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A Pharmacological Approaches on moringa oleifera Plant- a Brief Review

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Abstract

In the last few decades use of traditional drugs has led to the popularization of herbal drugs because of their lesser side effects. This has led to the exploitation of the natural origin of many traditional plants for their pharmacological activities. *Moringa oleifera* one such traditional plant contains flavonoids, rhamnose, glucosinolate, isocytosinate, phenolic acids, carotenoids, tocopherols, vitamins and polyunsaturated fatty acids which shows anti-microbial, anti-fungal, hepatoprotective, anti-cancer, anti-diarrheal, anti-inflammatory, immunomodulatory and other pharmacological activities. The present review is to highlight the phytoconstituents, pharmacological effects and uses of *Moringa oleifera* over various diseases.

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Introduction

Medicinal plants constitute an important natural wealth of a country. They play a significant role in providing primary health care services to the rural population. They serve as therapeutic agents as well as important raw materials for the materials for the manufacture of traditional medicines [1]. *Moringa oleifera* Lam (*M. oleifera*) is a cruciferous plant in the *Moringaceae* family. *M. oleifera*, also known as horseradish tree or drumstick tree by locals, is a popular in several parts of the world [2]. *M.oleifera* is recognized as "The Miracle Tree" due to its versatile, extremely nutritious and nutraceutical potential uses [3]. National Institute of Health (NIH) has honored this plant as "Botanical of the year-2007". *M. oleifera* is consumed not only for its nutritional value, but also for its medicinal properties [4]. *M. oleifera* are rich in beta-carotene, vitamin C, vitamin E and polyphenols are a good source of natural antioxidants [5]. Currently, *M. oleifera* is reported to enhance a broad range of biological functions including anti-inflammatory, anti-cancer, hepatoprotective and neuroprotective functions. Further more studies have shown that it has anti-diabetic, anti-rheumatoid arthritis, anti-atherosclerosis, anti-infertility, pain relief, anti-depression, diuretic and thyroid regulation properties [6].

Morphology

Moringa oleifera is a tropical deciduous perennial dicotyledonous tree. The stem is brittle with a corky, whitish-gray bark, drooping branches, pale green and bipinnate or more commonly tripinnate leaves (30-60 cm long) with opposite, ovate leaflets [7]. Roots have the taste of horseradish. The twigs are finely hairy and

green. Flowers are white, scented in large axillary down panicles, pods are pendulous, ribbed and seeds are triangle [8].

Fig 1 *Moringa oleifera*

Phytochemical Composition

Drumstick tree is rich in the compounds especially common sugar, rhamnose, glucosinolate, isocytosinate, flavonoids and phenolic acids, carotenoids, tocopherols, polyunsaturated fatty acids (PUFAs), highly bioavailable minerals etc. In the stem, leaves, flowers, pods and seeds of *M. oleifera*, 4-O-(a-L-rhamnopyranosyloxy)-benzylglucosinolate (glucomoringin) predominates among glucosinolate [9]. Its stem bark is comprised of two alkaloids namely moringinine and moringine [10]. Different parts of the *M.Oleifera* tree have most abundant minerals such as zinc (Zn), sodium (Na), iron (Fe), calcium (Ca), potassium (k), copper (Cu), manganese (Mn) and magnesium (Mg) [11]. A total of 32 metabolites were found in the leaf and stem tissues of *M. oleifera* out which 22 were found in both stem and leaf tissues. Only stem tissues contained glutamine, tryptophan and glutamate while only leaf tissues contained p-cresol, tyrosine, guanosine, adenosine and 4-aminobutyrate [12]. The glutamine, tryptophan and glutamate were present only in stem tissues while p-cresol, tyrosine, guanosine, adenosine and 4-aminobutyrate were found only in leaf tissues [13].The purified whole-gum exudate of *M. oleifera* shows the presence of D-glucose, D-xylose, L-rhamnose, L-arabinose, D-mannose and D-galactose. Whereas the degraded gum was found to contain L-glucose, L-mannose (6-O) and L-galactose [14]. The ethanolic extracts of flowers of *M.oleifera* have shown the presence of Dodecanal, Decanoic acid, Sipo, Ocenol, Satol, Oleol, cis-9-Octadecen-1-ol and 9-Octadecen-1-ol [15]. Another study found that the flowers contained Kaempferol-3-rutinoside and that the leaves contained alanine, aspartic acids, valine, glycine, glutamic acids, threonines, leucines, methionines, cysteines, tryptophans, phenylalanines, lysines, histidine and isoleucines [16]. Meanwhile, the steam was examined for the presence of β-sitoster. Additionally, it has been claimed that seeds contain a number of amino acids, 4-(L-rhamnosyloxy) benzyl isothiocyanate and moringyne. Benzyl Isothiocyanate was reported in *Moringa* roots [17].

