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Review Article

## Review on *Moringa oleifera* Plant

Shubham Sharma \*, Ritu Rani , Ajeet Pal Singh, Amar Pal Singh

Department of Pharmaceutics, St. Soldier institute of pharmacy, Lidhran Campus, Behind NIT (R.E.C.), Jalandhar –Amritsar by pass, NH-1, Jalandhar - 144011, Punjab, India

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### \*Address for Correspondence:

Shubham Sharma, Department of Pharmaceutics, St. Soldier institute of pharmacy, Lidhran Campus, Behind NIT (R.E.C.), Jalandhar – Amritsar by pass, NH-1, Jalandhar -144011, Punjab, India

### Abstract

The most extensively grown species of the monogeneric, Moringaceae family, which is native to south Asia, is *Moringa oleifera*, sometimes known as "The Miracle Tree." The medium-sized agroforestry tree *Moringa oleifera* (Moringaceae) is native to south Asia but has now naturalized in many other nations. *Moringa* is also thought to be a treatment for malnutrition. It has several pharmacological characteristics, including antioxidant, hepatoprotective, cardioprotective, anti-inflammatory, anti-diabetic, and anti-cancer effects. It was discovered that every portion of the plant contains bioactive components. To far, over a hundred chemicals, comprising alkaloids, flavonoids, anthraquinones, vitamins, glycosides, and terpenes, have been identified from various sections of *Moringa oleifera*. These leaves have been used for many years in traditional medicine to treat a wide range of illnesses. These leaves have the potential to avert the plague of starvation and associated illnesses due to their potent nutritional content. In this article, we will keep an eye on *Moringa Oleifera* Plant overview.

**Keywords:** *Moringa Oleifera* plant, Miracle Tree, Herb, Drumstick, Herbal Medicine

## INTRODUCTION

In tropical and subtropical countries, *Moringa oleifera* is a highly recognized herb that promotes health.<sup>1</sup> The word "generic root" (Morunga) in Dravidian (Indian language) refers to *M. oleifera* Lam. (syn. *Moringa pterygosperma* Gaerthn, *Moringa moringa* Millsp.). Kelor, Marango, Moonga, Mlonge, Mulangay, Nébédáy, Saijhan, Sajna, or Benzolive are some further regional names. The English names for this tree are West Indian Ben, Horseradish, Drumstick, Never Die, and Radish.<sup>2</sup> Because of ingredients included in its leaves, *Moringa oleifera* is often used for its anti-inflammatory qualities. Poultices made of seed units have been used in India to alleviate glandular irritation. According to many research on extracts of the plant *Moringa oleifera* seed pods, leaves, and seeds conducted on humans and animals along with the toxicity studies that have been looked at thus far, it is advised that they be protected for usage in amounts that are typically utilized.<sup>1</sup> Foliar nutrient (juice extracted from the leaves), green manure (from leaves), animal forage (leaves and treated seepod-cake), biogas (from leaves), blue dye (wood), alley cropping (biomass production for biodiesel and fertilizing), fencing (living trees), and biogas (from leaves) are among the main applications of moringa.<sup>3</sup> There are fourteen more species in the genus *Moringa*, including *Moringa oleifera* Lam (Moringaceae). The sole recognized name for this species, according to "The Plant List" (<http://www.theplantlist.org>), is *M. oleifera*. No synonyms are currently recorded for this name.<sup>4</sup> For many ages, people have utilized a variety of plant species as both traditional medicines and dietary supplements to treat a wide range of illnesses.<sup>2</sup> One of the first treatments for a wide range of

illnesses, herbal therapy has a comparatively high patient base because to its affordability, accessibility, and ability to fit into the sociocultural fabric of the populace. The WHO has declared that the greatest place to get a wide range of medications is from herbal or medicinal plants.<sup>2</sup> The majority of researchers think about employing MO as a substitute for curative care or to alleviate and prevent illness symptoms. Even yet, given these studies, observations, suggestions, and particular claims, Western (conventional) medicine has been incredibly hesitant to explore its nutritional and therapeutic possibilities. Given the widespread recognition of several "super foods," such as green tea and garlic, this cautious attitude seems unexpected.<sup>6</sup> Because all of the plant's portions are rich in proteins, vitamins, minerals, and carotenoids, the moringa plant has found widespread usage in agriculture, medicine, and other sectors.<sup>7</sup> *Moringa* has a long history that begins about 150 B.C. Historical evidence indicates that the use of *Moringa* leaves and fruit contributed to the mental clarity and good skin of ancient kings and queens. On the battlefield, moringa leaf extract was fed to the ancient Indian Maurian soldiers. It was thought that the elixir drink gave them more energy and helped them cope with the stress and suffering of battle.<sup>2</sup> It originated in the north of India and swiftly moved to the south, where two of the most often consumed vegetable varieties are "Murungai keerai" (moringa leaves) and "Murungakaai" (drumsticks). The moringa tree is virtually native to all of Asia, almost all of Africa, South America, a small portion of North America, and a few isolated areas of Europe. The most well-liked and important source of income is consequently oil, which may be obtained from moringa trees. Most of the bioactive phenolic chemicals

