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Phytonutrients: *Moringa oleifera* leaf extracts an incredible health super food supplement

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Abstract

Herbs have been used for centuries to treat various ailments without any side effects. *Moringa oleifera* Lam., (MO) is a good source of phytochemicals having a wide range of impending applications in medicine and dietary supplement preparations. MO has the following properties like antibacterial, antioxidant and protease inhibition properties. The MO plant parts (seeds, fruits pods, flowers) are said to hold several medicinal values through the leaves are thought to be major medicinal values. MO possesses antiinflammatory, hepatoprotective, antinociceptive, oxidative DNA damage protective, antiperoxidative, and cardio protective effects. These properties attributed due to the MO herb contain various functional bioactive components including, flavonoids, alkaloids, natural sugars. MO is rich in protein, vitamins, minerals, amino acids, phenolic acids and phytosterols. Thus MO has become a prominent herb with several therapeutic values. Hence, the present study provides a comprehensive report on MO and its therapeutic values. In addition, the scope for the future perspectives of MO is also discussed.

Keywords: MO tree parts, bioactive phytoconstituents, therapeutic values

Introduction

Medicinal herb has been used for centuries to cure various ailments. Past few decades synthetic drugs have been modernised and used for various ailments in developed countries. However, in developing countries people are still rely on traditional medicine. MO contains polyphenols, antioxidants, phytonutrients (carotenoids, tocopherol, and ascorbic acids) minerals, vitamin C and vitamin E. MO possess the following broad range of biological functions like anti-cancer, hepato protective, anti-inflammatory, neuro protective function^[1, 3, 4]. Several research articles revealed that MO have excellent therapeutic values including anti-rheumatoid arthritis, anti-infertility, anti- depression, anti-inflammation, thyroid regulation, anti-diabetics and diuretic effects^[5, 6]. Developed countries are using this MO as an effective dietary supplement to combat malnutrition.

MO tree parts like leaves, flowers and seeds have been found to be valuable. Thus the valuable MO has gained remarkable understanding over the past few decades, thereby leading to invention of its pharmacological function and basic mechanism. The provided in this article would give an idea about pharmacological properties of MO and suggest that the MO leaves could serve as an effective dietary supplement to reduce problems associated with malnutrition.

Botanical description of MO

Common name- Drumstick tree, and Botanical name - *Moringa oleifera*. MO belong Moringaceae family of shrubs and trees which is a single genus family. The moringaceae family comprises of 13 species which is distributed in Indian subcontinent. Most commonly the MO tree height is around 10-15m and diameter is about 45cm. The bark has whitish grey and surrounded by thick cork with drooping branches (Pandey *et al.* 2011). MO originated from Himalayan Mountain of northern India and now the plant has been cultivated in various regions for various purposes (Leone *et al.* 2015). The plant grows in a place having warm, dry and moist. The temperature ranging from 25-35 °C and pH 5.0-9.0 required to grow MO tree, under sunlight, at an altitude of 550 meter. India is producing large amount (1.1–1.3 million tons/year in the area of 38000 ha) of MO pods. The following pie chart would give information of MO production approximately in the state of India Patel *et al.* 2010.

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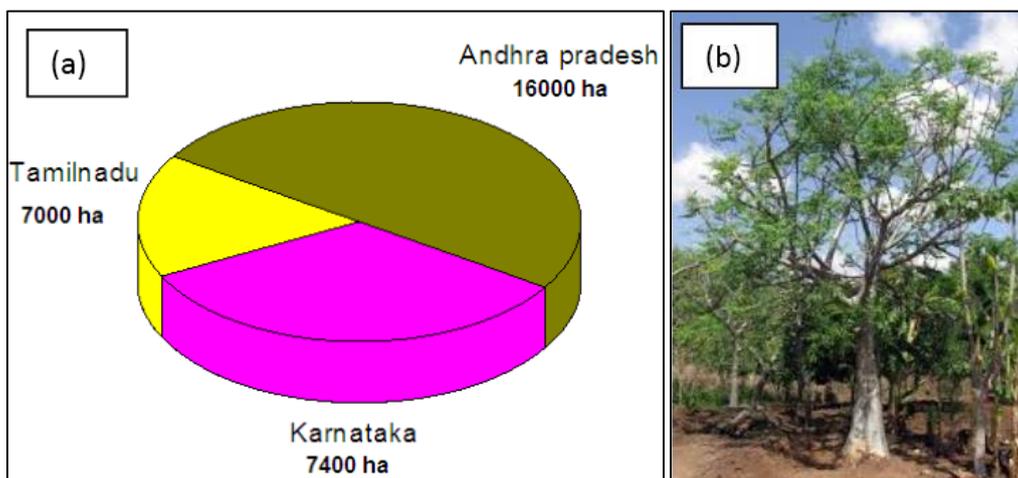


Fig 1: (a) Large amount of Moringa cultivation in Indian states and (b) Moringa tree

MO extracts preparation methods

MO extraction methods involve the separation of pharmacologically active molecules of plant from the MO plant parts by using some selective solvents in standard extraction techniques procedures. The MO extracts thus obtained for further process to prepare valuable medicines in the form of oral liquids, tinctures, tablets and capsules.



