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Sahjana (*Moringa oleifera*), pharmacognosy and pharmacology: A review

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Abstract

Moringa oleifera is an edible plant with a wide variety of nutritional and medicinal virtues, which have been attributed to its roots, bark, and leaves, flowers, fruits and seeds. It has medicinal properties.

Keywords: *Moringa oleifera*, medicine, phytosterols

Introduction

Moringa oleifera is an edible plant with a wide variety of nutritional and medicinal virtues, which have been attributed to its roots, bark and leaves, flowers, fruits and seeds [1]. *Moringa oleifera* is one of the vegetables of the Brassica order and belongs to the family Moringaceae. The Moringaceae is a single genus family with 13 known species [2]. Moringa is rich in nutrition owing to the presence of a variety of essential phytochemicals present in its leaves, pods and seeds. In fact, moringa is said to provide 7 times more vitamin C than oranges, 10 times more vitamin A than carrots, 17 times more calcium than milk, 9 times more protein than yoghurt, 15 times more potassium than bananas and 25 times more iron than spinach [3]. Moringa is rich in phytosterols like stigmasterol, sitosterol and campesterol which are precursors for hormones. These compounds increase the estrogen production, which in turn stimulates the proliferation of the mammary gland ducts to produce milk. It is used to treat malnutrition in children younger than 3 years [4].

Nutritive properties

Every part of *M. oleifera* is a storehouse of important nutrients and antinutrients. The leaves of *M. oleifera* are rich in minerals like calcium, potassium, zinc, magnesium, iron and copper. Vitamins like beta-carotene of vitamin A, vitamin B such as folic acid, pyridoxine and nicotinic acid, vitamin C, D and E also present in *M. oleifera* [5]. Phytochemicals such as tannins, sterols, terpenoids, flavonoids, saponins, anthraquinones, alkaloids and reducing sugar present along with anti-cancerous agents like glucosinolates, isothiocyanates, glycoside compounds and glycerol-1-9-octadecanoate. Moringa leaves also have a low calorific value and can be used in the diet of the obese. The pods are fibrous and are valuable to treat digestive problems and thwart colon cancer [6].

Leaves

Moringa leaves contain fiber, fat proteins and minerals like Ca, Mg, P, K, Cu, Fe and S. Vitamins like Vitamin-A (Beta-carotene), vitamin B-choline, vitamin B1-thiamine, riboflavin, nicotinic acid and ascorbic acid are present. Various amino acids like Arg, His, Lys, Trp, PheThr, Leu, Met, Ile, Val are present. Phytochemicals like tannins, sterols, saponins, terpenoids, phenolics, alkaloids and flavonoids like quercetin, isoquercetin, kaemfericitin, isothiocyanates and glycoside compounds are present. The presence of minerals and vitamins help in boosting the immune system and cure a myriad of diseases [6]. Seeds contains oleic acid (Ben oil), antibiotic called pterygospermin and fatty acids like Linoleic acid, linolenic acid, behenic acid, Phytochemicals like tannins, saponin, phenolics, phytate, flavonoids, terpenoids and lectins. Apart from these, fats, fiber, proteins, minerals, vitamins like A, B, C and amino acids. The presence of flavonoids gives its anti-inflammatory property. The antibiotic pterygospermin is responsible for antimicrobial properties [7].

Root bark

Alkaloids like morphine, moriginine, minerals like calcium, magnesium and sodium. The alkaloid helps the bark to be antiulcer, a cardiac stimulant and helps to relax the muscles [8].

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Flower

It contains calcium and potassium and amino acids. They also contain nectar. The presence of nectar makes them viable for use by beekeepers.

Pods

Rich in fiber, lipids, non-structural carbohydrates, protein and ash. Fatty acids like oleic acid, linoleic acid, palmitic acid and linolenic acid are also present. The presence of PUFA in the pods can be used in the diet of obese ^[9].

Table I: Physical and chemical parameters ^[10].

Iodine value		68.00-71.80
Refractive index (40 °C)		1.4590-1.4625
Density (24 °C)		0.9036-0.9080 mg/ml
Saponification value		180.60-190.50
Unsaponifiable matter		0.70-1.10%
Colour (1 in. cell)		0.95-1.10 R + 20.00-35.30 Y
Oleic acid		78.59%
Tocopherols (in the oil were up to)	alpha	123.50-161.30 mg/kg
	gamma	84.07-104.00 mg/kg
	delta	41.00-56.00 mg/kg
Palmitic acid		7.00%
Stearic acid		7.50%
Behenic acid		5.99%
Arachidic acid		4.21%

Pharmacology

Moringa oleifera Lam. (Family: Moringaceae) is a tree cultivated for different purposes such as medicine, vegetable, spice, for cooking and cosmetic oil. It is known as Drumstick in English, Saragvo in Gujarati, Sohanjna in Hindi, Sajna in Bengali, Nugge in Kannada, Shigru in Malayalam, Shevga in Marathi, Shobhanjana in Sanskrit, Munaga in Telugu and Murungai in Tamil. All parts of the tree are considered to possess medicinal properties and used in the treatment of ascites, rheumatism and venomous bites and as cardiac and circulatory stimulant ^[11].

Medicinal properties

Anti-inflammatory

Anti-inflammatory activity of leaf extract has been observed in a carrageenan-induced paw edema model. Extracts of bark showed anti-inflammatory activity comparable to diclofenac in the same model. Anti-inflammatory properties of root have also been reported. Mechanism underlying the anti-inflammatory activity may be attributed to the regulation of neutrophils and c-Jun N-terminal kinase pathway. Active ingredients contributing to anti-inflammatory property are tannins, phenols, alkaloids, flavonoids, carotenoids, β -sitosterol, vanillin, hydroxymellein, moringine, moringinine, β -sitostenone and 9-octadecenoic acid ^[12].