that are now accessible are members of the flavonoid group, which includes kaempferol and quercetin.<sup>8</sup> *M. oleifera* is the most widely utilized and researched species due to its pharmacological and phytochemical qualities that are linked to human health. The realization that moringa was a helpful plant led to a rise in popularity for moringa cultivation in the 1990s. Because every part of the Moringa tree has several uses, it is a multipurpose tree.<sup>9</sup> *M. oleifera* is native to the sub-Himalayas of India, but it has spread to many tropical and subtropical areas of the world, including the Caribbean islands, the Philippines, Africa, the Americas, Asia, and the Middle East.<sup>10</sup> The origins of moringa are said to be in Agra and Oudh, in northwest India, just south of the Himalaya Mountains. It is grown throughout the tropics for a variety of applications, including industrial, medical, and dietary purposes.<sup>11</sup> There are thirteen species of the monogeneric Moringaceae family in the genus *Moringa oleifera* worldwide. These include *M. oleifera* (found in North-West India), *M. arborea* (found in Kenya), *M. concanensis*, *M. drouhardii* (found in South-Western Madagascar), *M. stenopetala*, *M. longituba*, *M. ovalifolia*, *M. peregrine*, *M. pygmaea*, *M. borziana*, *M. rivae*, *M. ruspoliana*, and *M. hildebrandtii*.<sup>2,12</sup>



Figure 1: *Moringa Oleifera* Plant

## THE MORINGA OLEIFERA (MIRACLE TREE) PLANT

Other names for *M. oleifera* include horseradish tree, drumstick tree, dandalonbin, Mulangay, Mlonge, Benzolive, Sajna, Kelor, Punjabi, Sujna, Marango, and Saijihan.<sup>4</sup> *M. oleifera* is a member of the following groups: Order: Capparales; Family: Moringaceae; Genus: *Moringa*; Species: *oleifera*; Super division: Spermatophyta; Division: Magnoliophyta; Class: Magnoliopsida; Sub class: Dilleniidae; Order: Plantae.<sup>13</sup> Class Magnoliopsida, division Magnoliophyta, order Capparales, and family Moringaceae include *Moringa oleifera*. There are twelve more species of trees and shrubs in this family. The genus *Moringa* has thirteen species.<sup>3</sup> The little, aesthetically attractive *Moringa oleifera* tree grows quickly and thrives in dry, sandy environments. The long, drumstick-shaped pods that house the seeds of this plant are one of its defining features. It has been demonstrated that moringa can reach a height of 4 meters in its first year of development and can produce fruit in the same year.<sup>14</sup> There are seven known uses for *M. oleifera*: gum, coagulant, food, medicinal, fence, fodder, and fuel. Leafy greens are abundant in protein, minerals, beta-carotene, and

antioxidant compounds—nutrients that are frequently lacking in the diets of underdeveloped nations.<sup>3</sup> Although seeds are black in color, they can sometimes be white in areas where they are not suitable. A reasonable tree can yield between 15,000 and 25,000 seeds annually; reasonable seeds mature in fourteen days or less. A seed's typical weight is 0.3 grams. Trees that are 5–10 meters tall may thrive in scorching, arid regions or humid tropical climates.<sup>1</sup> *M. oleifera* has bisexual, white or milky white blooms. It produces almost spherical pods and seeds.<sup>4</sup> The antioxidant components included in moringa leaves, including flavonoids, ascorbic acid, carotenoids, and phenolics, allow the leaves to keep food that contains lipids fresher for longer.<sup>3</sup> The fact that almost every portion of a tree has some kind of benefit is crucial in regions where people directly depend on trees, food, and animals for their subsistence.<sup>14</sup> MO has many white fragrant zygomorphic blooms, green pinnate leaves, a pliable trunk, and sticky bark.<sup>15</sup> *M. oleifera* grows best at temperatures between 25°C and 35°C. Drought barely affects it, which explains why different types of soil have adapted.<sup>4</sup>

