

A REVIEW

Nutraceutical potential of *Moringa oleifera*

■ Babita Yadav

SUMMARY

Northern India, south of the Himalayas, is inhabited to the largest habitat of *M. oleifera*, a tropical deciduous tree that belongs to the *Moringa* family. *M. oleifera* includes a variety of nutrients, including protein, vitamin A, minerals, essential amino acids, flavonoids, and isothiocyanates. Extracts of *M. oleifera* have a number of health benefits, including anti-inflammatory, antioxidant, anti-carcinogenic, hepatoprotective, neuroprotective, hypoglycemic, and lipid-lowering properties. The health advantages of *M. oleifera* are due to its phytochemicals, including flavonoids and isothiocyanates. This article is a review that concluded studies on *M. oleifera*'s bioactivity and pharmacological processes in the prevention and treatment of chronic illnesses. These disorders include inflammatory diseases, neuro-dysfunctional diseases, diabetes, and cancer. Studies on *Moringa oleifera* are summarized in this review, focusing on taxonomy, cultivation, nutritional characteristics, medical applications and value-added products.

Key Words : *Moringa oleifera*, Nutrient composition, Medicinal values, Antioxidants, Flavonoids

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Kmony *et al.* (2016) studied that *Moringa oleifera* arborea is native to Kenya. *Moringa oleifera* pygmaea, which is native to Somalia; *Moringa oleifera* borziana, which is native to both Somalia and Kenya; *Moringa oleifera* rivalins, which is native to Kenya and Ethiopia; *Moringa oleifera* longitude, which is native to Kenya, Ethiopia and Somalia; *Moringa oleifera* stenopetala, which is native to Kenya and Ethiopia and *Moringa oleifera* ruspoliana, it has been introduced from India, Pakistan, Afghanistan, Bangladesh, Sri Lanka, Southeast Asia, West Asia, the Arabian Peninsula, East and West Africa, southern

Florida, throughout the West Indies and Mexico, among other regions. for Peru, Paraguay and Brazil (Leone *et al.*, 2015 and Fidrianny *et al.*, 2021). It has become naturalized along roadsides on the coastal plains and lower slopes of Puerto Rico. It was initially cultivated mainly for its ornamental value and as a component of fences and hedges. Annual temperature variation is quite high in its natural habitat, with minimum and maximum shade temperatures between “1 to 3°C and 38 to 48°C during the coldest and warmest months, respectively. The average annual rainfall here varies between 750 and 2200 millimetres. Although such places have the most potential for irrigation or are distinguished by a high water table, farmers in the semi-arid and arid regions of India, Pakistan, Afghanistan, Saudi Arabia and East Africa cultivate reseda because of its exceptional

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resistance to drought. These areas receive annual rainfall as low as 300 mm. In some places in Puerto Rico with annual rainfall between 1,000 and 1,800 millimeters (Leone *et al.*, 2015), the Reseda plant has begun to establish a naturalized population. *Moringa oleifera* is a tree that changes its leaves throughout the year and grows very quickly. The tree can grow to a height of 10–12 m (32–40 ft) and its trunk can be as wide as 45 cm (1.5 ft). The bark is of a whitish-grey colour encased in a thick layer of cork around it. Young shoots have a scaly bark that is either purplish or greenish-white. The tree has a flexible crown composed of pendulous, delicate branches and its leaves form fluffy foliage consisting of tripinnate leaves (Kmony *et al.*, 2016). In today's society, people of all ages and backgrounds are often exposed to varying degrees of one or more types of stressors in various contexts. Because they belong to the ideology that "prevention is better than cure," members of the current generation seek for biomolecules derived from plants with the purpose of improving both their health and their general wellbeing. This desire results from rising levels of consumer knowledge and a phobia of contemporary therapies based on chemical ingredients (Samanta *et al.*, 2015 and Jahan *et al.*, 2019). In addition to containing the necessary minerals, the plant components of *Moringa oleifera* are loaded with phytochemicals. *Moringa oleifera* is a member of the Moringaceae family. These phytochemicals are useful against a wide range of human ailments, such as diarrhoea, diabetes, fever, dysentery, hepatitis, bronchitis, hypertension, cancer, epilepsy, colitis, the common cold, anaemia, ulcers or external sores, headache, dental caries, arthritis and so on, It is crucial to bring attention to the fact that the medical properties of *Moringa oleifera* have been referenced in ancient Ayurvedic literature, such as the Charak Samhita (Sandeep *et al.*, 2019 and Ali *et al.*, 2022).