Fig 2: Moringa based dietary supplements in the form of tablets, powder and soft and hard gelatine capsules

The following are the methods which are commonly used to prepare medicinal plant extracts [7-9].

Maceration: In this process, the coarsely MO (leaves/pods, flowers/barks or seeds) powders placed in a stoppered vessel containing solvents for a period of 3 days with frequent agitation at room temperature. The mixtures are then strained and clarified by ultrafine filtration after the mixtures kept for 6-8 hours.

Infusion: This method involves the preparation of MO crude drug by maceration with cold/boiling water.

Digestion: This is another form of maceration. MO coarsely powdered leaves placed in a vessel and gentle heat is being given continuously to the extracts.

Percolation: MO based tinctures and fluid extracts have been prepared by percolation methods. MO extracts prepared by percolation methods contain active ingredients which possess lot of medicinal values. Specified amount of MO menstruum usually taken in a percolator and allowed for about 4-6 hours. Sufficient amount of MO menstruum added to produce required volume of MO extract and further clarified by ultrafiltration.

Soxhlet extraction: In this method, finely grounded MO plant

parts powder placed in a soxhlet apparatus. Flask contains extracting solvent which is heated and condensed, dripped into the thimble containing crude MO drugs, and extracts by contact. The advantage of this method is large amount of active molecules extract can be obtained with minimum amount of solvents.

Fermentation: Most of the medicinal plants extracts derived by this methods are having large number of active molecules which possess various pharmacological activities. Ancient Ayurveda adopted this fermenting technique to extract like asava and arista. This process involves fermenting the MO plant parts using some aqueous alcoholic solvents. In this method MO plant parts taken in vessel in the form of decoction over a period of time. During fermentation, alcohol thus evolved would act as preservatives. But this fermentation methods in ayurveda not yet standardized, hence further scientific studies required to standardize this methods.

Ultrasound extraction: MO plant parts usually placed in an ultrasonic bath with an adequate amount of solvents. The process is generally carried with a frequency ranging from 20-2000 KHz. This increase plant parts cell wall permeability and produce cavity [10].

Phytochemical composition

MO plant parts are a good source of phytochemicals such as glucosinolates, flavonoids phenolic acids highly bioavailable vitamins and minerals, carotenoids tocopherols polyunsaturated fatty acids and folate. In particular MO plant leaves contains Glycoside niazirin, niazirin [11]. The Mature MO flowers contain phytochemicals such as D-mannose, protein, D-glucose, ascorbic acid and polysaccharide [12]. The MO plant pods contains Nitriles, isothiocyanate, thiocarbamates, 0-[2'-hydroxy-3'-(2''-heptenyloxy)]-propylundecanoate, and 0-ethyl-4-[(α -1-rhamnosyloxy)-benzyl] carbamate, methyl-p-hydroxybenzoate and β -sitosterol. The mature MO seeds contains protein, fat, carbohydrate, methionine, cysteine, mono-palmitic, 4-(α -L-rhamnopyranosyloxy)-benzylglucosinolate, benzylglucosinolate, moringyne, and dioleic triglyceride [13]. The seed oil contains essential vitamin A and beta carotene [14, 15]. The MO bark and root contains 4-(α -L-rhamnopyranosyloxy)-benzylglucosinolate and 4-(α -L-rhamnopyranosyloxy)-benzylglucosinolate, benzylglucosinolate respectively [16-22].

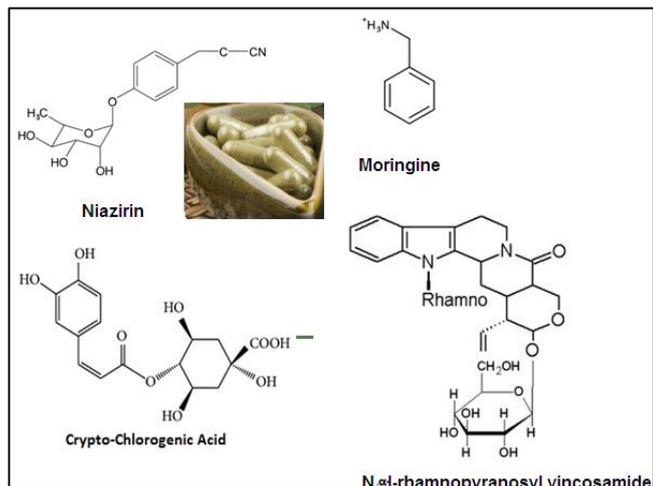


Fig 3: Some important phytochemicals of MO plant parts

Therapeutic values of *M. oleifera*

The MO plant parts such as leaves, flowers, barks, roots and seeds are containing various biologically active molecules. These biologically active molecules would be able to treat various ailments such as hysteria helminthic bladder, sores scurvy, paralysis, prostate problems, and other skin related ailments. The phytochemicals present in MO plants shown various activities such as anti-microbial, anti-inflammatory, anti-dislipidemic, antihyperglycemic and hepatoprotective properties [23].