## PHYTOCHEMISTRY

Numerous basic supplements have been found in *Moringa oleifera* for example nutrients, minerals, amino acids,  $\beta$ -carotene, omega 3 and 6 unsaturated fats and cell reinforcements.<sup>1</sup>

The chemical constituents of *M. oleifera*, including those in its leaves, seeds, roots, flowers, gum, barks and fruit pods, have been extensively studied and can be broadly divided into flavonoids, carbamates, glucosinolates, phenols, steroids and carotenoids.<sup>4</sup>

Almost all flavonoids are found in the leaves, with quercetin and kaempferol being the representative compounds. They are mainly in the bound form of glucosides. 36 flavonoids have been isolated from *M. oleifera* and classified as flavonols and isoflavones.<sup>4</sup>

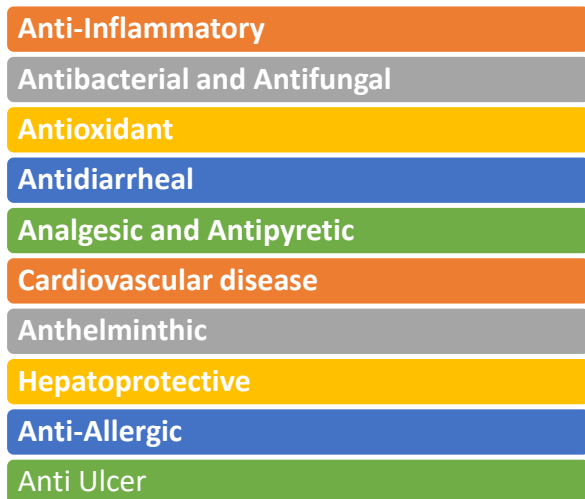
Carbamates are bioactive compounds and are also present in *M. oleifera*. To date, 45 phenols, including their esters and glycosides, have been isolated from the leaves and seeds of *M. oleifera*.  $\beta$ Carotenoids, as a micronutrient, exist in many plants and also play an important role in preventing diseases and improving immunity.<sup>4</sup>

The *Moringa oleifera* leaves are high wellspring of omega 3 and omega 6 polyunsaturated unsaturated fats.<sup>1</sup>

## MEDICINAL USES

The leaves have been used in traditional medicine to treat a variety of conditions, such as diabetes, hypertension, genitourinary disorders, arthritic conditions, typhoid fever, parasite infections, and skin illnesses. Flowers are used to make aphrodisiacs and to cure spleen enlargement, tumors, hysteria, muscular disorders, and inflammations.<sup>3</sup> The leaf, seed, and root extracts of *Moringa Oleifera* have been shown in vitro and in animals to have anticancer, hepatoprotective, hypoglycemic, anti-inflammatory, antibacterial, antifungal, antiviral, and anti-sickling properties. They also help prevent Alzheimer's disease, stomach ulcers, lower cholesterol, and promote wound healing, according to the Memorial Sloan-Kettering Cancer Center website.<sup>16</sup> To make a decoction or extract, barks are cooked in water and then steeped in alcohol. These can be used to treat uterine disorders, impaired vision, joint discomfort, diabetes, anemia, and hypertension, toothaches, hemorrhoids, and stomach illnesses (such as ulcers and assisting in digestion).<sup>3</sup> The plant *M. oleifera* (Moringaceae) exhibited inhibitory activity primarily against a few infectious disease-causing viruses: (A) Human Immunodeficiency Virus (HIV), which causes Acquired Immune Deficiency Syndrome (AIDS) in

humans; (B) Herpes Simplex Virus (HSV), which causes fever blisters or cold sores around the mouth and lips as well as genital infections in human bodies; (C) Hepatitis B Virus (HBV) affects the human liver and results in inflammatory conditions, cirrhosis, and liver cancer; (D) Epstein-Barr Virus (EBV) causing various non-malignant, premalignant, and malignant lymphoproliferative diseases in humans; (E) Foot-and Mouth Disease Virus (FMDV), which causes blisters in humans and some hoofed animals; and (F) Newcastle Disease Virus (NDV), which affects bird species and passable.<sup>17</sup>