Anti-diabetic properties

Moringa has been shown to cure both Type 1 and Type 2 diabetes. Type 1 diabetes is one where the patients suffer from non-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. 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 ^[13].

Anticancer properties

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. Cancer treatments like surgery, chemotherapy and radiation are expensive and have side effects. *M. oleifera* can be used as an anticancer agent as it is natural, reliable and safe, at established concentrations. Studies have shown that moringa can be used as an antiproliferative 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 may be due to its ability to induce reactive oxygen species in the cancer cells ^[14].

Other diseases

Moringa can be used as a potent neuroprotectant. Cerebral ischemia is caused due to obstruction of blood flow to the brain. This leads to reperfusion and lipid peroxidation, which in turn results in reactive oxygen species. Moringa with its antioxidants can reduce the reactive oxygen species, thereby protecting the brain. *M. oleifera* is used to treat dementia, as it has been shown to be a promoter of spatial memory ^[15].

Antioxidant activity

MO fruits and leaves have antioxidant properties. Extract of leaf showed a concentration-dependent increase in glutathione level and a decrease in malondialdehyde level, fruit extract showed beneficial results in eliminating free radicals, extract of roots significantly reduced iron and FeSO₄-induced microsomal lipid peroxidation in a dose-dependent manner. Pods were capable of scavenging peroxy, superoxol and 2, 2-diphenyl-2-picryl hydrazyl (DPPH) radicals ^[16].

Cardiovascular activity

Extract of MO leaf significantly reduced cholesterol levels and displayed a protective role on hyperlipidemia induced by iron deficiency in male Wistar rats. Antihypertensive effect of leaf extract on spontaneous hypertensive rats was shown, in addition to reduced chronotropic and inotropic effects in isolated frog hearts. Active constituents for hypotensive action are niazinin A, niazinin B and niazimicin ^[17].

Gastroprotective and anti-ulcer activities

Extract of leaves remarkably reduced ulcer index in ibuprofen-induced gastric ulcer model and in pyloric ligation test and a significant reduction in cysteamine-induced duodenal ulcers and stress ulcers was also observed. Bisphenols and flavonoids could be contributing to this property.

Antiasthmatic activity

Extract of seeds showed protection against asthma as investigated in various models; the proposed mechanism for this effect was a direct bronchodilator effect combined with anti-inflammatory and antimicrobial actions and inhibition of immediate hypersensitive reaction. Ethanol extract of seeds tested against ovalbumin-induced airway inflammation in guinea pigs showed a significant increase in respiratory parameters and reduction in interleukins in bronchoalveolar lavage ^[18].

Anti-obesity activity

Significant reduction in body mass index was observed after oral treatment with leaf powder compared with that in obese control. Treatment of hypercholesterolemia rats with methanolic extract of MO leaf for 49 days showed a remarkable reduction in total cholesterol, triglycerides and body weight, moreover, liver biomarkers, organ weight and blood glucose levels were also decreased. Mechanisms include downregulation of mRNA expression of leptin and resist in and upregulation of adiponectin gene expression in obese rats [19].

Wound-healing activity

Extracts of leaf, dried pulp, and seeds showed a significant increase in hydroxyproline content, wound-closure rate, granuloma-breaking strength, and granuloma dry weight, and a decrease in scar area and skin-breaking strength in incision, excision, and dead space wound models in rats.

Antidiarrheal activity

Extract of seeds showed significant reduction in gastrointestinal motility and were found to be effective in castor oil induced diarrhoea in male Wister rats. Antidiarrheal activity can be attributed to phytochemical ingredients such as tannins, saponins, and flavonoids [20].

Immunomodulatory activity

Methanolic extract of this plant stimulated both humoral and cellular immune response. In addition, extract showed an increase in optical density and stimulation index, indicating splenocyte proliferation.

Commercial applications

Moringa seeds are used to extract oil called the Ben oil [21]. This oil is rich in oleic acid, tocopherols and sterols. It can also withstand oxidative rancidity. The oil can be used in cooking as a substitute for olive oil, as perfumes and also for lubrication. The pods can absorb organic pollutants and pesticides. Moringa seeds also have great coagulant properties and can precipitate organics and mineral particulates out of a solution. Chemical coagulants such as aluminum sulfate (Alum) and ferric sulfate or polymers removes suspended particles in waste water by neutralizing the electrical charges of particles in the water to form flocs making particles filterable [22]. *M. oleifera* seed is a natural coagulant, containing a cationic protein that can clarify turbid water. This property of *M. oleifera* seeds is attracting much research as other coagulants such as alum, activated carbon and ferric chloride are expensive and rare. A two stage clarifier was developed for the treatment of tapioca starch waste water by placing coconut fiber followed by a layer of sand media mixed with powdered *M. oleifera*, this leads to improvement on physical and chemical characteristics, stabilizing pH value. Moringa seed extract has the ability to eliminate heavy metals (such as lead, copper, cadmium, chromium and arsenic) from water. *M. oleifera* functionalized with magnetic nanoparticles such as iron oxide were found beneficial in surface water treatment by lowering settling time. Seed extracts have antimicrobial properties that inhibit bacterial growth, which implies preventing waterborne diseases [23]. These properties of *M. oleifera* seeds have wide applicability in averting diseases and can enhance the quality of life in rural communities as it is highly abundant.

Conclusion

Authors found that *Moringa oleifera* had medicinal value and is useful in variety of diseases.

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