Moringa oleifera (Sajina or Drumstick) a Natural Herbal Plant as a Super Food for All Purpose - A Review Article

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ABSTRACT

Moringa oleifera is a tropical tree mostly grown in developing countries. This tree is an excellent source of different nutrients like amino acids, phytochemicals, vitamins, minerals and so it is known as a superfood. *Moringa oleifera* is very important to combat malnutrition as it is a natural energy booster and nutrient dense. The therapeutic value of this tree is also notable. Different parts of this tree such as root, bark, fruits, leaves and pods have hepatoprotective, anticancer, antidiabetic, anti-inflammatory, anti-asthmatic, anti-bacterial, antidiuretic and anti-microbial activities along with significant reduction in blood pressure and cholesterol levels. *Moringa oleifera* also play a crucial role in brain and nervous system functions like improvement of spatial memory, dementia, Parkinson's disease and others. This review briefly describes the plant Drumstick and its different parts with its uses, nutritional aspects and therapeutic uses.

Keywords: *Moringa oleifera*; Nutritional aspects; Malnutrition; Therapeutic value.

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Introduction

Immunity boosting ideas are catching on like wildfire all across the globe. A strong immune system is one of the main reasons for which people have survived COVID-19 that resulted in widespread destruction of human civilization. There was no suitable treatment for curing COVID-19 patients. However, the recommendation to take supplements played a vital role in strengthening the immune systems of individuals. The greatest way to boost our immune system naturally is to use different medicinal plants and herbs[(1)]. Drumstick is considered to be one of the finest meals for boosting immunity as well as preventing and treating approximately 300 ailments. According to some researchers Drumstick is also named as a superfood. It is a commercial crop that farmers plant because they may profit greatly from its appeal on both the local and global markets. It is a crop that is both environmentally benign and suitable for sustainable farming.

The wonder superfood "Drumstick" of an Indian native is also called as Sajina, Moringa, Horseradish tree and Benzolive tree etc. Superfoods are foods that are rich in nutrients and hence provide health advantages(2). Functional foods may have health benefits because they include bioactive substances with certain biological capabilities(3). It seems that the phrase "superfood" was first used to describe Muffins in a Canadian publication in 1949. Drumsticks have a wide range of beneficial health properties that date back to the beginning of Ayurveda(2). The forests play a big part in preserving the environment and help us generate income. It is impossible to overstate the value of forests to the environment(4).

The tree Drumstick

A small to medium-sized, evergreen or deciduous tree, the drumstick tree is indigenous to Northern India, Pakistan, and Nepal. Beyond its original region, it is farmed and has naturalized in many places including South Asia, numerous Southeast Asian Nations, the Arabian Peninsula, tropical Africa, Central America, the Caribbean and tropical South America(5). The subtropical plant moringa can withstand brief frosts. A mature tree may be killed by a freeze but it can also recover. When chopped or frozen, it swiftly sprouts new growth from the ground or from the trunk. The ideal temperature range for the tree is 25-35 °C (77-95 °F), yet it may endure temperatures as high as 48°C (118 °F) for brief periods(6).

Different parts of Drumstick

One of the most common species in the Moringaceae family is *Moringa oleifera* (*M. oleifera*). Nearly every portion of this tree offers extraordinary qualities for food, medicine or other industrial uses(7). An essential food product known as *M. oleifera* has received a lot of attention as the "Natural nutrition of the tropics." In many nations, notably in India, Pakistan, the Philippines, Hawaii, and many parts of Africa, this tree's leaves, fruit, blossoms, and immature pods are consumed as a very nutritious vegetable(8).

Description of different parts

Roots: Acrid, harsh, strong and thermogenic; Leaves: typically, tripinnate, 45 cm long, opposite pinnate and pinnules; leaflets 0.6-1.0 cm wide and 1.2-2.0 cm length. The terminal obviates the lateral elliptic; Flowers: Large panicles of white, fragrant flowers; Fruits: (Pods) Pendulous, green, triangular, 9-ribbed, and measuring 22 to 50 cm or longer; Seeds: The wings had a triangular angle. Depending on the region, a tree will only flower and bear fruit once or twice a year. For example, in central India, where trees lose their leaves between December and January and January and February, flowering and fruiting take place primarily between November and March(9).