**Figure 2: Uses of Moringa Oleifera Plant**

**Anti-Inflammatory Activity:** As the body's defensive reaction to stimuli, inflammation has been linked to metabolic syndrome, cardiovascular disease, and cancer. *M. oleifera* seed extracts have been demonstrated to control the generation of NO, TNF- $\alpha$ , and IL-1 $\beta$  in LPS-stimulated mice macrophages—indices of inflammatory activity.<sup>4</sup> A number of parts of *M. oleifera* (leaves, pods, flowers, and roots) showed a notable anti-inflammatory activity. Anti-inflammatory substances include tannins, phenols, flavonoids, alkaloids, carotenoids,  $\beta$ -sitosterol, vanillin, moringin.<sup>13</sup>

**Antibacterial and Antifungal Activity:** The urinary tract infections produced by both Gram-positive and Gram-negative bacteria, including *Staphylococcus aureus*, *Escherichia coli*, and *Staphylococcus saprophyticus*, may be inhibited by the methanolic leaf extract of *M. oleifera*. Additionally, the juice from Moringa leaves demonstrated promise against harmful germs to humans. In a variety of fungal strains, including *Aspergillus flavus*, *Aspergillus nidulans*, *Rhizoctonia solani*, *Aspergillus niger*, *Aspergillus terreus*, *Aspergillus oryzae*, *Fusarium solani*, *Cladosporium cladosporioides*, *Trichophyton mentagrophytes*, *Penicillium* species, *Penicillium sclerotigenum*, *Pullarium* species. The inhibitory effect of extracts from leaves, seeds, and stems of *M. oleifera* has been identified.<sup>13</sup>

**Antioxidant activity:** The 90% (90: 10 ethanol: water) ethanol-ethanol gradient extract, which is the ideal gradient solvent for *M. oleifera* leaves, was shown to contain the maximum antioxidant activity in *M. oleifera* leaves.<sup>4</sup> It was discovered that the volatile oil produced by distilling the dried *M. oleifera* leaves had antioxidant properties. The ingestion of Moringa seeds has the potential to cure oxidative stress- and inflammation-related cardiovascular disorders, including high blood pressure. The entire antioxidant activity of *M. oleifera* leaves may be attributed to its polyphenols.<sup>4</sup>

**Antidiarrheal Activity:** Three types of phytochemical substances with antidiarrheal effects include tannins, saponins, and flavonoids.<sup>18</sup>

**Hematological Activity:** Women who were pale and had hemoglobin levels that were somewhere in the mean range participated in a randomized, double-blind, placebo-controlled study. After receiving an aqueous extract of moringa leaf in the 8–12 g/dL range, the average corpuscular hemoglobin concentrations rose. The potential of moringa to significantly raise platelet count in human subjects in good health during a 14-day period.<sup>18</sup>

**Analgesic and Antipyretic:** The antipyretic action of ethanol and the source of ethyl acetic acid in seeds was quite strong.<sup>18</sup> Both the leaves and pods are consumed as antipyretics in Thailand.<sup>4</sup>

**Anthelmintic activity:** It is discovered that *M. oleifera* leaves exhibit superior dose-dependent anthelmintic action compared to *Vitex negundo* leaves. Moreover, *M. oleifera*'s anthelmintic action was demonstrated in an in-vitro investigation where the leaf extracts prevented egg embryonation, egg hatching, and caused death in both L1 and L2 larvae of *Haemonchus contortus*. The biologically active components, however, neglected to mention that these investigations may also be used to create natural medications based on this feature for toxicity and associated pharmacokinetic testing.<sup>4</sup> The herb has strong anthelmintic action, meaning it required very little work to render Indians unconscious.<sup>18</sup>

**Diuretic Activity:** Rodent urine production was increased by extracts from seeds, roots, leaves, flowers, and bark; a leaf extract exhibited some secondary diuretic action that was more pronounced than control but not as much as hydrochlorothiazide. The occurrence of avenasterol, stigmasterol,  $\beta$ -sitosterol, and campesterol was linked to this action.<sup>18</sup>

**Cardiovascular disease:** When rats were given 100 mg/kg bw of the extract of moringa leaves daily, their cholesterol levels dropped by 50% and their internal carotid atherosclerotic plaque production fell by 86.52% when compared to the control group. By reducing vascular oxidative stressors in the aorta and enhancing endothelial function of resistant arteries, the ingestion of Moringa seeds was found to have antioxidant and anti-inflammatory properties in hypertensive rats. This study offered proof that eating moringa seeds can help alleviate cardiovascular conditions including elevated blood pressure and others that are brought on by inflammation and oxidative stress.<sup>9</sup>