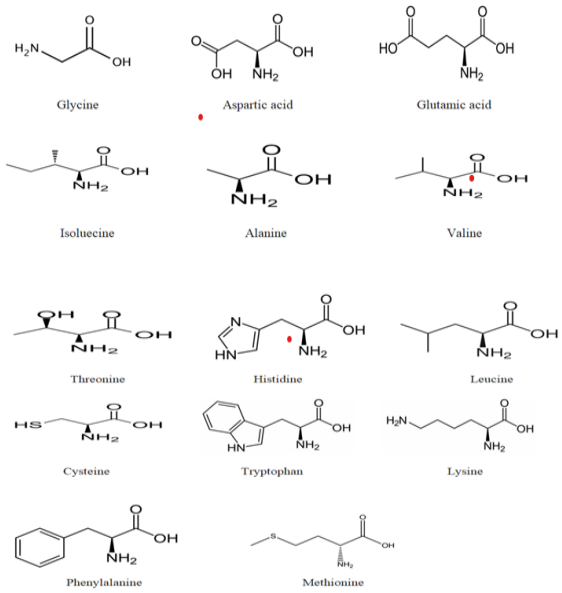

Fig 2 Isolation of phytochemical properties

Ethno-Medical Properties and Uses

The therapeutic qualities of the *M.oleifera* species are well-known. *Moringa* provides a rich and rare combination of nutrients, amino acids, anti-oxidants, anti-aging and anti-inflammatory properties used for nutrition and healing. It is used to treat malnutrition [18]. It has been used for treating skin infections, anemia, anxiety, asthma, blood impurities, bronchitis, chest congestion, cholera, conjunctivitis, cough, diarrhea, eye and ear infections, fever, glandular, swelling, abnormal blood pressure, hysteria, psoriasis, respiratory disorders, semen deficiency, sore throat, tuberculosis, diabetes, pregnancy and even for treating intestinal worms. *Moringa* oil has tremendous cosmetic value and is used in body and hair care as a moisturizer and skin conditioner [19, 20].

Pharmacological Properties

Antioxidant activity

Various studies have been done to investigate the antioxidant activities of various plant parts (leaves, flowers, pod, seed, stem, bark and root etc) of *M. oleifera* plant. In vitro and in vivo antioxidant activity was determined using the 1, 1-diphenyl-2-picrylhydrazyl (DPPH), free radical scavenging assay 2, 2-azino-bis 3ethylebenzothiazoline-6-sulfonic acid (ABTS) and

organic solvents such as methanol and acetone extract from leaves and aqueous extract from roots [21].

Antibacterial activity

Antibacterial activities of different parts of plants including leaves, seeds and pods have been reported against enteropathogens wound bacteria's such as, *E. coli, S. typhi, P. aeruginosa, E. cloace, P. vulgaris, S. aureus, M. kristinae, E. aerogenes, Shigella, B. cereus, Streptococcus-B-haemolytica, B. subtilis, K. pneumonia, B. megaterium* [22].

Immunomodulatory activity

M. oleifera extract showed both immunosuppressive and immunomodulatory activity. Due to the presence of isothiocyanate and glycoside cyanides compounds in *M. oleifera* leaves. The cyclophosphamide-induced immunosuppression has been decreased by stimulating the cellular and humoral immunity. Additionally, the plant activated the immunomodulatory system using animal experimental models of cellular and humoral immunity [23].

