

Review Article

Human consumption, nutritional value and health benefits of Moringa (*Moringa oleifera* Lam.): a review

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ABSTRACT

Moringa is an expeditious-growing evergreen perennial plant and has wide adaptability to grow in different environmental conditions. The nutritive value and medicinal benefits of its leaves, flowers, pods, roots, and stem barks are established by philanthropic research. Edible parts are rich in protein, vitamins, minerals, antioxidants, and other chemical compounds with medicinal properties. The pods and leaves are mainly used as vegetables and ingredients in soups and curries. It is used to boost the nutritional value of food, as well as to boost the immune system and antioxidant levels, lower blood sugar levels and maintain inflammation. Moreover, Moringa leaves flavonoid amelioration of total antioxidant capacity in the lens. Its leaves, pods, and leaf powder contain a high proportion of Vitamin A, which can help to prevent night blindness and eye problems in children.

Keywords: Drumstick, Food values, Medicinal uses, Antioxidants

INTRODUCTION

Continuous population growth has increased the food demand as well as increased the alternative sources of food to meet the nutritional needs.¹ Moringa (*Moringa oleifera* Lam.) is one of the most delicious food in the world and is also used for human consumption and medical purposes.² This plant is the most widely cultivated species of a monogeneric family, the Moringaceae, which is native to the sub-Himalayan tracts of India, Pakistan, Bangladesh, and Afghanistan.³ Leaves and pods of Moringa are rich in protein, vitamins, minerals, and antioxidants and have tremendous sources of nutrition security and income generation but often seem to be underutilized. Moringa is widely cultivated for the diversified use of its pods and

green leaves as vegetables and medicine. It is considered a good source of food supplement, due to its high protein content with a prominent source of nutrients and antioxidants.⁴ Leaves and pods are used as a substitute in soups, lentils, and other preparations in Southeast Asia. Still, there is an information gap in the potential uses of Moringa as a food supplement and food fortification. It has enormous potential uses but is very less explored.⁵ Antioxidants play an important role in inhibiting and scavenging free radicals, thus protecting humans against infections and degenerative diseases.⁶ In 2010, there were around 32 million blind people and 191 million with poor vision. One in three blind people suffered from cataracts.⁷ Identifying modifiable risk factors for cataracts is imperative and may avail to establishing preventive

measures.⁸ Medicinal plants are being utilized in the management of sundry ocular perceiver ailments from antediluvian times. Medicinal plants are utilized in case of cataracts, ocular perceiver infections, conjunctivitis, ocular perceiver dryness, and other ocular perceiver disorders in many countries.⁸⁻¹¹ This review paper briefly discusses human consumption, alimential values, and the health benefits of Moringa.

METHODS

A Moringa-related review paper has been developed by philanthropist researchers' works and their renowned articles. To collect the research work, authors have searched for three-dimensional papers on human consumption, the nutritional value and the health benefits of Moringa. The information outlined in this review has been accumulated from over fifty works. All the works were extensively reviewed by the authors as group work and they decided to write up such a paper. Most of the works are in the Asian sub-tropical region and are more or less similar to the environmental and ecological patterns of Bangladesh. This review paper tried to establish the benefits of Moringa among the people of Bangladesh as well as abroad.

HUMAN CONSUMPTION

Recent studies suggest that Moringa should be utilized as a purposeful ingredient in the diet.¹² Moringa leaves have various nutrients and minerals that are consumed regularly for good health and well-being.^{13,14} The pods of the Moringa are cooked as a vegetable and used in soups, stews, or curries. The young, cooked pods are tasty, fiberless, and eaten like green beans. The leaves can be eaten as greens, boiled, fried, or in soups and stews. The seeds can be extracted and eaten boiled or fried like peas when they are still green. Seeds are roasted and eaten like peanuts. The root and seeds can be dried and ground for use as a seasoning. Even processed buds and flowers can be eaten in various dishes. Dry flowers are also used as tea. The resin from the trunk of the tree is useful for thickening sauces. Moringa leaves, pods, and seeds are an exceptionally good source of protein, vitamins, calcium, iron, magnesium, zinc, ascorbic acid, flavonoids, phenolics, amino acids, methionine, cystine, and carotenoids. These are used to improve numerous health issues by keeping our bodily organs healthy.^{15,16} Dried leaf powder can be added to any kind of food as a nutritional supplement. Especially in cultures where the staple diet consists mainly of a starchy dish, side dishes are very important for nutrients like proteins, vitamins, and minerals. In this way, moringa can easily be added to such side dishes and can, in this way, easily provide the necessary nutrients and contribute to nutrition security. The leaves and immature pods of Moringa are extensively used as vegetable accompaniments and as health foods in southern India. The leaves are cooked and eaten like spinach or used to prepare soups and salads. It is consumed by pregnant women to enhance breast milk production.¹⁷

