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Moringa oleifera Lam: A review

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Abstract
Moringa oleifera lam native to India grows in the tropical and subtropical regions of the world. It is commonly known as 'drumstick tree' or 'horseradish tree'. Moringa can withstand both severe drought and mild frost conditions and hence widely cultivated across the world. With its high nutritive values, every part of the tree is suitable for either nutritional or commercial purposes. The leaves are rich in minerals, vitamins and other essential phytochemicals. Extracts from the leaves are used to treat malnutrition, augment breast milk in lactating mothers. It is used as potential antioxidant, anticancer, antidiabetic, anti asthmatic, antimicrobial agent etc. *M. oleifera* seed, a natural coagulant is extensively used in water treatment. The scientific effort of this research provides insights on the use of moringa as a cure for diabetes and cancer and fortification of moringain commercial products. This review explores the use of moringa across disciplines for its medicinal value and deals with cultivation, nutrition, commercial and prominent pharmacological properties of this "Miracle Tree".

Keywords: *Moringa oleifera*, anti cancer, anti diabetic

Introduction
This fast growing tree was anciently used in Roman, Greeks and Egyptians, which now cultivated for human food, medicine, dye, fodder and water purification or clarification. It has much impressive range medicinal uses with higher nutritional value. From last few years, there has been an exponential growth of herbal medicines because plant drugs constitute a major share of all officially medicinal system like AYUSH. More than 70 to 80% people still use non allopathic system of medicine [1]. The screening of various plants according to their traditional uses and nutritional value based on their therapeutic value leads to discovery of newer and safer alternative for treatment of various ailments. One of such plants of medicinal value is moringa oleifera lam, belongs to family moringaceae. It is indigenous to south Asia, mainly in Himalayas foothills, India [2]. It has been grown and naturalized in other countries like Afghanistan, Sri Lanka, Bangladesh, east and west Africa throughout west indies from Mexico to Peru, Paraguay and Brazil [3].
Synonyms [4]:
Sanskrit - Subhanjana, Latin – Moringa oleifera, Hindi – Saguna, Sainjna, Gujarati – suragavo, Telugu – Munaga, Mulaga, Tamil – Morigkai. Malayalam – Murinna, Sigru, Punjabi – Sainjna, Soanjna, Unani – Sahajan, Ayurvedic – Haritashaaka Tikshnagandhaa, Raktaka, Akshiva, Arabian, Rawag, French – Moringe a graine ailee, Morungue, Spanish – Angela, Ben, Moringa, Portuguese –Moringa, Moringueiro, Chinese – La ken, English 0 Drum stick tree, Horseradish tree, Ben.

Botanical description & distribution
Moringa oleifera is a small, fast growing evergreen or deciduous tree that usually grows up to 10 or 12 m in height. It has a spreading, open crown of drooping, fragile branches, feathery foliage of trip innate leaves, and thick, corky, whitish bark. The leaves are bi pinnate or more commonly tripinnate, up to 45 cm long, and are alternate and spirally arranged on the twigs. Pinnae and pinnules are opposite; leaflets are 1.2 to 2.0 cm long and 0.6 to 1.0 cm wide, the lateral leaflets elliptic, the terminal ones obovate; petioles of lateral leaflets are 1.5 to 2.5 mm long, those of terminal ones 3 to 6 mm long. The leaflets are finely hairy, green and almost hairless on the upper surface, paler and hairless beneath, with red tinged midveins, with entire (not toothed) margins, and are rounded or blunt-pointed at the apex and short pointed at the base. The twigs are finely hairy and green, becoming brown [5, 6, 7]. The fragrant, bisexual, yellowish white flowers are borne on slender, hairy stalks in spreading or drooping axillary clusters (panicles) 10–25 cm long. Individual flowers, set in a

basal cup (hypanthium) ca. 3 mm long, are approximately 0.7 to 1 cm long and 2 cm broad, with five unequal yellowish white, thinly veined, spathulate petals, five stamens with five smaller sterile stamens (staminodes), and a pistil composed of a 1 celled ovary and slender style [8, 9]. The fruits are pendulous, linear, three-sided pods with nine longitudinal ridges, usually 20 to 50 cm long, but occasionally up to 1 m or longer, and 2.0 to 2.5 cm broad. The pods, each usually containing up to 26 seeds, are dark green during their development, and take approximately 3 months to mature after flowering [10, 11].