Anticancer activity

Cancer is a deadly disease that spreads rapidly in humans. It has been demonstrated that various parts of plants including the stem, fruit and leaves of *M. oleifera* are effective in preventing cancer. Different analysis was carried on animals for the confirmation of the advantages of *M.oleifera* leaves, which inhibit cancerous diseases in rats with hepatic carcinomas [24]. *M. oleifera* leaf extract prevented cancerous human alveolar epithelial cells from proliferating and invading [25].

Neuroprotective activity

As a result of neural survival and neurite outgrowth, the *M. oleifera* extract had a neuroprotective effect. It also prevents Alzheimer's disease by altering electrical activity and brain monoamine levels. It has been claimed that M. oleifera leaves have a high concentration of polyphenols and other antioxidant compounds that scavenge free radicals or activate cellular antioxidant system by protecting the neuron system [26].

Cardio-protective activity

Cardio-defensive effect of *M.oleifera* extract of different parts of plants was studied in a rat model with the isoproterenol (ISP)-induced model of myocardial damage. Because chronic use of *M. oleifera* showed a slowing effect on isoproterenol-induced hemodynamic disorganisation, the extract of *M. oleifera* had a neuroprotective effect. The modulation of the long-term effects of *moringa* treatment with biochemical enzymes like superoxide dismutase, glutathione peroxidase, catalase, lactate dehydrogenase and creatine kinase-MB was found to be significantly favourable. It was discovered that the antioxidant, antiperoxidative and myocardial preservative properties of the leaf extract were responsible for the cardio protective effect. The *M. oleifera* treatment reduced the rate of lipid peroxidation growth in myocardial tissues. Additionally, *M. oleifera* reversed the ultra structural disturbance and harmful histopathological effects brought on by isoproterenol [27].

Anti-inflammatory activity

Moringa oleifera extracts from the leaf, seeds, pods, flowers and roots have been found to have strong anti-inflammatory properties. The presence of 4-[(-hamnosyloxy) benzyl] isothiocyanate, 4-[(4-O-acetyl—L-rhamnosyloxy) benzyl] isothiocyana, kaempferol glucosides, quercetin and other compounds was observed in these various parts. The compounds 3, 5-dihydroxy-6-methyl-2, 3-dihydro-4H-pyran-4-1, 9-octadecenamide, 1, 3-dibenzyl urea and aurantiamide acetate are 4-(2-O-acetyl—L-rhamnosyloxy) benzyl isothiocyanate, 4-(3-O-acetyl—rhamnosyloxy) benzyl sothi Rats weighing 120 to 160 g were used to study the anti-inflammatory effects of root aqueous extract. The dose of 750 mg/kg administered at 1, 3 and 5 hours inhibited the development of edema. The pod extract has reportedly been shown to improve inflammatory-related disorders like allergic rhinitis, asthma, cancer, rheumatoid arthritis and atopic dermatitis [28].

Antifungal activity

Inhibition of the fungal activity of leaves, stem and seeds of *Moringa* against *A. niger, A. flavus, A. terreus, A. oryzae, A. nidulans, C. cladosporioides, F. solani, P. sclerotigenum, Penicillium sp., Pullarium sp., R. solani*, mentagrophyte and Dermatophytes have been observed. The antifungal activity of *Moringa* leaf extract was analysed using the agar well diffusion method. While aqueous extract was found to be more effective against *Saccharomyces cerevisiae* and leaf extract was reported to be active against *Candida albicans* and *Aspergillus Niger*. The *Moringa oleifera* seed extract demonstrated antifungal action against a variety of fungi, including dermatophyte, non-dermatophyte and yeast, which have been differentiated from the fungal infection of human nail and skin [29].

