

## MORINGA OLEIFERA: A REVIEW ARTICLE ON THE “TREE OF LIFE” & IT’S MAGICAL PROPERTIES

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### ABSTRACT

Moringa oleifera is a tree cultivated originally in northern India and many tropical and subtropical countries. It is grown widely in several countries such as India, Africa, South and Central America, Mexico, Hawaii, Asia and Southeast Asia. Various different parts of Moringa oleifera such as leaves, seeds, bark, roots, sap, and flowers are widely for medicinal purpose, and the leaves and immature seed pods are used as food products in human nutrition and show magical effects. It's leaves, pods, seeds, gums, bark and flowers of Moringa are used in more than 80 countries to relieve various mineral and vitamin deficiencies, support cardiovascular system, maintain blood-glucose levels, neutralize free radicals and reduce oxidation, provide support to anti-inflammatory mechanisms, enrich anaemic blood and support immune system. The sole purpose of this review is to highlight and spread awareness about the nutritional and medicinal properties of Moringa oleifera.

**KEYWORDS:** Moringa oleifera, nutritive properties, medicinal properties, toxicity.

### INTRODUCTION

*Moringa oleifera* is also known as moringa, drumstick or horseradish and it is a perennial tree that belongs to the Moringaceae family.<sup>[1]</sup> *Moringa oleifera* is a fast growing tree that may grow as high as 7 to 15 m and reach a diameter of 20 to 40 cm at chest height.<sup>[2]</sup> It has ability to tolerate wide range of rainfall, with minimum annual rainfall requirements estimated at 250 mm and maximum at over 3000 mm.<sup>[3]</sup> Several preparations of *M. oleifera* have been used for their anti-inflammatory, antihypertensive, diuretic, antimicrobial, antioxidant, antidiabetic, antihyperlipidemic, antineoplastic, antipyretic, antiulcer, cardiac activities. *M. oleifera* leaves show potential in treating hyperglycemia and dyslipidemia.<sup>[4]</sup> *Moringa oleifera* is rich in nutrition due to the presence of a several different

phytochemicals in different parts such as leaves, pods and seeds. *Moringa oleifera* provides more vitamin C than oranges, more vitamin A than carrots, more calcium than milk, more protein than yoghurt, more potassium than bananas and more iron than spinach.<sup>[5]</sup> The seeds of *Moringa oleifera* has a scientific interest as *M. oleifera* seed kernels which contain a significant amount of oil (up to 40%) with a high-quality fatty acid composition (oleic acid > 70%) and, after refining resistance to oxidative degradation.<sup>[6]</sup> *Moringa* oil may also be used as replacement for olive oil in diet, cosmetics, and a lubricant for fine machinery. Moreover, after oil extraction, the seed cake of *Moringa oleifera* can be effective in waste water treatment as a natural coagulant.<sup>[7]</sup>



Figure 1: “Miracle tree” *Moringa oleifera*.

Kingdom	Plantae
Subkingdom	Tracheobionta
Super division	Spermatophyta
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Dilleniidae
Order	Capparales
Family	Moringaceae
Genus	<i>Moringa</i>
Species	<i>Oleifera</i>

Source: Nadkarni KM. Indian materia medica. Vol. 1. 3rd ed. Bombay, India: Popular Prakashan; 2000. p. 811.<sup>[26]</sup>

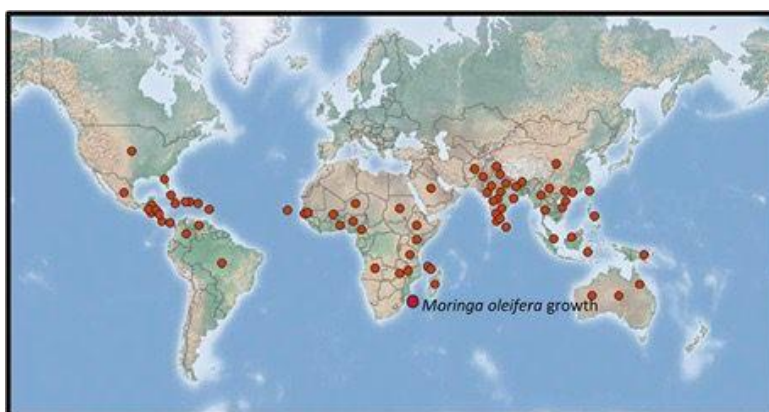
**Figure 2: Taxonomic classification of *Moringa oleifera*.**

