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## *Moringa oleifera*: An edible medicinal plant

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### Abstract

*Moringa oleifera* (Family–Moringaceae) is a native plant of India but also seen in tropical and sub-tropical region of the world. It is commonly known as “drumstick tree” but in Bengali it is known as “Sajne.” Every part of the plant is rich in nutritive components. The leaves, bark, roots, pods and flowers are rich in essential vitamins, minerals and phytochemicals. The flowers are used in West Bengal, India as antiviral agent. Apart from this it is used as promising antioxidant, anti-inflammatory, anticancer, antimicrobial and antidiabetic agent. The leaves, roots and barks not only possess antioxidant, anti-inflammatory, anticancer, antimicrobial and antidiabetic but also shows antipyretic, antiepileptic, antiulcer, diuretic, antispasmodic, cholesterol lowering activity. This review focuses on the medical properties of the plant with special focus on the flower.

**Keywords:** *Moringa oleifera*, sajne, botanical characteristics, chemical constituents, nutritional aspects, pharmacological attributes

### 1. Introduction

*Moringa oleifera* lam. Belongs to the family Moringaceae, a fast-growing deciduous tree native to Indian subcontinent [1]. It has been introduced to Florida, Latin America, the Pacific Islands, and the Caribbean [2]. Traditionally *Moringa oleifera* plants have been used for its medicinal attribute. In many countries queens and kings used moringa for the improvement of their skin. In India soldiers used to have moringa for energy during war time [3]. Apart from this there are several traditional uses like healing asthma, fever, wounds sore throats and skin infections. Every part of the plant has its own uses like seeds are mainly used for water purification, trunks are used as gum, oil is as biofuel and flowers are used as honey and nutrients supplement [2]. *Moringa oleifera* also known as “Mother’s Best Friend” and “Miracle Tree” for its nutrient constituents. The plant is rich in essential amino acids and calcium, potassium, vitamin A and vitamin C in high amount [3]. It also has vanillin, bayrenol, 4-hydroxy mullein, indole acetic acid, benzylisothiocyanate, indolacetonitrile, polysaccharides, flavanoids, protein components and spirochin [4]. Height of the tree generally varies from 32 to 40 feet and the trunk is generally 1.5 ft. The flowers of the plant have yellowish-white petals which are thinly veined and unequal. The flowers are 2 cm vast and 1.0 to 1.5 cm elongated in diameter. Flowering begins March-April of the year [5]. Total antioxidant property is high in flower than other part of the plant [6]. Particularly in flower the presence of flavonoids, steroid, alkaloids, phenol terpenoids, glycosides are confirmed by many qualitative assays [7-9]. *Moringa oleifera* flower is also used in alley cropping, honey, biogas and fertilizer making [10]. The dried flower of *Moringa oleifera* is used to cure muscle disease and inflammation [11]. Growing scientific evidence suggest that this plant has many medicinal properties. For the proven potential the other parts of the plant such as leaves, pods and roots have grown much interest for research as compared to flowers in spite of its traditionally proven medicinal and nutritional properties [12]. Thus, the current review will focus specially on flower with other parts of the plant.

### 2. Taxonomic Classification

**Domain:** Eukaryota

**Phylum:** Magnoliophyta

**Order:** Viales

**Family:** Moringaceae

**Genus:** *Moringa*

**Species:** *Moringa oleifera*

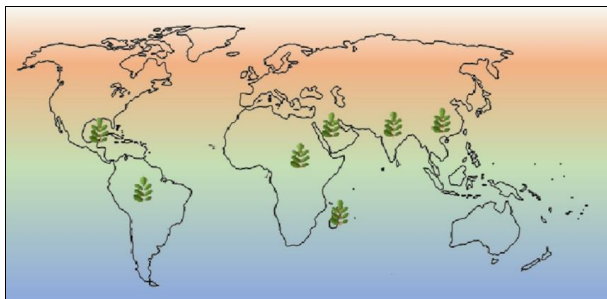
### 3. Identification

**Common name:** Drumstick Tree

**Regional Name:** Sajna, Senjana, Nugge, Mochak, Murungai, shevga, Muringai, Shigru, etc.

### 4. Habitat

Countries where the tree is found: India, Andamans, Bangladesh, Bhutan, Myanmar, Nepal, Pakistan, Indonesia, Philippines, West Indies, Zambia, Yemen, Madagascar, Mali, Malawi, Maldives, Malaysia and many more.