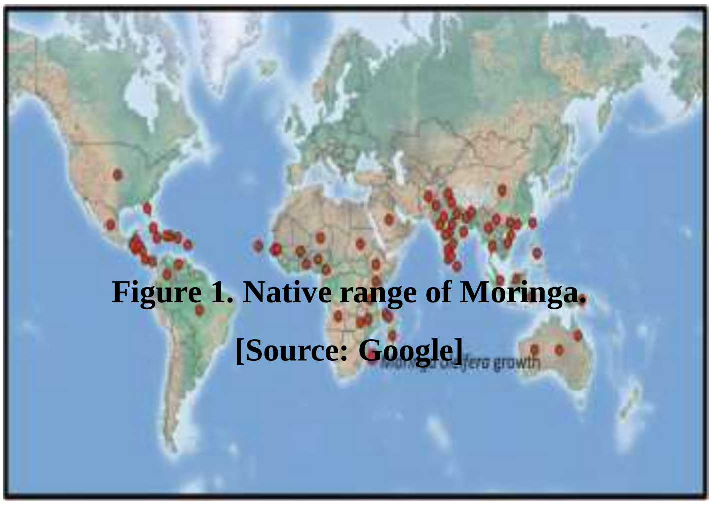

Figure 1. Native range of Moringa.
[Source: Google]

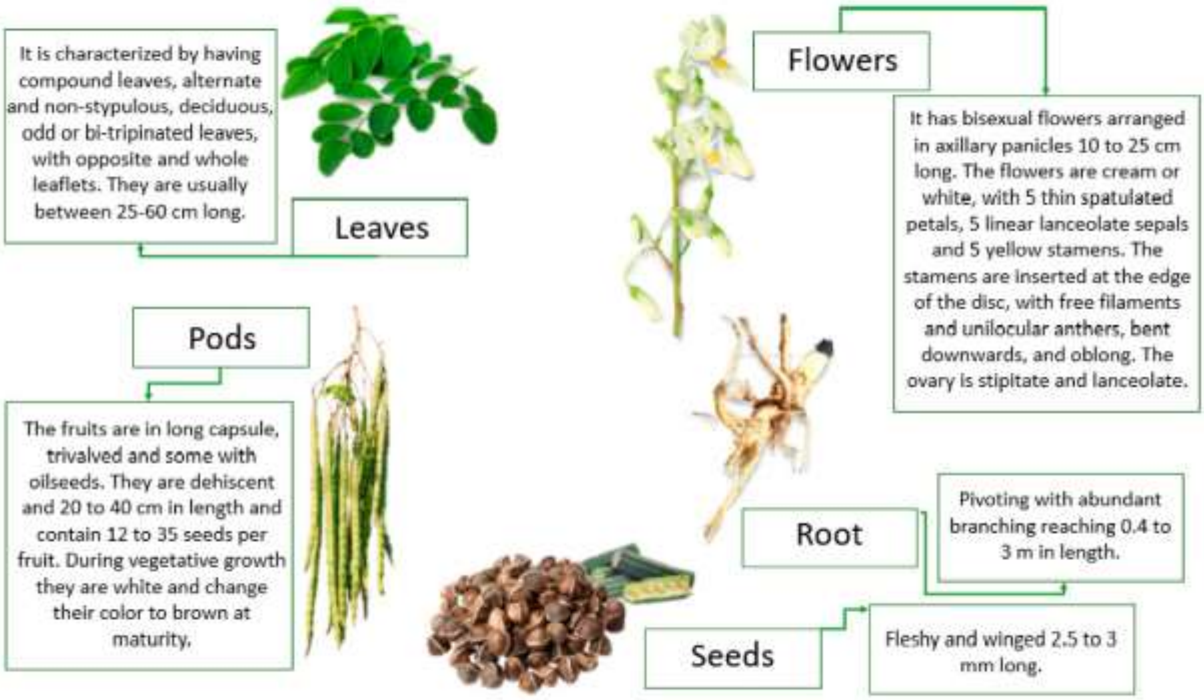

Figure 2: Parts of Moringa[10]

All parts of *M. oleifera* tree is edible and it is used for different purposes. Compared to other portions of *M. oleifera*, the leaves have the highest concentration of nutrients, particularly in terms of protein content (19-29% in the leaves). They are also a great source of vitamin E, vitamin A (four times as much as a carrot), vitamin C (fresh leaves have seven times as much vitamin C as an orange) and vitamin B[10].