Drumstick tree is indigenous to the Himalayan foothills of South Asia from north eastern, (33 °N, 73 °E) to northern West Bengal State in India and north eastern Bangladesh where it is commonly found from sea level to 1,400 m on recent alluvial land or near riverbeds and streams [12, 13].

(A) Flower in stage

(B) Fruiting stage

(C) Mature Fruit Stage

(D) seeds of *Moringa oleifera lam*

Phytoconstituents of plant *Moringa oleifera* Lam

Leaves of plants are aqeous and alcoholic (extract) and phytoconstituents – niazirin and niazirinin – nitrile glycosides, 4- 904-O-acetylalpha – L-rhamnosylaxy) benzyl isothiocyanate, Niaziminin A and Niaziminin B, three mustard oil glycosides, niaziminin, a thiocarbamate, 4-(alpha -1- rhamnopyranosyloxy) – benzylglucoisinolate, quercetin-3-O-glucoside and quercetin-3-O(6 malonyl-glucoside), Niazimicin. Pyrrole alkaloid and 40-hydroxyphenylethanamide (marumoside A and B) 4. Alpha and gamma tocopherol 2. Seeds of the plant phytoconstituents are methionine, crysteine, 4-benzylglucosinolate, moringine, benzylglucosinolate, niazimicin niazirin. The pods of palnts phytoconstituetns are isothiocyanate, nitrites, thiocarbamates, O-propylundecanoate, O-ethyl-4-benzyl carbamate, methyl-p-hydroxybenzoae, beta sitosterol. The bark of plants containe 4-(alpha-L- rhamnopyranosyloxy) benzylgiucosinolate. The flower of the plants contiane D glucose, quercetin, isoquerecetin, kaemopherol, kaempferitin and ascorbic acid, protein, D- mannose. Roots are moringine, moringinine, spirachin, 1,3, dibenzyl urea, alpha phellandrene, p-cymene, deoxy niazimicine, 4-benzylglucosinolate. Steam contain 4-hydroxyl mullein, vanillin, beta sitosterone and beta sitosterol [14, 15].

Pharmacological activity

Anti diabetic activities

Moringa has been shown to cure both Type 1 and Type 2 diabetes. Type 1 diabetes is one where the patients suffer from on production of insulin, which is a hormone that maintains the blood glucose level at the required normal value. Type 2 diabetes is one associated with insulin resistance. Type 2 diabetes might also be due to Beta cell dysfunction, which fails to sense glucose levels, hence reduces the signaling to insulin, resulting in high blood glucose levels [16]. Several studies have shown that, moringa can act as an anti diabetic agent. A study has shown that the aqueous extracts of *M. oleifera* can cure streptozotocin induced type 1 diabetes and also insulin resistant type 2 diabetes in rats [17]. In another study, the researchers fed the STZ-induced diabetes rats with Moringa seed powder and noticed that the fasting blood glucose dropped [18]. Also, when the rats were treated with about 500 mg of moringa seed powder/kg bodyweight, the antioxidant enzymes increased in the serum. This shows that the antioxidants present in moringa can bring down the ROS caused in the Beta-cells due to the STZ induction [19]. STZ causes ATP dephosphorylation reactions and helps xanthineoxidase in the formation of superoxides and reactive oxygenspecies (ROS) in Beta cells. In hyperglycemic patients, the beta cells get destructed [20]. Therefore, high glucose enters the mitochondria and releases reactive oxygen species. Sincebeta cells have low number of antioxidants, this in turn causes apoptosis of the beta cells [21, 22]. This reduces insulin secretion leading to hyperglycemia and in turn diabetes mellitus Type 2. The flavonoids like quercitin and phenolics have been attributedas antioxidants that bring about a scavenging effect on ROS. It can be hypothesized that the flavonoids in Moringa scavenge the ROS released from mitochondria, thereby protecting the beta cells and in turn keeping hyperglycemia under control [23, 24].