Antiviral activity

Herpes simplex viruses were resistant to the antiviral effects of a *Moringa oleifera* extract (HSV-1). *M. oleifera* extract has been shown to inhibit the activity of HSV-1 in mice that lacks kinase and is resistant to phosphonoacetate. The extract was administered at a

dose of 750 mg/kg to stop the skin lesions, lower the mortality rate and lengthen the mean survival time of the infected mice. Cellular immunity in mice with herpetic skin lesion and HSV-1 infection was reduced by using *M. oleifera* leaf extract. The antiviral activity of *M. oleifera* seed oil was also examined against HSV. Niaziminin and 4-[(4′ -Oacetyl-alpha-L-rhamnoxyloxy) benzyl] isothiocyanate both reduced the activity of the Epstein-Barr virus. At the concentration of 1-50 μg/mL dose, inhibited the foot and mouth diseases virus concentration. Hydroalcoholic extract of *Moringa* leaves has been shown to reduce the ccDNA level of the hepatitis B virus (HBV) in HepG2 cells [30].

Fibrosis

According to *Fakurazi S et al.,* (2008) the renal dysfunction is caused by kidney fibrosis, which is described as a radical buildup of harmful connective tissue on the kidney parenchyma. The main cause of kidney fibrosis is epithelial to mesenchymal transition (EMT) and the TGF-1-SMAD pathway and hypoxia are known to be the main regulators of EMT. *M. oleifera* extract inhibits TGF-induced expression of fibronectin, type I collagen, and PAI-1 in rat kidney fibroblast cells. Furthermore, the phosphorylation of SMAD4 and ERK expression caused by TGF-β was selectively inhibited by *moringa* root extract. These findings imply a potential mechanism by which moringa root extract may lessen renal fibrosis through its anti fibrotic activity in rat kidney fibroblast cells. Rats with CCl4-induced liver fibrosis had their fibrosis reduced by taking *M. oleifera* seed extract orally [31].

Antispasmodic and Antitumor activity

According to *Gilani AH et al.,* (1994) the pharmacological studies of *Moringa* leaves, ethanol extract and its constituent have antispasmodic activity that is most likely caused by calcium channel blockades. Blood pressures are stabilized by the juice of *moringa* leaves. The anti-spasmodic properties of its roots and the potential anti-tumor properties of its leaves come from *Moringa*. Because it contains a variety of bioactive substances, *moringa* is a potent anticancer plant. Niazimicin and thiocarbamates, in particular are bioactive substances that give *M. oleifera's* leaves powerful anticancer properties. The various plant components exhibit spasmolytic activity, supporting the plant's traditional use in gastrointestinal motility disorders [32].

Hepatoprotective activity

Extract of leaves has shown hepatoprotective effects against carbon tetrachloride and acetaminophen-induced liver toxicity in Sprague Dawley rats and also hepatoprotective effect against antitubercular drugs and alloxan-induced liver damage in diabetic rats. This plant-based diet for 21 days showed significant potential in attenuating hepatic injury. Alkaloids, quercetin, kaempferol, flavonoids, ascorbic acid and benzylglucosinolate were found to be responsible for hepatoprotective activity [33, 34].

Hematological activity

According to *Suzana D et al.,* (2017) a randomized, double-blind, placebo-controlled study was carried out on women who were anemic with hemoglobin levels between 8 and 12g/dL and were treated with aqueous extract of moringa leaf, the results showed an increase in mean hemoglobin and mean corpuscular hemoglobin concentration [35].

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 action 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 [36, 37].

Conclusion

As per the review, it is concluded that the plant *Moringa oleifera* is having ample phytoconstituents i.e., flavonoids, phenolic acid, glycosides, isocytosinate, carotenoids, tocopherols, polyunsaturated fatty acids and glucosinolates which are related to many pharmacological activities briefly discussed in this review. It is an ethno medicinal herb utilized by traditional healers to control various diseases like asthma, fever, diarrhea, cough, chest pain etc. This indicates the medicinal significance of the plant. Various studies have been conducted on this plant to explore possible pharmacological activities. It opens a new arena for researchers to prove its therapeutic effect by researching at a molecular level.

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