Uses of different parts

Above mentioned parts of the Drumsticks are edible and there is a good nutritional value so the uses of different parts are explained below:

1. **Roots:** The Moringa roots proximate analysis revealed that it contained 49% nitrogen free extract, 14% crude protein, 2% fat, 5% ash, 23% crude fibre and 7% moisture[11]. The most prevalent macronutrients present in Moringa root powder solution were potassium, sodium, magnesium, phosphorus and calcium. Detectable amount of zinc, iron, and copper were also present in less quantities. Moringa root powder showed strong antibacterial activity against *E. coli*[12].
2. **Seed:** The seeds include 2% nitrogen free extract, 47% crude protein, 34% fat, 3% ash, 5% crude fibre, and 7% moisture[11]. It contains monounsaturated fatty acids with a high monounsaturated/saturated fatty acids (MUFA/SFA) ratio, sterols and tocopherols as well as proteins rich in sulfated amino acids. *M. oleifera* seeds are also a viable resource for food and non-food uses[13]. A study was conducted to determine the effectiveness and safety of *M. oleifera* seed kernels in the treatment of bronchial asthma. Hemoglobin readings dramatically increased in majority of patients and erythrocyte sedimentation rate significantly decreased. So, *M. oleifera* seed kernel has potential benefits in bronchial asthma patients[14].
3. **Leaves and bark**: The leaves of the *M. oleifera* tree are found to have high nutritive value. Its leaves are frequently used in cooking and in more recent years it has been investigated as a potential nutraceutical. Tulsi, ginger, lemon grass and other herbs and flavorings were used to produce moringa infusions[15]. Moringa leave powder can be stored for a longer

time when its leaves are dried and crushed without affecting its nutritive value. In comparison to the control and other variants, the moringa herbal combination made up of 80% moringa powder and 20% turmeric powder is more acceptable[16]. Studies on the components of moringa leaves showed their potency for using them as culinary ingredients[17]. This natural resource was used in the formulation of a moringa leaf-enriched biscuit[17]. A study was also done to assess the quality of pasta that had varying amounts of powdered moringa leaves added to it[18]. Moringa leaves has been used for so long to treat a variety of diseases. Investigation of this plant's haematinic effects revealed a rise in the number of white blood cells, haemoglobin, packed cell volume and red blood cells[19]. In vitro study of *M*. *oleifera* leaves revealed their activity against colorectal, breast, and hepatocarcinoma cells. *M. oleifera* nanocomposites can be used as natural resource for cancer prevention[20].

According to traditional medicine, the bark of the moringa tree possesses therapeutic power[21]. A study was conducted on locating the most heavily contaminated lakes in and around the city of Bangalore and their phytoremediation utilizing powdered, dried and chemically altered leaf and bark. It was revealed that these treated water samples were more potable and that they may be used on a broader scale[21]. In another study, oral administration of aqueous extract of *M. oleifera* bark to Wistar strain albino rats was done for its antiurolithiatic potential. When *M. oleifera* bark extract was administered orally to both groups, the weight of bladder stones was lowered than control group[22].

4. **Pods**: In the second year of growth, lobes and pods are generated. The hypotensive action of the complete *M. oleifera* pods and its component elements namely the coat, pulp and seed were studied[23]. A study was done to determine the chemical and mineral contents of freshly harvested entire and seedless pods from the *Moringa stenopetala* and *M. oleifera* plants. The findings showed that whole fresh pods of both species of Moringa had higher levels of crude proteins and fat than pods without seeds. Both Moringa species fresh pods could be used as an alternative source of protein supplement for livestock feed[24].
5. **Flower**: The blooms of *M. oleifera* known as murungai poo are extensively employed in many traditional medical systems. The flowers have promising antibacterial, antifungal, anti-larval, antioxidant, anti-inflammatory and anticancer activities because of the phytoconstituents present in them[25]. Methanol and aqueous extract from *M. oleifera* flower pods demonstrated the highest levels of antibacterial and antioxidant activity and it showed excellent potential for application as a natural preservative and nutraceutical in the food industry[26].