**Fig 1:** Parts of world where *Moringa oleifera* is found (2009 [www.outline-world-map.com](http://www.outline-world-map.com))<sup>[13]</sup>

### 5. Botanical Characteristics

#### 5.1 Morphology

Fast-growing and deciduous trees include the *Moringa*. Given that it typically develops to a height of 10 meters, the *Moringa oleifera* is regarded as a small to medium-sized tree. Typically, *Moringa oleifera* trees have a diameter of 20 to 40 centimeters.



**Fig 1:** Stem and Branches of *Moringa oleifera* tree.

#### 5.2 Stem

*Moringa oleifera* tree possess a seldom poorly formed but straight stem (Figure 1). At the height of 2 meters branching normally occurs but it can be reach up to 3m<sup>[14]</sup>.

#### 5.3 Tree Branches

The branches (Figure 1) occur in a haphazard manner and the canopy of the tree appears umbrella like<sup>[14]</sup>.

#### 5.4 Leaves

The leaves (Figure 2) are green or greyish color with the

length of 20 to 70 cm long. It is very often is mistaken as legume due to its leaf. The leaflets are 2 cm in length. Petiole is long and consist of pinnae (8-9 pairs)<sup>[15]</sup>.



**Fig 2:** Leaves of *Moringa oleifera* plant

#### 5.5 Flowers

The flowers (Figure 3) are of white color and moderately fragrant. Flowers are 10 to 25 cm long, diameter is of 2.5 cm.



**Fig 3:** Flower of *Moringa oleifera* plant.

#### 5.6 Fruits

The fruits (Fig. 4) are sometimes named as pods are capsule shaped trilobed structure. Generally, the pods are of green color but a reddish color is also seen when it is immature. Pods are 30 to 120 cm long and 1.8 cm in width. Fruits are mainly seen in the time of March and April<sup>[16]</sup>.



**Fig 4:** Fruit of *Moringa oleifera* plant

### 6. Nutritive value

Every part of *Moringa oleifera* a is jam-packed with phytonutrients. The leaves are full of nutrients and nutrients. Copper, potassium, magnesium, calcium, and zinc are present in high amount in leaves<sup>[27]</sup>. Other than that, *Moringa*

*oleifera* also contain Vitamin B in the form of folic acid, nicotinic acid, and pyridoxine. Vitamin C, E, beta-carotene (vitamin A) and D also present in the leaves, bark and fruit [28]. Due to its low caloric value, it can be used in diet for obesity and for digestive issue pods are used as it is fibrous in nature [29]. From a research review we came to know that the average amount of protein and fiber is 20.66% and 46.78% respectively in immature pods. Amino acid content in pod is 30%, in flower 31% and in leaves the amount is 44% [30]. *Moringa oleifera* leaves can provide 1000mg of calcium, whereas moringa powder can provide 400 mg of calcium which is considered very good for human growth. It is already reported that moringa contains higher amount of iron than spinach [31, 32]. It also contains zinc which is responsible for RNA and DNA synthesis and for development of sperm cell [32].

## 7. Phytochemistry

*Moringa* species contains plentiful phytonutrients such as terpenes, flavonoids, glucosinolates, steroids, saponins, alkaloids, tannins, and glycosides etc. The divergence of these

phytochemicals subsidized to its various pharmacological uses. Moringa plant has high antioxidant capacity due to its large number of flavonoid contents. Sterol or flavanol forms of the flavonoid are found in *Moringa oleifera*. The detail phytochemical present in this species is described below:

The glucosides, flavanols and flavonoid present in leaves are Rutin [21], Quercetin [18], Isoquercetin [19], Kaempferol [18], Vicenin-2 [20], Apigenin [21], Myricetin [17], Isorhamnetin [18], Epicatechin [17], Kaempferol-3-O-glucoside [22]. Flower also contains Quercetin [18], and Kaempferol [18]. Stem and bark contain Procyanidins [22, 23]. Phenolic acid present in the leaves is Gallic acid, Salicylic acid [17, 22], Syringic acid [17, 22], Ellagic acid [17], Caffeic acid [17], Chlorogenic acid [22], Sinapic acid [22]. Terpene present in pods is All-E-Zeaxanthin, All-E-lutein, All-E-luteoxanthin, 13-z-Lutein and in aerial part  $\alpha$ -Amyrin and  $\beta$ -Amyrin [22]. Sterol and alkaloid present in leaves are  $\beta$ -sitosterol [22], Niazimicin, Niaziminin [25]. Among these  $\beta$ -sitosterol [28] also present in seeds and aerial parts. In oil Stigmasterol [22] and Campesterol [22] are the sterol presented. Linoleic acid [26] and Linolenic acid [22, 26] is present in oil of plant (Figure 5).

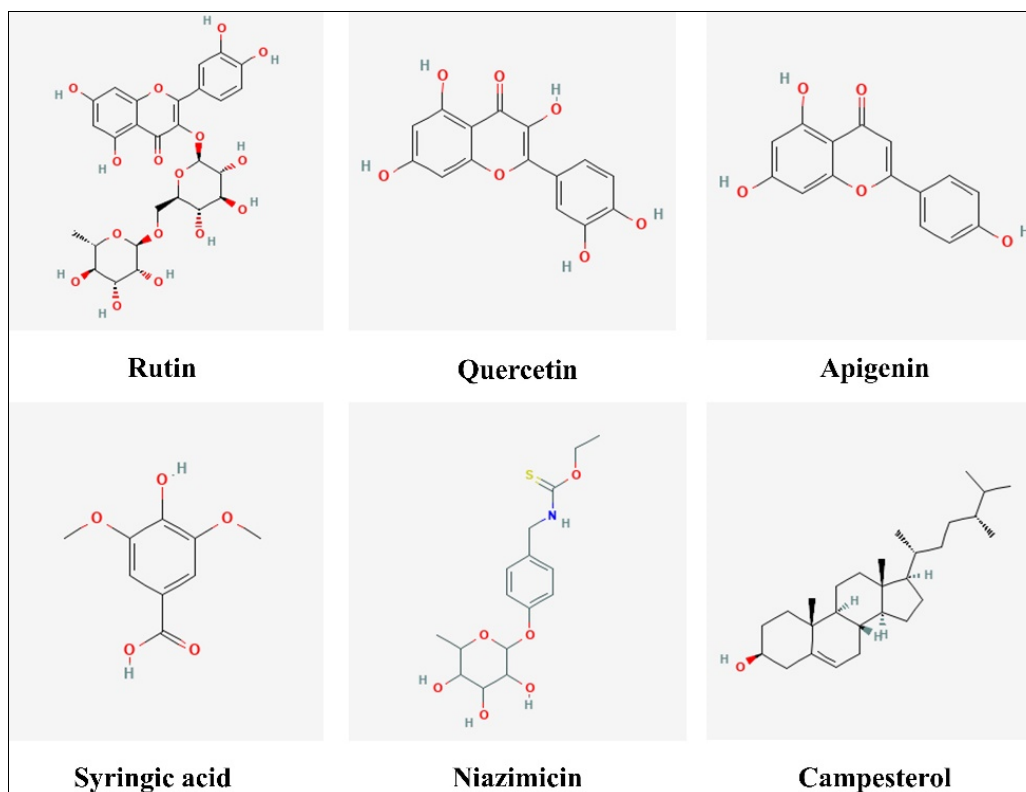


Fig 5: 2D Structures of Different Chemical Compounds Present in *Moringa oleifera*

## 8. Medicinal Properties

*Moringa oleifera* already known for its ethnomedicinal uses for Asian mainly in West Bengal, India and among Africans. It is known that it can cure 300 diseases. As it is rich in phytonutrients that make it a good medicinal plant [32].