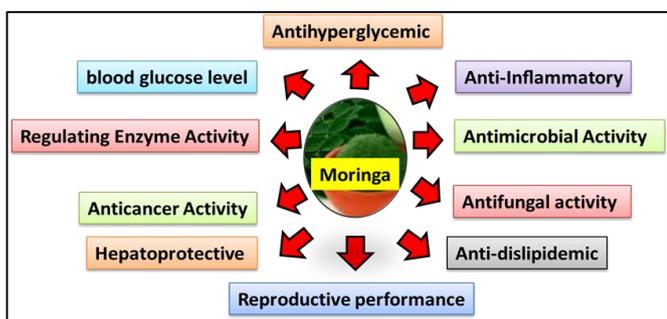


Fig 4: Therapeutic values of Moringa Oleifera

Reproductive performance

Moringa can serve as a single source to combat malnutrition. Importantly, the lack of bioavailable nutrients affects human health development from childhood to adult age person. Studies indicated that MO has essential bio available nutrients and had the highest reproductive success rate [24-30].

Antimicrobial and antifungal activities

Different parts of Moringa plant extracts (water soluble extracts) has inhibitory effects on the growth and cell permeability of various species of pathological bacteria. It is reported that, the MO root extract contain pterygospermin that has powerful antibacterial and fungicidal effects [31-35]. Ethanolic extract of MO root bark contain deoxy-niazimicine found to be antibacterial and antifungal activities [36-38].

Anti-Inflammatory activities

Inflammation is important part of immune system and it protects the body against injury and trying to heal itself [39]. However, longer time chronic inflammation lead to diseases such as diabetes, autoimmune diseases, cardiovascular

diseases, cancer, and arthritis etc., [40-43]. It is reported that the MO aqua-alcoholic seed extract can reduce distal colon weight as a marker of inflammation and tissue edema, ulcer and mucosal inflammation severity in acetic acid-induced acute colitis rat models [44]. Thus the MO extracts can be considered as an alternative solution for inflammatory bowel disease. One more studies that MO seed extract conatin enriched isothiocyanate which showed significant reduction in carrageenan-induced rat paw edema, which is comparable to aspirin.

Anticancer Property of *M. oleifera*

It is known that cancer is the second major cause of death around the globe, thus effective treatment without side effects is needed immediately. The existing chemotherapeutic based drugs quit costly and often produce side effects. Several epidemiological studies based on plant extracts have been developed to treat breast, lung, and colon cancer [45-47]. MO plant leaves extracts possesses effective inhibitory action on the growth of breast, pancreatic, and colorectal cancer cells [48-50]. There are studies that moringa contains moringa isothiocyanates may open up a new way to treat cancer effectively in its early stage.

Enzyme regulating Activity of MO plant extracts

MO plant parts extracts can restore the loss of enzymes such as GSH and GST activity which offer vital role in carcinogenesis [51]. The MO aquoues-alcoholic extract could progress the levels of hepatic cytochrome. There are studies that MO shown antioxidant properties which is correlated with chemo preventative activities. Thus it is known from literature that MO extracts inhibits cell proliferation, suppress angiogenesis, and enhances drug metabolism.

Blood Glucose level modulatory activity of MO extracts

Diabetes mellitus is a metabolic disorder and MO leaves extracts have been reported for the treatment of this metabolic disorder [52]. For instance, it is reported that MO extracts has shown to progress plasma glucose disposal in Goto-Kakizaki rats. Another reports that methanolic extract of MO suppress cyclooxygenase activity, and inhibits lipid peroxidation diabetic induced rats [53]. MO extracts has also regulate glucose levels in alloxan-induced type II diabetic rats without giving any adverse side effects, it is reported [54]. Another report that MO leaves extracts decreased blood glucose level because the extract contains polyphenols (quercetin-3-glycoside, rutin, kaempferol and glycosides) [55].

Conclusions

MO has essential phytochemicals which possesses potent anti-inflammatory activity, Anti-fungal, anti-microbial, blood glucose level regulating activity, anti-cancer activity and enzyme regulating activities. MO reduces the oxidative stress by scavenging free radicals. MO also enhances the neuroprotective activities. In addition, MO has the capability of reducing the risk of cancer. Thus, the abundant MO plant parts gives a potential to treat various ailments. However, in this regard, the detailed research and developmental activities required both invivo as well invitro are required. This exploration of research and developmental activities allow rational and accurate recommendation of phytochemical constituents. Further standardisation of MO plant extracts needs to be evaluated in a detailed manner.

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