Nutritional aspects of *Moringa oleifera*

The functional components of Moringa are particularly effective because of their high nutritional and nutraceutical qualities, individual health advantages and great ability to address malnutrition. The majority of research studies revealed that moringa leaves are incredibly nutrient-dense, having highest concentration of antioxidants and are a good source of vitamins A, B, C, D, E, and K. The plant is also particularly rich in minerals like calcium, iron, potassium, magnesium, manganese, and zinc in addition to vitamins[27]. Approximately 821 million people worldwide are currently undernourished, 151 million children under the age of five are stunted and 613 million women and girls between the ages of 15 and 49 experience iron deficiency. Due to a range of vital phytochemicals found in Moringa leaves, pods and seeds, Moringa is rich in nutrients and can help to prevent malnutrition and other nutrient related diseases[28]. Malnutrition has a significant impact on a country's socioeconomic development since physically and mentally stunted people may have lower productivity. The components of *M. oleifera* trees are edible because of its incredibly high nutritional content[29]. Moringa is a plant that grows in developing countries and has already been utilized in India in projects to combat child malnutrition. Its dried leaves can be used and maintained readily in powdered form. A child can consume all of his daily Vitamin A requirements, 80% of his daily calcium needs, 60% of his daily iron needs and approximately 40% of his daily protein needs by consuming 30g/d of dried leaves powder[30]. It was found that the Moringa leaf extract included 8.1 g of protein, 1.7 g of fat, 2.1 g of dietary fibre, 9.1 g of carbohydrates and a variety of vitamins and minerals[31]. Moringa methanol extracts had increased phenolic content and stronger antioxidant activity according to in-vitro tests. As a neuroprotective agent *M. oleifera's* nutritional and functional qualities may help to reduce oxidative stress and offer essential nutrients for a balanced diet[32].

Table 1. Nutritional value of fresh and dried *M. oleifera* leaves compared to other foods[10].

Content in (mg/ 100g)	Fresh Leaves	Dry leaves	Other Foods
Vitamin A	7	18.9	Carrot: 1.89
Vitamin C	220	17.3	Orange: 30
Calcium	440	2003	Cow's milk: 120
Iron	085	28.2	Spinach: 1.14
Potassium	259	1324	Banana: 88
Protein	6700	27,100	Yogurt: 3100

In particular, amino acids, minerals and the antioxidant content of *M. leaf* extract are examined in a study. The analysis of *M. leaf* extract yielded 15 different types of amino acids including threonine (9403.09), lysine (11694.16), leucine (18087.41), isoleucine (9321.59), phenylalanine (17236.01), valine (11183.48), methionine (5684.68) and tryptophan (2577.82), while non-essential amino acids included histidine (9965.39), proline (10068.07), tyrosine (8641.63), aspartate acid (16585.76), glycine (13027.13), arginine (13123.94), alanine (14474.52), glutamate acid (30106.87), serine (10055.98), cysteine (470.37) in ppm[33].

High quantities of unsaturated fatty acids, particularly an omega-9-fatty acid (up to 76.29%) at a dose level of 15 kGy were discovered in the Moringa oil. The three saturated acids that accounted for 12.66% of the total dosage were palmitic, stearic and arachidic[34].

Therapeutic uses of *Moringa oleifera*

The Ayurvedic and Unani medical systems have long recognized the multiple therapeutic benefits of *M. oleifera*[35].

Diuretic activity

A dose-dependent diuretic effect was obtained by an extract of *M. oleifera* leaves[36] Phytochemical analysis of the ethanolic extract showed presence of carbohydrates, reducing sugar, combined reducing sugar, glycosides, tannins (which are not present in the seeds), alkaloids, flavonoids, saponins, steroids, and flavonoids. The extract had a considerable impact on the production of overall urine volume in a test of diuretic activity[37].