### 8.1 Antimicrobial Activity

*Moringa oleifera* was tested against *B. subtilis*, *S. aureus*, *E. coli*, *P. aeruginosa*, and *K. pneumoniae* and good growth reduction have been observed which make it a noticeable antibacterial agent [33]. Anti-fungal activity also been observed.

### 8.2 Anti-Oxidant Activity

As already been discussed moringa is possess phenolic

compounds which make it a good source of anti-oxidant. *Moringa oleifera* contains thiocarbamates, flavonoids, glucosinolates and isothiocyanates. These phytochemicals suppress chelate metal ions and ROS. Further these compounds reconstruct membrane-bound antioxidants [34]. Vitamin A and Vitamin C and  $\beta$ -carotene the leading component of drumstick induce antioxidant properties. It is also reported that moringa possess strong inhibition of lipid per oxidation, nitric oxide radical, superoxide, and DPPH activity. The leaves of moringa restrict oxidative damage as it has high antioxidant activity [40].

### 8.3 Activity against gastric ulcer

Study by Das *et al.* suggest that in the gastric ulcer models induced by ibuprofen and pyloric ligation, water extract of

leaves was studied. It was observed in control group severe ulcer was produced by both the models but *Moringa* reduce the ulcer significantly [30]. In compare to Famotidine with *Moringa oleifera*, it was seen both reduce the acidity of gastric juice  $p < 0.05$  (significantly). In case of rats possess ulcer induced by indomethacin aqueous leaf extract was seen protecting the rat in dose dependent manner [33]. In preventing ulcer development, it could be beneficial because of tannin along its protein vasoconstriction and precipitating [36].

#### 8.4 Analgesic Activity

Tail immersion and Hotplate method have been used to review the analgesic action of aqueous extract of *Moringa oleifera* seeds. The aqueous extract and its several fractions that is as Petroleum ether, Diethyl ether, Ethyl acetate and n-Butanol showed analgesic activity and it is tantamount with aspirin at the dose of 25mg/kg [37]. The study suggests that *Moringa* seeds can be taken as analgesic and is equipotent to Aspirin [33].

#### 8.5 Anti-Inflammatory Property

Ndiaye *et al.* [38] investigated the anti-provocative effects of *Moringa oleifera* root extracts (aqueous) in rodents. (Weight: 120 - 160 g). Development of oedema was observed at 1, 3, 5-hour time interval. But when the dose was further increase that is 100mg/kg the oedema formation was not noticed at 1 and 3 hours but at 5 hours it was potentiated. Indomethacin the standard drug for inflammation also shows formation of oedema at 1, 3, 5 hours and reduce it 49.1, 82.1 and 46.9% respectively. So, it can be told that the root of *Moringa* can be used as anti-inflammatory drug [43].

#### 8.6 Cardioprotective Property

Hydroalcoholic extract (lyophilized) of *M. oleifera* has shown cardioprotective activity against myocardial infarction (isoproterenol induced model). With the chronic *M. oleifera* treatment, mitigating benefits have been noted, and perturbation has also been noted. Catalase, superoxide dismutase, lactate dehydrogenase, and glutathione peroxidase

showed substantial modulation, but no discernible repercussion on reducing glutathione in resemblance to the ISP control group. Nandave *et al.* conducted out the investigation. It inhibits the oxidation of lipids in myocardial muscle [39].

#### 8.7 Wound Healing Property

For this research, *Moringa oleifera* leaf water extract was taken into consideration. Rat models received the aqueous extract at a dosage of 300mg/kg (dead space wound, excision, and incision). The study revealed the for its better maturation and alignment as well as increased deposition of collagen. Aqueous extract of *Moringa oleifera* shows strong wound healing [40].

#### 8.8 Anti-Urolithiatic Property

The study of anti-urolithiatic activity was done by Karadi *et al.*, 2006 [41]. They investigated the effects of alcoholic and aqueous preparations of *moringa* root-wood on urolithiasis. First the rats were fed with Ethylene glycol which results in the hyperoxaluria followed by the surge of phosphate and calcium excretion through renal. It was noted that the oral administration of both extracts resulted in a decrease in exalted urinary oxalate levels and a managerial reaction on autogenous oxalate synthesis.