Nutrient content varies with preparation method, leaf and pod age, and harvest season. Due to its ten times higher vitamin A content than carrots, seven times vitamin C than oranges, seventeen times calcium than milk, and fifteen times potassium than bananas, it is known as the miracle plant.⁴

NUTRITIONAL VALUES

The leaves, fruits, flowers, and pods of this tree are used as highly nutritive vegetables. Different parts of this plant contain a profile of important minerals and are a good source of protein, vitamins, beta-carotene, amino acids, and various phenolics.¹⁸ All plant parts, especially the leaves and pods of the Moringa tree, are rich in protein, vitamins, minerals, antioxidants, and phytochemicals of nutritional and medicinal value.¹⁹ All parts of Moringa are a good source of nutritionally essential minerals Ca, P, Mn, Zn, and Cr, and the leaves and flowers might be potential sources of Fe supplements for humans and livestock.²⁰ *Moringa oleifera* oil contains a high level of oleic acid (65.00%), palmitic acid (12.31%), linoleic acid (16.00%), palmitoleic acid (2.10%), and stearic acid (5.10%), respectively.²¹ The chemical composition ranged from 19.34% to 22.42% for protein; 1.28% to 4.96% for lipids; 7.62% to 14.60% for ash; and 30.97% to 46.78% for dietary fiber.²² Calcium and potassium are rich in leaves, and the grains are rich in copper. Leaves and seeds also contain high levels of vitamin E and C.¹⁷ The use of flowers could be recommended as an antioxidant supplement due to their high levels of phenols and flavonoids. These values are even higher than the ones observed in leaves, which are currently the most commercialized part of the plant.²³ Leaves contained more than two times as much protein (29–36%) compared to pods (11–15%). Similarly, nutrients including calcium and iron are significantly higher in leaves (2314–3487 ppm and 276–418 ppm, respectively) than in pods (2017–2032 ppm and 61–68 ppm, respectively). Potassium content was found to be higher in both leaves and pods, but pods contained more than four times as much phosphorus (1.5–1.7%) as leaves (0.34–0.38%).²⁴ The ability of moringa to address nutritional deficiencies is based on the abundance of vitamins, minerals, and protein found in the leaves and pods. These include vital nutrients such as beta-carotene, iron, zinc, vitamin C, and all essential amino acids.²⁵ Moringa is rich in macro and micronutrients and other bioactive compounds that are important for the normal regulatory functioning of the body, developing the immune system and preventing certain diseases.⁵ Mechanically dried leaf powder is a good-quality natural food product with potential industrial prospects for Bangladesh. There is a certain amount of calcium is found (2 g 100 g⁻¹), with a considerable amount of magnesium (0.368 g 100 g⁻¹) and beta-carotene (50269.29 µg 100g⁻¹).¹² The use of the powdered form of Moringa leaves has increased in non-native countries because of its high nutritional properties.²⁶ It is now used to fight against malnutrition in children and nursing mothers as well.²⁷ Moringa leaves have more protein than peas and more iron than spinach.²⁸ Moringa is

recognized as an excellent source of phytochemicals with potential applications in functional and medicinal food preparations due to its nutritional and medicinal properties.²⁹ It contains a rich source of vitamin A, vitamin C, and milk protein. Different types of active phytoconstituents like alkaloids, protein, quinine, saponins, flavonoids, tannin, steroids, glycosides, fixed oil, and fats are present.³⁰ Glutathione (GSH) plays a leading role in preserving lens pellucidity. It also acts as an antioxidant and stabilizes proteins in minimized form.^{31,32} Moringa preparations have potential antihypertensive, anti-inflammatory, hypolipidemic, and anti-diabetic properties.³³

MEDICAL USE

Evidence recognizes that Moringa has been used as a traditional medicine in numerous Indian sub-continents since the 18th century. Several studies also stated that there are so many medicinal properties in various parts of the Moringa tree. Plant roots, leaves, bark, gum, leaves, flowers, seeds, and fruits are used for various ailments in the indigenous medicine of South Asia.⁴ Leaves, flowers, seeds, and almost all parts of this tree are edible and have immense therapeutic properties, including antidiabetic, anticancer, antiulcer, antimicrobial, and antioxidant properties.⁵ In addition, it helps to increase the antioxidant level, reduce the blood sugar level and sustain inflammation.³⁴⁻³⁶ This plant is widely used as a nutritional herb and contains valuable pharmacological actions like anti-asthmatic, anti-diabetic, hepatoprotective, anti-inflammatory, anti-fertility, anti-cancer, antimicrobial, antioxidant, cardiovascular, anti-ulcer, central nervous system (CNS) activity, anti-allergic, wound healing, analgesic, and antipyretic activity.³⁰ Moringa oil has a content of 72% oleic acid and is used in cosmetic products