**Source:** A Review of the Phytochemical and Pharmacological Characteristics of *Moringa oleifera*.

#### Plantation, cultivation and soil conditions

*Moringa oleifera* can be grown in any tropical and subtropical regions with temperature ranging between 25–35 °C. It requires sandy soil with a marginally acidic to alkaline pH and rainfall of 250–3000 mm.<sup>[8]</sup> For seed production of *Moringa oleifera*, sowing is preferred as it shows improved cultivation and resulting in profitable production.<sup>[9]</sup> *Moringa* seeds are generally sown during

the rainy season and can germinate and grow without irrigation, but for commercial purposes, irrigation through a drip system is recommended, allowing seed production during the dry season as well.<sup>[10]</sup> *M. oleifera* seeds germinate within 2 weeks of sowing (up to 2 cm). They are reported 3–6 weeks after germination in nurseries, when they reach a height around 30 cm. Depending on the ecotype of *M. oleifera*, the number of germinating seeds per kilogram is from 3 to 9 thousand. The Ideal storage conditions for seed is 3°C with a humidity ranging upto 5%–8%.<sup>[11]</sup>



**Figure 3: Topographical distribution of *Moringa oleifera*. (Source: <https://www.cabi.org/isc/datasheet/34868>)**

#### Nutritive Properties

*M. oleifera* is a store house of essential nutrients and anti-nutrients. It is rich in minerals like calcium, potassium, zinc, magnesium, iron and copper.<sup>[12]</sup> *M. oleifera* is rich in various essential vitamins like beta-carotene of Vitamin A, Vitamin B such as folic acid, pyridoxine and nicotinic acid, vitamin C, D and E.<sup>[13]</sup> Apart from the vitamins various phytochemicals such tannins, sterols, terpenoids, flavonoids, saponins, alkaloids. While glucosinolates, isothiocyanates, glycoside compounds along with reducing sugars act as anti-cancer agents.<sup>[14]</sup>

#### Medicinal Properties

##### ➤ Anti-Cancer Activity

Cancer is a common disease, often harmful & also causes death due to improper medication. Approx 2.4 million cancer cases are most commonly detected in

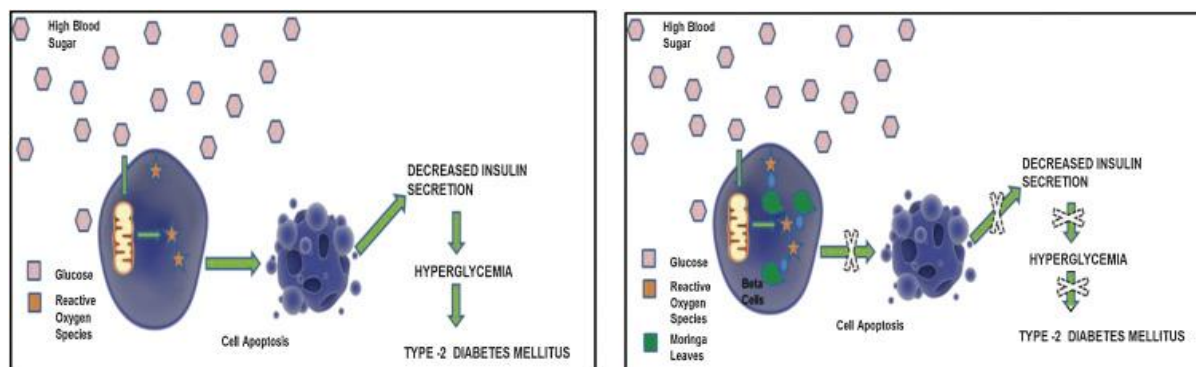
India, There are no specific reasons which causes cancer but several other surrounding/lifestyle factors like smoking, lack of exercise and radiations can cause cancer.<sup>[15]</sup> Various treatment for Cancer include surgery, chemotherapy and radiation therapy are expensive and show major side effects. *M. oleifera* is often used as an Anticancer agent as it is natural, reliable source and is safe at certain concentrations. Moringa is also commonly used as an anti-proliferative agent in treatment of cancer which acts by inhibiting the growth of cancer cells. As studies suggest that the anti-proliferative effect on cancer cells is due to its ability to induce reactive oxygen species in the cancer cells. The presence of reactive oxygen species induced in the cells leads to apoptosis.<sup>[16,17,18]</sup>