Taxonomic classification and cultivation :

M. oleifera is a species that originated in India but has since discovered its way to a large number of other tropical and subtropical countries, where it has become naturalised. It is presently being produced for a variety of purposes, including consumption by people, utilisation as feed for animals and aquaculture, and application in industrial settings. The following is the taxonomic classification of the species *M. oleifera*, as described by Ali *et al.*, 2022

Domain	:	Eukaryota
Kingdom	:	Plantae
Phylum	:	Spermatophyta
Subphylum	:	Angiospermae
Class	:	Dicotyledonae
Order	:	Capparidales
Family	:	Moringa oleiferaceae
Genus	:	<i>Moringa</i>
Species	:	<i>Oleifera</i>

In accordance with the standards established by the Angiosperm Phylogeny Group IV (APGIV), the family *Moringa oleiferaceae* is now considered to be a part of the order Brassicales as individual members of the genus. Those certain members of this order include radishes and cabbages. The *M. oleifera* tree is a type of softwood tree that is resistant to drought and proliferates. It is most commonly found in countries that are located in the subtropics and semi-arid parts of the tropics. It may be multiplied by transplanting, direct sowing and stem cuttings because these methods can be used individually (Leone *et al.*, 2016). Because it has decreased requirements for fertilisers, water and other management approaches, the production of *Moringa oleifera* is popular among a wide variety of different types of farmers. This is especially true in more developed countries. It is believed to be cultivated in places with an altitude of upto 1000 metres and an annual rainfall range of 750 to 2250 millimetres. *M. oleifera* cannot survive in environments with frost or standing water, even though it can grow in soil with a pH ranging from 4.5 to 8.0. *M. oleifera* is sensitive to both elements (Hsu *et al.*, 2006). It may reach a height of 12 metres and have a diameter of around 60 centimetres at its most significant point (Orwa *et al.*, 2009). The leaves have an unusual bipinnate morphology and an alternating arrangement.

It is a compound with three pairs of pinnate leaves, has a triangular shape, and may reach anywhere from 20 to 70 centimetres in length. The flowers may grow to 12 millimetres and can be either wholly white or creamy white. The *Moringa oleifera* fruit, which looks like a trilobite capsule, can be 20 to 60 centimetres long, depending on the variety. The fruits are ready to be plucked around three months after the flowers have finished blooming on the plant. The pods take on a brown colour once they have reached full maturity and are ready to be harvested. Each *Moringa oleifera* pod can contain anywhere from 12 to 35 seeds, weighing an average of

0.3 milligrammes each. Each year, a single *Moringa oleifera* tree can yield anywhere from 15,000 to 25,000 sources when picked for its fruit (Chirania *et al.*, 2022). In addition, the tree has significant and considerable potential to improve people's standard of living (Daba, 2016 and Villafuerte and Villafurte-Abonal, 2009).

The *Moringa oleifera* tree : Uses throughout history:

The individuals who inhabited during the time of the Indus Valley Civilization (3300–1700 BC) were selecting and growing foods that were high in health-promoting phytonutrients, according to the archaeological data. In addition, Hippocrates, also known as the “Father of Medicine,” stated somewhere between 460 and 370 BCE that one should “let food be thy medicine and medicine be thy food.” Hippocrates emphasised the significance of plant-based therapeutic molecules for health and well-being in addition to the nutritional value of plant foods. It should be no surprise that this substantiates the robust support for food-based herbal medicines that existed in ancient times for “excellent health and well-being,” which is today's Sustainable Development Goal 3 (SDG 3) of the United Nations (Sandeep *et al.*, 2019 and Ali *et al.*, 2022). The second school of thought contends that the first documented usage of medicinal herbs dates back around 60,000 years, more precisely to the Middle Paleolithic period. Wills (2016) found that out of 3,91,000 different vascular plants, *M. oleifera* is the one that has the most significant economic significance (Senthilkumar *et al.*, 2018). In several parts of the world, *Moringa oleifera* leaves and fruits were traditionally included in diets to improve physical and mental healing. Leaf extract was given to troops of the Maurya Empire on the battlefield between 322 and 180 BCE because it was believed to ease pain, reduce tension, and provide more energy. This was because *Moringa oleifera* leaf extract contains several phyto-chemicals. It is said that some of the earliest civilisations in the world- the Greeks, Romans and Egyptians, extracted oil from *Moringa oleifera* seeds to use in cosmetics and fragrances. These cultures include Greece, Rome and Egypt (Senthilkumar *et al.*, 2018).