#### 8.9 Anti-Diabetic Property

The plant *Moringa oleifera* has already been voiced for its ability to combat both Type 1 and Type 2 diabetes. The *Moringa oleifera* plant was found to have anti-diabetic properties, according to various research. *Moringa oleifera* has been shown to be competent in treating both Type 1 diabetes (streptozotocin-induced) and Type 2 diabetes (insulin resistance) in rats, according to research [43]. In another study it is revealed that moringa seed powder dropped the fasting blood glucose in STZ-induced diabetes rats [39]. The ROS caused by the Beta-cells came down due to antioxidants in *Moringa* and it is caused due to STZ induction [28].

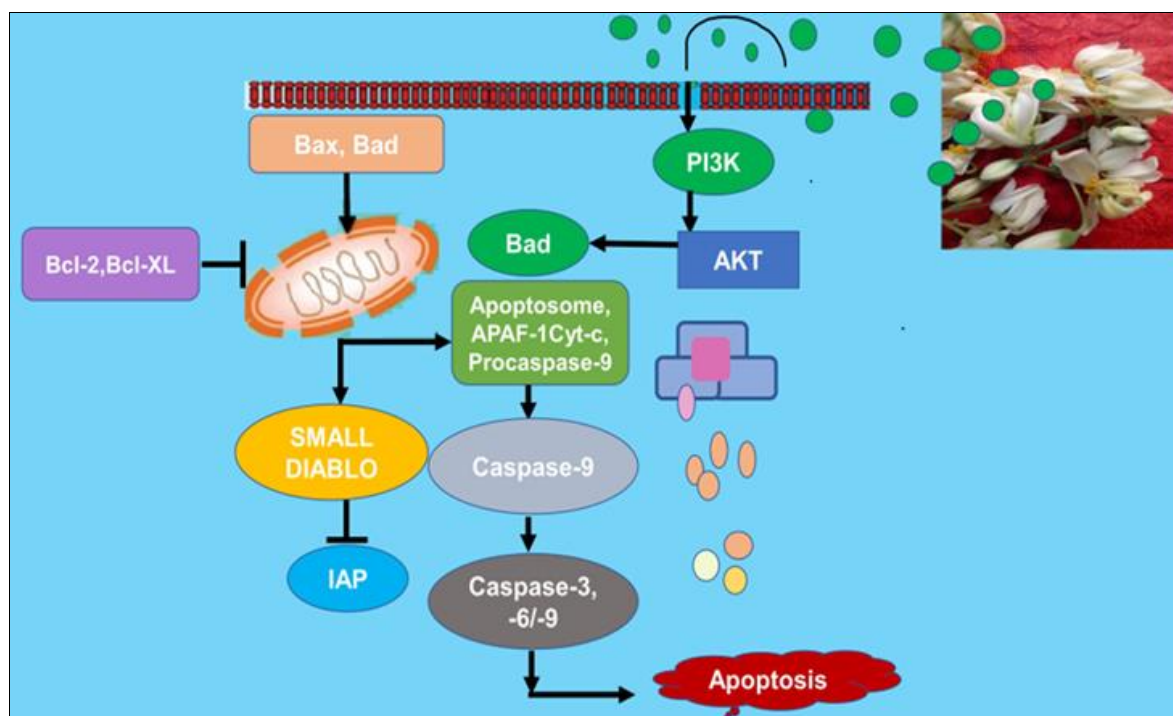


Fig 6: Apoptosis by *Moringa oleifera* flower

### 8.10 Anticancer Property

*Moringa oleifera* also possess anti-cancer activity. As it is rich in anti-oxidant activity reacting oxygen species generate in cells expedite apoptosis (Figure 6). Further this was substantiated by the upregulation of caspase 9 and 3<sup>[32]</sup>. According to the study<sup>[44]</sup>, the IC<sub>50</sub> value of flower extract in prostate cancer cell (PC-3) is 22.61 µg/mL at 24 hours & 6.25 µg/mL at 48 hours. By annexin V staining it confirm of apoptosis and G1 phase cell cycle arrest.

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### 10. Conflict of Interest

The authors declared there is no conflict of interest concerning the review, authorship, and publication of the article.

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