##### ➤ Anti-diabetic Activity

Moringa has shown effective results in treatment of Type

1 and Type 2 diabetes. Type 1 diabetes is one where the patients are unable to produce required amount of insulin, which is essential to maintain the blood glucose levels in body. Type 2 diabetes is one as where body builds insulin resistance. Type 2 diabetes can also be caused due to dysfunction of Beta cell, due to which it is unable to sense glucose levels, which leads to reducing signals to insulin, resulting in high blood glucose level in body. Study has shown that antioxidant present in

moringa powder can decrease ROS (Reactive oxygen species) in beta cells due to STZ (Streptozotocin) induction. STZ causes ATP dephosphorylation reaction and also it causes xanthine oxidase to form superoxides and reactive oxygen species.<sup>[19,20]</sup> Flavonoids like quercetin and phenolics present in moringa has shown scavenging effect on ROS and also avert cell apoptosis of beta cells.<sup>[21,22]</sup>



**Figure 4: Mechanism of diabetes and effect of Moringa on progression of diabetes.** Source: <https://ars.els-cdn.com/content/image/1-s2.0-S2213453016300362-gr1.jpg>

#### ➤ Cardiovascular Activity

Active constituent of Moringa leaf like Niazinin A, Niazinin B, and Niazimicin are responsible for reducing cholesterol levels also shows cardioprotective effect against isoproterenol-induced myocardial infarction and significantly shows protective role on hyperlipidemia induced by iron deficiency in male Wistar albino rats.<sup>[23,24,25]</sup> Study was done of moringa oleifera lam. Which shows reduction in inflammation and lipid accumulation on various tissue system.<sup>[26]</sup>

#### ➤ Diuretic Activity

Leaves, flowers, seeds, roots, and bark extract of Moringa leaves increase urine outputs and shows diuretic actions. Extract like Campesterol, stigmasterol,  $\beta$ -sitosterol, and avenasterol were responsible for Diuretic action.<sup>[27]</sup>

#### ➤ Antimicrobial Activity

Flavonoids, tannins, steroids, alkaloids, saponins, benzyl isothiocyanate, and benzyl glucosinolate found from extract of moringa leaves were found to be responsible for antimicrobial activity and Ethanolic extract of Roots and bark of Moringa shows antimycotic activity against *Neurospora crassa*, *Aspergillus niger*, *Rhizopus stolonifer*, *Microsporum gypseum*. Study also shows it can also use for water purification as it restrict bacterial growth in agar and nutrient medium.<sup>[28,29]</sup>

#### ➤ Antioxidant Activity

*M. oleifera* shows promising effects in reducing the accumulation of ROS (Reactive Oxygen Species) and its leaves effect against  $H_2O_2$ -induced oxidative damage by reducing free radicals. As per the *in vitro* tests it shows effect by reducing lipid peroxidation and increasing level

of glutathione along with antioxidant enzyme activity.<sup>[30,31]</sup> The ability of *M. oleifera* to show antioxidant effect was confirmed by DPPH assay (2,2-diphenyl-1-picrylhydrazyl) radical scavenging test.<sup>[32]</sup> Pods of *M. oleifera* have the ability of scavenging peroxy, superoxyl, and 2, 2-diphenyl-2-picryl hydrazyl (DPPH) radicals.<sup>[33,34]</sup>