Blood pressure lowering activity

M. oleifera leaves have the potency to reduce both systolic and diastolic blood pressure. The Moringa leaf can therefore act as a natural method of lowering blood pressure and can be viewed as an alternative treatment[38]. Another study suggests that endothelium-dependent vasorelaxation and the reduction of vascular dysfunction and oxidative stress may be the mechanisms by which Moringa leaves reduce blood pressure in L-NAME-hypertensive rats. Moringa leaves are potentially helpful as a natural remedy for hypertension[39].

Cholesterol lowering

A study suggests that a standardized *M. oleifera* blend used as dietary supplement may lower cholesterol and triglyceride levels by preventing cholesterol absorption at the tested dose[40]. The lipid profile of normal human individuals in a study was not affected by *M. oleifera* and there were no changes in blood pressure or body mass index after a period of 14 days[41].

Hepatoprotective activity

The extract of *M. oleifera* leaves improved innate antioxidant activity and reduced CCl4-induced liver damage making it suitable for use as a hepatoprotective medication in future[42]. A study was conducted to assess the hepatoprotective effects of *M. oleifera* on chicken liver which was damaged by paracetamol. Based on this finding, the study infers that *M. oleifera* may have hepatoprotective properties[43].

Anticancer activity

Since ancient times *M. oleifera* has been a popular vegetable in many nations. It has a large number of phenolic compounds with a diverse range of biological activity. A study was done for anticancer properties of *M. oleifera* leaf extracts in vitro and in silico. The study demonstrated that *M. oleifera* leaves may have the ability to suppress the growth of cancer cells while also enhancing human health. The phytochemicals from *M. oleifera* leaves can be employed as the primary medications to cure cancer according to in vitro and in silico studies[44]. According to a study, *M. oleifera* leaves have antioxidant activity as well as cytotoxic and anti-chemo capabilities. It could also be used as a medical plant for nutraceutical and alternative new anticancer products[45]. *M. oleifera* has anti-oxidant characteristics and is used to treat inflammatory and malignant illnesses with its pods, seeds, leaves, and bark. The majority of research found that *M. oleifera* leaves were more powerful than other plant parts. The potency of this extract was increased using ethanolic and ethyl acetate extractions. It was shown to have anti-cancer and antioxidant activities acting at the genetic and molecular levels[46].

Antidiabetic activity

To prevent diseases like diabetes mellitus, *M. oleifera* is utilized in herbal medicine. Studies comparing diabetic rodents treated with and without extracts from *M. oleifera* for blood glucose or lipid levels were considered. Diabetic mouse models treated with *M. oleifera* showed considerably better improvement on diabetic hypertriglyceridemia and hypercholesterolemia[47]. The prevalence of diabetes has increased especially in low-and middle-income nations. To suppress the high expense of medications and their negative effects on patients, medicinal plants could be productively incorporated into a cost-effective diabetes treatment plan. In-depth research on the use of *M. oleifera* in the management of diabetes would be significant in the fight against the double burden of malnutrition in light of the findings gathered[48].

Anti-inflammatory activity

The dental health of smokers may be improved by medicinal plants with an anti-inflammatory effect of *M. oleifera*. According to research, moringa showed promise for improving oral health in smokers by reducing gingivitis and dental inflammation[49]. In a study the anti-inflammatory properties of aqueous extract of *M. oleifera* leave were investigated in experimentally induced inflammation in albino rats. Researchers came to the conclusion that aqueous extracts of *M. oleifera* leaves have anti-inflammatory properties[50].

Anti-asthmatic activity

A study was determined for the effectiveness and safety of *M. oleifera* seed kernels in the treatment of bronchial asthma. According to the study, *M. oleifera* seed kernels may be helpful for people with bronchial asthma[51]. The inhibition of the initial hypersensitive response, histamine release and the infiltration of various inflammatory cells as potential anti-asthmatic mechanisms of action are all conceivable mechanisms of action for the anti-asthmatic effects of *M. oleifera* seed kernel ethanolic extract[52].