Diabetes leads to several complications such as retinopathy, nephropathy and atherosclerosis etc. Moringa can be used to prevent such ailments. When there is hyperglycemia, the blood glucose reacts with proteins and causes advanced glycatedend products (AGEs). These AGEs bind to RAGE which gets expressed on the surface of immune cells. This interaction leads to increased transcription of cytokines like interleukin-6 and interferon's. At the same time, the cell adhesion molecules are expressed on the surface endothelium of arteries [25]. This facilitates trans endothelial migration which causes inflammation in the arteries and leads to atherosclerosis. Moringa is used as an anti atherosclerotic agent [26]. The anti atherogenic nature can be accounted for by the antioxidant properties of moringa.

Anti cancer activities

Cancer is a common disease and one in seven deaths is attributed due to improper medication. Around 2.4 million cases are prevalent in India, while there are no specific reasons for cancer to develop. Several factors like smoking, lack of exercise and radiation exposure can lead to the disease [27]. Cancer treatments like surgery, chemotherapy and radiation are expensiveand have side effects. *M. oleifera*

can be used as an anticancer agent as it is natural, reliable and safe, at established consent rations. Studies have shown that moringa can be used as an anti neoproliferative agent, thereby inhibiting the growth of cancer cells. Soluble and solvent extracts of leaves have been proven effective as anticancer agents. Furthermore, research papers suggest that the anti-proliferative effect of cancer maybe due to its ability to induce reactive oxygen species in the cancer cells. Researches show that the reactive oxygen species induced in the cells leads to apoptosis. This is further proved by the up regulation of capsize 3 and caspase 9, which are part of the apoptotic pathway [28-30]. Moreover, the ROS production by moringa is specific and targets only cancer cells, making it an ideal anticancer agent.

Tiloke *et al*. [31] also showed that the extracts increased the expression of glutathione-S-transferase, which inhibits the express of antioxidants. Anticancer agents targeting cancer using ROS induction are common, but these substances should also be able to attack the antioxidant enzymes [33-35]. *M. oleifera* is used to treat dementia, as it has been shown to be a promoter of spatial memory. The leaf extracts haves hown to decrease the acetylcholine esterase activity, there by improving cholinergic function and memory.

Anti microbial activity

Moringa oleifera leaves, roots, bark and seeds of *Moringa oleifera* show anti-microbial activity against bacteria and fungi. The plant shows *in vitro* activity against bacteria, yeast, dermatophytes and 39 elminthes by disc- diffusion method. The fresh leaves and aqueous extract from the seeds inhibit the growth of Pseudomonas aeruginosa and staphylococcus aureus [36].

Anti-inflammatory activity

Methanolic and aqueous extract of root and bark, methanolic extract of leaves and flowers and ethanolic extract of seeds of *Moringa oleifera* posses anti inflammatory activity. *In vitro* anti inflammatory activity from the hot water infusions of flowers, leaves, roots, seeds and stalks or bark of *Moringa oleifera* using carrageen an induced and the extract was pharmacologically evaluated [37].

Anti asthmatic activity

Alcoholic extract of this plant seed kernels were found spasmolytic in acetylcholilne, histamine, BaCl2 and 5HT induced broncho spasm. In same study, it shown protection against egg albumin and compound 48/80 induced mast cell degrantulations as well as pretreatment with alcoholic extract of Moringa oleifera seed kernel, decrease carrageen in induced paw edema [38].

Dosage of *Moringa oleifera*

Leaf of this plants 10 27 ml juice, root bark: 2-5 g powder, stem bark: 2-5 g powder, seeds: 5-10 g powder, leaf, flower, fruit, seed, bark, root: 1-3 g powder, 50-100 ml. decoction [39, 40].

Conclusion

The plant *Moringa oleifera*; family Moringaceae posses broad spectrum of pharmacological activities. Also, most of the parts of plant like seeds, leaves, flowers and roots are used for treatment of various diseases. Literature reports that aqueous, ethanolic and methanolic extracts are widely used for investigation, identification, and estimation purpose. In future the active constituents can be isolated and formulated into suitable dosage form and delivery system. Also, in future *in vivo* studies based on animal models can be done for better effect.

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