#### ➤ Anti-Inflammatory Activity

A remarkable anti-inflammatory effect has been seen in different parts of *M.oleifera* such as leaves, pods, roots, flowers. The isolated compound from *M.oleifera* named as (4-[2-o-Acetyl-alpha -l-rahmannosyloxy) benzyl] thiocyanate possesses inhibitory activity of nitric oxide and is effective in Raw264.7 cell lines: A macrophage/monocyte like cells/ cell lining of mouse.<sup>[35]</sup> Compounds in moringa like tanins, phenols, alkaloids, flavonoids, carotenoids Beta-sitosterol, vanillin and moringin shows anti-inflammatory properties.<sup>[36]</sup> Aurnatiamide acetate and 1,3-dibenzylurea, present in moringa roots inhibits TNF- $\alpha$  production.<sup>[37]</sup> It has been found that Nuclear factor kappa B translocation can be blocked by *M.oleifera* leaves extract.<sup>[38]</sup>

#### ➤ Oxidative stress

An study was conducted on methotrexate-induced mice and it showed that pretreating with an extract of *M.oleifera* on mice poisoned with methotrexate could protect them from redox imbalance.<sup>[39]</sup>

It has also been found that antioxidant potential of moringa roots can be used as an excellent and preventive source in animal epidermal oxidative stress injury.<sup>[40,41]</sup> Antioxidant potential of moringa leaves against diclofenac-sodium induced liver can be considerable



liver protective.<sup>[41]</sup>

#### ➤ **Fertility and Anti-fertility Activity**

Moringa leaves and roots shows beneficial effect in possessing fertility and abortion-inducing properties. Study has been done by taking aqueous extract at a 200 and 400mg/kg which shows more abortifacient and anti-fertility effects. Ingestion of moringa before and during pregnancy can lead to adverse fetal development by causing rigorous contraction of the uterine wall.<sup>[42,43]</sup>

#### ➤ **Hepatoprotective activity**

In Moringa leaves, flavonoids like quercetin, kaempferol, isoquercetin, rhamnetin shows various benefits. Quercetin in moringa flowers is responsible for hepatoprotective effect.<sup>[44]</sup>

Methanolic extract of moringa leaves at low dose shows change in hepatorenal and hematological profile with rise in serum aminotransferase concentration, alkaline phosphate, plasma cholesterol level, bilirubin and serum LPO levels [measure of lipid peroxidation].<sup>[45]</sup>

Study shows that moringa leaves is effective in hepatoprotective properties by decreasing levels of AST, ALT, ALP.<sup>[46]</sup> Continuous treatment with the extract of this plant for around 20-21 days helps reduce liver injuries.<sup>[47]</sup>

#### ➤ **Anti-Ulcer / Gastroprotective Activity**

In moringa leaves, presence of Bisphenols and flavonoids shows reduced level of ulcer index, duodenal ulcer and stress ulcer in ibuprofen induced gastric ulcer model.<sup>[48]</sup> Study also shows significant amount of reduce free radicals and neutralize the acidic behaviour of gastric juice which shows protective effect on gastric ulcer.<sup>[49]</sup>

The presence of flavonoids shows protective effect in ulcer by increasing capillary resistance which shows less cell injury.<sup>[50]</sup>

#### ➤ **Anti-Obesity Activity**

The studies showed that continuous oral treatment of *M. oleifera* for 45-49 days has reduced the BMI (Body Mass Index) in rats with hypercholesterolemia by suppressing mRNA expression of resistin and leptin and relatively increase gene adiponectin in rats.<sup>[51,52]</sup>

#### ➤ **Anti-Venom Activity**

*M. oleifera* also shows anti venom activity against 'Naja Nigricollis' species of snakes in rats. Naja Nigricollis's venom causes deterioration of phospholipids due presence of neurotoxins which further also shows effect on neurotransmission and causes hemorrhage.<sup>[53]</sup>

#### ➤ **Toxicity**

Study was conducted on Sprague-dawley rats to study acute toxicity of moringa leaf powder. And it was found that oral administration of dried leaves upto 2000mg/kg

has no harm or lethal effect on human body.<sup>[54]</sup> Another study was conducted where acute and sub acute level of moringa was studied. In study methanolic extract was used and it has been found that acute toxicity was seen at 4000mg/kg and at 5000mg/kg mortality was observed. Therefore it is concluded in the study that moringa extract can be use for nutritional purpose.<sup>[55]</sup>

### **CONCLUSION**

The objective of this review was to explore and spread awareness about *Moringa oleifera*'s magical properties present in various parts of its plant like leaves, seeds, bark, roots, sap, flowers which shows promising effects in treatment of various diseases.

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