Anti-bacterial and anti-microbial activity

A study on *M. oleifera* juice and extract contain an antibacterial agent that could be used to create novel medications to combat the pathogenic bacteria that cause serious sickness in humans[53]. Studies also reveal the ability of *M. oleifera* seed powder to filter water and determines how well seed extracts work against some bacterial growths. *M. oleifera* seed powder is a suitable source for water filtration due to its capability to decrease turbidity and coliform count in significant amount. A significant antibacterial activity was present in the acetone extract of the seed[54].

Impact of Moringa on skin and hair care

According to a study treatment with *M. oleifera* indicated a reduction of unpleasant skin sebum discharges released by sebaceous glands throughout the winter season in humans due to effectiveness of this plant on these secretions[55]. Reactive oxygen species (ROS), which create skin collagen imperfections and ultimately rough skin are mostly caused by solar UV radiation. The findings of a study revealed that Moringa cream supports anti-aging skin benefits and improves skin revitalization effects[56]. Moringa seed oil containing phytosterol and fatty acid has the potential to treat alopecia[57].

Importance of Moringa in brain and nervous system function

Nowadays research is being carried on globally to find out suitable plant extracts in order to prevent neurodegenerative illnesses. An investigation based on the critical part that oxidative stress plays in age-related dementia, *Moringa oleifera's* have an antioxidant and nootropic properties, the improvement of spatial memory and the neuroprotective effects of *M. oleifera* leaf extract in age-related dementia in animal models was established. Report suggests that *M. oleifera* leaves extract as a potent brain protector and enhance cognitive function[58]. In Ayurvedic medicine the leaf of this plant is used to cure paralysis, nervous debility and other neurological disorders. Additionally, research has been reveals that *M. oleifera* leaf has potent nootropic and neuroprotective effects in animal models[59]. Studies on *M. oleifera* seed oil or aqueous *M. oleifera* leaf extracts may help mice with scopolamine-induced memory impairment. The phytochemical evaluations of those two distinct formulations were also examined. According to the studies, *M. oleifera* seed oil is superior to *M. oleifera* leaf extracts as a neuroprotective since it improves memory impairment[60]. In a study, with the help of the enzyme myrosinase, glucomoringin (GMG) is bioactivated to produce the corresponding isothiocyanate, which may have neuroprotective properties in the treatment or prevention of Parkinson's disease (PD). It may lead to the development of a safe formulation of a bioactive molecule that is produced by exogenous myrosinase hydrolysis of the natural phytochemical GMG and is effective in treating or preventing Parkinson's disease (PD)[61]. A study done to determine whether the ethanolic extracts of *Panax ginseng* leaves, *Panax ginseng* rhizomes, *Vitis vinifera* seeds, *M. oleifera* leaves, and *Alpinia galanga* leaves had any neuroprotective effects on human neuroblastoma (SHSY5Y) cells. Among the examined plants, MLE has the potential to become a neuroprotective agent[62]. A few recent experimental research have documented *M. oleifera's* have neuroprotective properties against the symptoms of Alzheimer's disease, dementia, Parkinson's disease, stroke, and neurotoxicity where *M. oleifera* has been shown to contain a number of neuroprotective phytochemicals, suggesting that it may have promising neuroprotective benefits[63].

Conclusions

All parts of *M. oleifera* are edible, the leaves, roots, flowers, pods and seeds so they can be used in a variety of recipes to enhance the nutritional profile of foods because of high proteins, fibre, vitamins, and antioxidants to treat malnutrition in developing nations like India. The important medicinal applications of *M. oleifera* include its anti-inflammatory, anti-asthmatic, cholesterol and blood pressure lowering, hepatoprotective, anticancer, antidiabetic, antibacterial properties, neuroprotective benefits and others.

The developing country like India, where malnutrition is a big burden for the economically lag in comparison to another country. In this situation locally available Sajina will be very helpful for reduction of malnutrition by its nutritional values as well as provide economic benefits. Finally, the tree Drumstick grown in abundance in developing country with high nutritional value this plant is particularly beneficial in the fight against malnutrition and neurodegenerative disorders.

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