringa oleifera is well known for its pharmacological actions and is used for the traditional treatment of diabetes mellitus (40).

The hypo-glycemic activity of Moringa oleifera, with significant blood glucose lowering activities has been confirmed (41). Methanol extract of its dried fruit powder produced N-benzyl thiocarbamates, N-benzyl carbamates, benzyl nitriles and benzyl which prove to trigger insulin release significantly from the rodent's pancreatic beta cells and have cyclooxygenase enzyme and lipid per oxidation inhibitory activities (42).

Hypo-glycemic and anti-hyper-glycemic activity of the leaves of Moringa oleifera may be probably due to the presence of terpenoids, which appears to be involved in the stimulation of beta cells and the subsequent secretion of preformed insulin (43).

Anti Fibrotic/Ulcer Activity

Major contributors to the treatment of liver fibrosis discovered to date are natural drugs. Constant efforts and studies on these natural drugs to treat liver fibrosis are being carried out in search for effective anti-fibrotic agents. It was recently discovered that the moringa oleifera seeds extract exhibited anti-fibrotic effect on liver fibrosis in rats (44).

It showed significant against CCL4- induced liver fibrosis in rats which was confirmed by histological finding as well as biochemical analysis of a marker of collagen deposition in liver known as hydroxyproline [44].

Anti-inflammatory Activity

A significant anti-inflammatory effect was observed in different parts of M. oleifera (leaf, pods, flowers, and roots). Active compounds such as tannins, phenols, alkaloids, flavanoids, carotenoids-sitosterol, vanillin and moringin have anti-inflammatory properties [45]. The M.oleifera fruit extract blocked nuclear factor kappa B (NF B) translocation, and the

chloroform extract was found to be cytotoxic at high concentrations (500–1000 g/mL). *M. oleifera* leaves extract was used in mice for treating atopic dermatitis in human keratinocytes and was found to be effective in reducing the expression of mannose receptor mRNA, thymic stromal lymphopoietin, and retinoic acid-related orphan receptor T in ear tissues [46].

Anti-Fertility Activity

The various parts of the plant possess fertility and abortion-inducing properties. The aqueous extract at a 200 and 400 mg/kg dose has been found to be more abortifacient and anti-fertility effects. Recent studies on hot and cold extracts of leaves of *M. oleifera* propose that ingestion of *Moringa* before, after, and during pregnancy may lead to adverse fetal developmental outcomes by causing rigorous contraction of the uterine wall [47]

Anti-Allergic Activity

The ethanolic seeds extract reduced histamine release and suppressed the anaphylaxis induced by anti-immunoglobulin G. The mechanism underlying this effect may be the membrane-stabilizing potential of mast cells in a noval albumin sensitization model[45].

Anti-Cancer Activity of *Moringa Oleifera*

Cancer is a common disease and one in seven deaths is attributed due to improper medication. Around 2.4 million cases are prevalent in India, while there are no specific reasons for cancer to develop. Several factors like smoking, lack of exercise and radiation exposure can lead to the disease [48].

M. oleifera can be used as an anti-cancer agent as it is natural, reliable and safe, at established concentrations. Studies have shown that moringa can be used as an anti-neoproliferative agent, thereby inhibiting the growth of cancer cells. Soluble and solvent extracts of leaves have been proven effective as anticancer agents. Furthermore, research papers suggest that the anti-proliferative effect of cancer may be due to its ability to induce reactive oxygen species in the cancer cells. Research shows that the reactive oxygen species induced in the cells leads to apoptosis [49,50,51].

Other Diseases

Moringa is prescribed by herbal practitioners for patients with AIDS. *Moringa* is suggested to be included in the diet, with the view of boosting the immune system of HIV positive individuals. However, more research is essential to validate the effect of moringa on anti-retroviral drugs [52].

The hydro-alcoholic extract of moringa flowers reduced the levels of rheumatoid factor, TNF-alpha and IL-1 in arthritic rats. This proves that moringa can be a potent therapy for arthritis [53].