Distribution and local name :

Moringa oleifera grows in India's sub-Himalayan foothills. Due to its health benefits, the *Moringa oleifera* tree has been planted in tropical and subtropical regions

worldwide, including the Middle East Asia, Africa, America and the Caribbean Islands (Sujatha *et al.*, 2017). The *Moringa oleifera* plant grows in China, the Philippines, Cambodia, Egypt, Mexico, Peru, West Africa, Brazil and the West Indies. India produces the most *Moringa oleifera*, with Andhra Pradesh, Tamil Nadu and Karnataka, contributing 1.1–1.3 million metric tonnes of pods (Koul and Chase, 2015). Africa calls the tree “Nebedaye” because it never dies. Its global spread is due to its better soil and climatic tolerance, propagation, and management. Thus, the *Moringa oleifera* tree has several names in many languages (Ali *et al.*, 2022).

Different kinds of dietary supplements:

Vitamin supplement :

The consumption of dietary supplements can significantly improve micronutrient intake. For instance, some examples of vitamins include vitamins A, D, E, and K (Mali *et al.*, 2022). These are all members of the B vitamin family. thiamin (B1), Biotin (H), folic acid (B9), cyanocobalamin (B12), riboflavin (B2), niacin (B3), pantothenic acid (B5), pyridoxine (B6) etc. Appropriate Daily Value, expressed as a percentage of the supplement; the phrase “recommended daily amount” refers to the quantity that a regulatory organisation specifies (Phil *et al.*, 2022).

Mineral supplement:

Additionally, mineral supplements are frequently chelated or bonded with bioavailable chemicals to enhance the body's ability to absorb them. Twenty-two minerals known to the public are primarily necessary for human health (Mali *et al.*, 2022). They may be broken up into two categories: the primary minerals primary and the body. Calcium, phosphorus, potassium, selenium, manganese, chromium, copper, iodine, iron, magnesium, molybdenum, sodium and zinc are all examples of minerals. Other minerals include sodium and potassium.

Proteins and amino acids in the body :

The human diet consists mainly of fundamental elements known as proteins and amino acids. The primary sources of protein are derived from either minerals or vegetables. Plant-based sources almost always lack one or more of the nine necessary amino acids, whereas animal-based sources always offer all the essential amino acids. The dietary protein that comes from animals has a variety of vitamins and minerals and contains the nutrients that are present in plant protein sources.

Additionally, there is a possibility that the compote has some level of saturated fat.

Natural dietary supplement:

During the first decade of this century, there was a significant spike in the consumption of herbal supplements. Herbal supplements contain plants or herbs (Mali *et al.*, 2022). It can include only one type of herb or a combination of many kinds of herbs. A herb is a plant or a component of a plant. It is claimed that these items can be helpful for a variety of conditions, including disorders of the skin, sexual issues and mental health issues (Dzuvor *et al.*, 2022).

Dietary fibre supplement :

Dietary fibre preparations made from defatted rice bran can decrease cholesterol and have a laxative effect. Both have additional advantages for preventing or mitigating cardio-vascular disease, diabetes, obesity, and colon cancer. It has been reported that rice bran is a rich source of fibre that may be added to various food items. Rice bran can be found (Hamid and Luan, 2000). [Citation needed] *Psyllium* is a kind of dietary fibre beneficial in treating irritable bowel syndrome, an inflammatory bowel illness (Mali *et al.*, 2022).

Probiotic supplement:

In the past few years, probiotics, defined as “living, viable microbial organisms,” has emerged as a potentially life-saving therapeutic strategy for various illnesses. They use oral digestive and probiotics as dietary supplements, which s been linked to red, which is guessing several types of cancer, including breast, colon, rectal, prostate, and bronchogenic cancers (Chirania *et al.*, 2022).

Pharmacological activity:

Antibacterial :

Antibacterial *M. oleifera* seeds, stem bark, leaves, and root bark. *M. oleifera* seed extract contains a water-soluble lectin that inhibits pathogenic bacteria growth, survival, and cell permeability The antibacterial and fungicidal pteridosperm deoxy natamycin is found in the roots of *M. oleifera* *M. oleifera* root bark has antibacterial and antifungal properties due to the chloroform-ethanol fraction-deoxy-natamycin toothpaste aglycon. Stem bark extract kills *S. aureus*. *Staphylococcus aureus* and *Enterococcus faecalis* are inhibited by aqueous and ethanolic *M. oleifera* leaf

extracts. The leaf ethanol extract had the largest mean inhibitory zone against *S. aureus* and Streptococcus compared to the experimental toothpaste from *M. oleifera* vs mouthwash (Kashyap *et al.*, 2022).