to increase the health and strength of hair and skin.³⁷ Used to treat diseases such as hypertension, diabetes, anaemia, fertility problems, neurodegenerative, liver, and kidney diseases as well as skin disorders and cancer.³⁸ Various parts of this plant, such as the leaves, roots, seeds, bark, fruit, flowers, and immature pods, have been used since ancient times. It is used as it is extremely rich in vital nutrients and medicinal value, and is known to heal and cure many diseases.³⁹ Moringa leaves flavonoid improvement of total antioxidant capacity in the lens, prevention of protein oxidation, and lipid peroxidation.³ Vitamin A deficiency causes impaired dark adaptation and night blindness. Eating Moringa leaves, pods, and leaf powder, which contain a high proportion of vitamin A, can help to prevent night blindness and eye problems in children. Ingesting its leaves with oil helps in fulfilling Vitamin A requirements and perhaps delays the onset of cataracts. Also, the juice can be instilled into the eyes in cases of conjunctivitis.⁴⁰ The most prevalent symptoms of cataracts are impaired vision, decremented contrast sensitivity, color perturbation, and glare. Evidence also shows that ingredients of these plants are used for cataract management in the traditional systems of medicine like ayurveda, traditional Chinese medicine, and Korean traditional medicine. Natural compounds consisting of antioxidant or anti-inflammatory secondary metabolites can serve as potential leads for anti-cataract agents.⁸ Treatment with *Moringa oleifera* efficaciously retarded the prognosis of disease due to an increment in antioxidant enzymes.^{32,41,43} *Moringa oleifera* showed promising in vitro activity against glucose cataracts in an isolated goat lens model, but further studies are required to access the utilization of *Moringa oleifera* in humans for the obviation of cataracts.⁴⁴ Moringa may be serviceable in averting diabetes-induced retinal dysfunction.⁴⁵ An overview is given of some medicinal uses of the different parts of Moringa in Table 1.

Table 1: Common medicinal uses of the different parts of Moringa.

Parts	Medicinal uses
Seed	Seed extract exerts its protective effect by decreasing liver lipid peroxides. The antihypertensive compounds thiocarbamate and isothiocyanate glycosides have been isolated from the acetate phase of the ethanolic extract of Moringa pods. Moringa oil is extracted from seeds, and seeds contain around 35-40% oil. The healing properties of the oil are well known. ¹⁴ The pods have a potential role in the treatment of diarrhoea, liver and spleen problems, and joint pain. ⁴⁶
Leaf	The fresh leaf juice and aqueous extract of seeds inhibited the growth of <i>Pseudomonas aeruginosa</i> and <i>Staphylococcus aureus</i> . ⁴⁷ Applied as a poultice to sores, rubbed on the temples for headaches, and used for piles, fevers, sore throats, bronchitis, eye and ear infections, scurvy, and catarrh. Leaf juice is believed to control glucose levels and is applied to reduce glandular swelling. ¹⁴ The seed extract exhibited significant antibacterial activity against the pyoderma (skin infection with pus) causing bacterium, <i>S. aureus</i> in experimental mice. ⁴⁸
Root	Moringa roots have antibacterial activity 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. ⁴⁹ It is used as a cardiac stimulant, anti-ulcer, and anti-inflammatory agent. ^{50,51}
Flower	It has high medicinal values as a stimulant, aphrodisiac, abortifacient, and cholagogue, used to cure inflammations, muscle diseases, hysteria, tumors, and enlargement of the spleen; lower the serum cholesterol, phospholipid, triglyceride, VLDL, LDL cholesterol to phospholipid ratio, and atherogenic index; decrease the lipid profile of the liver, heart, and aorta in hypercholesterolaemic rabbits; and increase the excretion of faecal

Continued.

Parts	Medicinal uses
	cholesterol. ¹⁴ used as hypocholesterolemic and antiarthritic agents and can cure urinary problems and common colds. ⁵²
Stem bark	Rubefacients and vesicants are used to cure eye diseases and for the treatment of delirious patients, to prevent enlargement of the spleen and the formation of tuberculous glands in the neck, to destroy tumors and heal ulcers. The juice from the root bark is put into ears to relieve earaches and is also placed in a tooth cavity as a pain killer and has anti-tubercular activity. ¹⁴ Stem extract alleviates oxidative stress-induced cataract formation, and the mechanism of the effect is mainly related to its amelioration of the endogenous antioxidant system in the lens. ⁵³

CONCLUSION

The nutritive value and medicinal benefits of Moringa leaves, flowers, pods, roots, and stem barks are prominent. The pods and leaves are mainly utilized as vegetables and supplements. Edible components are opulent in protein, vitamins, minerals, antioxidants, and other chemical compounds with medicinal values. Most of the components of the plant Moringa contain a high proportion of Vitamin A, which can be used to avert night optical incapacitation and ocular perceiver quandaries in children.

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