Microbial diseases are widespread and there is a need for antimicrobial agents, *M. oleifera* has been proven as a good antimicrobial agent [54]. A study by Viera et al. [55] has shown that the extracts of *M. oleifera* can act against bacteria like *Bacillus subtilis*, *Staphylococcus aureus* and *Vibrio cholera*. The antibacterial effects of the seeds were accounted for by the presence of pterygospermin, moringine and benzyl isothiocyanate [56].

M.oleifera is used to treat dementia, as it has been shown to be a promoter of improving cholinergic function and memory [57]. Adeyemi et al. [58] showed that moringa in diet of rats, can increase protein content and decrease levels of urea and creatinine in blood, preventing renal dysfunction. Moringa decreased acidity in gastric ulcers by a percentage of 86.15% and 85.13% at doses of 500 mg and 350 mg, respectively and therefore can be used as an antiulcer agent [59].

Table 4: Nutritional compositions and medicinal uses of different parts of Moringa

Part of tree	Medicinal uses	Nutritive properties	Suggestion	References
Leaves	Moringa leaves treat asthma, hyperglycaemia, Dyslipidaemia, flu, heart burn, syphilis, malaria, pneumonia, diarrhoea, headaches, scurvy, skin diseases, bronchitis, eye and ear infections. Also reduces, blood pressure and cholesterol and acts as an anticancer, antimicrobial, Antioxidant, antidiabetic and anti-atherosclerotic agents, neuroprotectant.	Moringa leaves contain fiber, fat proteins and minerals like Ca, Mg, P, K, Cu, Fe, and S. Vitamins like Vitamin A (Beta-carotene), vitamin B-choline, vitamin B1-thiamine, riboflavin, nicotinic acid and ascorbic acid are present. Various amino acids like Arg, His, Lys, Trp, Phe, Thr, Leu, Met, Ile, Val are present. Phytochemicals like tannins, sterols, saponins, terpenoids, phenolics, alkaloids and flavonoids like quercetin, isoquercetin, kaemfericetin, isothiocyanates and glycoside compounds are present.	The presence of flavonoids gives leaves the antidiabetic and antioxidant properties. The isothiocyanates are anticancer agents. Flavonoids like quercetin and others are known for anti-proliferative, anticancer agent. The presence of minerals and vitamins help in boosting the immune system and cure a myriad of diseases.	[60,61,62,63,64,65]
Seeds	Seeds of moringa help in treating hyperthyroidism, Crohn's disease, antiherpes-simplex virus arthritis, rheumatism, gout, cramp, epilepsy and sexually transmitted diseases, can act as antimicrobial and anti-inflammatory agents.	Contains oleic acid (Ben oil), antibiotic called pterygospermin, and fatty acids like Linoleic acid, linolenic acid, behenic acid, Phytochemicals like tannins, saponin, phenolics, phytate, flavanoids, terpenoids and lectins. Apart from these, fats, fiber, proteins, minerals, vitamins like A, B, C and amino acids.	The presence of flavanoids gives its anti-inflammatory property. The antibiotic pterygospermin is responsible for antimicrobial properties. The other phyto-chemicals help in treating various diseases.	[60,66,67,68,69]
Root Bark	Root bark acts as a cardiac stimulant, anti-ulcer and anti-inflammatory agent	Alkaloids like morphine, moriginine, minerals like calcium, magnesium and sodium.	The alkaloid helps the bark to be antiulcer, a cardiac stimulant and helps to relax the muscles.	[70,71]
Flower	Moringa flowers act as hypocholesterolemic, anti-arthritis agents can cure urinary problems and cold.	It contains calcium and potassium and amino acids. They also contain necta.	The presence of nectar makes them viable for use by beekeepers.	[62,68]
Pods	Moringa pods treat diarrhea, liver and spleen	Rich in fiber, lipids, non-structural carbohydrates,	The presence of PUFA in the pods can	[62]

	problems, and joint pain.	protein and ash. Fatty acids like oleic acid, linoleic acid, palmitic acid and linolenic acid are also present.	be used in the diet of obese.	
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