Anti-inflammation :

Inflammation aids in the fight against infection. Chronic inflammation causes diabetes, cancer, autoimmune disorders, cardio-vascular disease, sepsis, colitis and arthritis (Kashyap *et al.*, 2022). Through NO and PGE-2 synthesis, IL-1 and TNF stimulate target cell iNOS, COX-2, and mPGES-1 expression or activity. *M. oleifera* reduces TNF-, IL-6, and IL-8 production in LPS- and CSE-stimulated monocyte-derived macrophages (MDM). *M. oleifera* seed hydro-alcoholic extract (MSHE) at 50, 100, and 200 mg/kg improved distal colon indicators and weight loss in acetic acid-induced acute colitis rats. Tissue emphysema, ulceration, mucosal inflammation, crypt damage, invasion, total colitis index, and MPO activity increased in treated groups. It may treat or prevent IBD in acetic acid-induced acute colitis rats(Yu *et al.*, 2022).

Cardioprotective properties:

Moringa oleifera and lovastatin were found to reduce serum cholesterol, phospholipids, triglyceride, VLDL, LDL, cholesterol to phospholipid ratio and atherogenic index, but they were found to increase HDL ratio (HDL/HDL-total cholesterol) in comparison to their respective controls. *Moringa oleifera* also increased HDL ratio (HDL/HDL-total cholesterol (Abdo *et al.*, 2021).

Diuretic properties :

Moringa is used orally to prevent pregnancy, improve the immune system, decrease inflammation, act as an antioxidant, prevent cramps, raise sex desire (as an aphrodisiac), prevent cramps, and promote the production of breast milk. *Moringa* is also administered to treat cramps (Chirania *et al.*, 2022). In addition to this, it is used to boost A number of individuals use it as a nutritional supplement or tonic. In certain cases, it is also referred to as a “water pill” (diuretic) (Abdo *et al.*, 2021).

Hepatoprotective effects :

According to the findings of biochemical and histological tests, *Moringa* was able to lessen the severity

of liver damage and the symptoms of liver fibrosis. The administration of an extract from *Moringa* seed lowered blood aminotransferase activity and globulin levels caused by CCl₄. The *Moringa* medication successfully lowered the elevated levels of the hepatic hydroxyproline content and the myeloperoxidase activity. In addition, immunohisto-chemistry tests demonstrated that *Moringa* significantly decreased the number of cells in the liver that were positive for smooth muscle alpha-actin, as well as the buildup of collagen I and III. The moringa seed extract showed a considerable inhibitory impact on 1,1-diphenyl-2-picrylhydrazyl free radical and a high lowering antioxidant capacity (Hasan *et al.*, 2022).

Antispasmodic, antiulcer properties :

Moringa oleifera roots are antispasmodic. The ethanolic extract and its components have antispasmodic properties, probably via blocking calcium channels (Chirania *et al.*, 2022).

Conclusion :

The recognition that “nutraceuticals” play an important role in improving one’s health has contributed to a recent increase in interest worldwide. Therefore, a “nutraceutical” is any substance that delivers medicinal or health advantages, including the prevention and treatment of illnesses, and that may be regarded as food or part of a meal. A preparation meant to augment one’s diet is a dietary supplement. *Moringa oleifera* is a fascinating plant that harbors many bioactive chemicals inside its tissues. The leaves of *Moringa oleifera* are loaded with a wide variety of beneficial compounds, including polyphenols, phenolic acid vitamins, carotenoids, flavonoids, alkaloids, saponins, isothiocyanates, tannins, glucosinolates. It is possible that the substantial contribution of bioactive chemicals found in *Moringa oleifera* leaves is responsible for their therapeutic qualities. Studies conducted both *in vitro* and *in vivo* on animals have shown substantial evidence that it possesses a wide variety of therapeutic benefits. Because of this, it is important to suggest using the leaves of *Moringa oleifera* as a medicine to prevent or treat diabetes, cardiovascular disease, dyslipidemia, cancer, and infectious disorders. *Moringa oleifera* has physiological and pharmacological impacts on people.

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