**Hepatoprotective Activity:** Of all the flavonoids found in Moringa, including kaempferol, isoquercetin, rhamnetin, and others, it is believed that quercetin in the flowers of the plant is responsible for the hepatoprotective properties. Additionally, a decrease in seraminotransferase function and level of globulin indicated that the seeds were beneficial against liver fibrosis caused by carbon tetrachloride.<sup>13</sup> In animal models, *M. oleifera* extracts can shield the liver from toxicity caused by chemicals; several bioactive components and processes have been investigated.<sup>4</sup>

In rats given a high-fat diet, the leaf extract of Moringa has been demonstrated to protect against liver damage by lowering LPO and raising GSH in addition to reducing tissues histopathology, aspartate aminotransferase (AST), alkaline phosphatase (ALP), and the enzyme alanine aminotransferase (ALT).<sup>9</sup>

**Anti-Allergic Activity:** The process underlying the ethanolic extract of seeds inhibition of latent cutaneous hypersensitivity induced by antibodies against immunoglobulin G (IgG) and histamine release from pole cells is unknown, but it may have deleterious effects on layer settling and reduced scratching recurrence in an ovalbumin enhancement approach.<sup>18</sup>

## MISCELLANEOUS USES

Fuglie lists the following as just a few of the numerous applications for moringa: alley farming (the biomass production); animal forage (leaves and treated seed-cake); biogas (from leaves); blue dye etc.<sup>2,18</sup> Moringa is utilized as both a natural coagulant for murky water and as animal feed. Because *M. oleifera* Lam and Moringa seed oil have such a large output, three *M. oleifera* seeds are utilized to make biodiesel. Because of its high nutritional content, it is often utilized as animal feed.<sup>4</sup>

Ayurvedic and Unani medical traditions have identified several therapeutic benefits linked to various portions of Moringa.<sup>19</sup>

## IN MALNUTRITION

Malnutrition has been addressed by moringa plants, particularly in young children and nursing moms. For a kid aged 1-3, one rounded tablespoon (8 g) of powdered leaves will provide around 14% of their protein, 40% of their calcium, 23% of their iron, and almost all of their vitamin A requirements. While pregnancy and nursing, six rounded spoonfuls of leaf powder will meet almost all of a woman's daily needs for calcium and iron. Because of its high protein as well as iron content, the leaves are strongly advised for expectant moms. More calcium than milk, more iron than spinach, more vitamin C than oranges, more potassium than bananas, as well as more vitamin A than carrots are all found in moringa leaves.<sup>2</sup>

## FOR ORAL HEALTH

Cavities, often known as tooth decay, are microbiological diseases brought on by particular kinds of bacteria that exist in the mouths of humans. Numerous studies *Moringa oleifera* methanolic extract has antimicrobial characteristics and can be used as an oral medication for dental caries. A multifactorial inflammatory disease, periodontitis is defined by the gradual breakdown of the tissues that support teeth. Because *Moringa oleifera* leaves contain a variety of antioxidant components, including carotenoids, flavonoids, phenolics, and important amino acids including lysine, cystine, methionine, and tryptophan, they are a rich source of natural antioxidants. As a result, they are appropriate for stopping the advancement of periodontal disease.<sup>2,20</sup>

## CONCLUSION

Moringa's medicinal and pharmacological qualities have made it a well-known plant. Its numerous bioactive ingredients offer health advantages above and above the necessities. Additionally abundant in vitamins, minerals, and carotenoids, *M. oleifera* is used as a superfood and has a higher medical value. The *Moringa oleifera* tree came into our hands from God's imagination. It has been given titles that translate to "Never Die," "The Only Thing that Grows in the Dry Season," and "Mother's Milk" by Africans in honor of it.

It's reasonable to argue that this plant has saved more lives than any other in developing nations. Owing to its great nutritional bioavailability and therapeutic qualities, it helps prevent several illnesses including diabetes, high blood pressure, cancer, and Alzheimer's disease by acting as an antioxidant. It's the tiniest plant with potential for use in every field, including agriculture, beautifying agents, health benefits, and so forth. The majority of the plant's components, including seeds, flowers, leaves, and roots, are used to cure various illnesses. *M. oleifera* might be a practical, reasonably priced, reasonably safe, and easily accessible source of minerals and proteins. It still has a significant impact on people's everyday lives, especially in developing and rural areas. As a result, it is suggested for use as a medicinal agent in the management and

treatment of many illnesses in addition to being a source of nutrients.

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All the authors have contributed equally.

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