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A COMPREHENSIVE REVIEW ON MEDICINAL PROPERTIES OF *MORINGA OLEIFERA*

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Abstract: *Moringa oleifera* Lam., often identified to as drumstick tree, is acknowledged as a rich and cost-effective source of photochemical with medical uses. Numerous studies outlining its nutritional and therapeutic qualities have been published in reputable scientific journals during the previous 20 years. *M. oleifera's* development is assumed to be driven by bioactive components such as flavonoids, phenolic acids, alkaloid compounds, phyptosterols, natural sugar, minerals, vitamins and organic acids. Moringa plant extracts are effective in medicine, supplements, water purification, and biodiesel production. Moringa is rich in phytochemicals such as tannins, alkaloids, steroids, and reducing sugars. Ideal temperatures for *M. oleifera* cultivation in tropical and subtropical regions: 25-35°C. Ideal soil for growth requires loamy or sandy composition, pH mildly acidic to slightly alkaline, and 250-3000 mm net rainfall. Tree cuttings, 4-5cm in diameter and 1m long, have weaker roots and are wind and drought-sensitive. Spacing is vital for commercial agriculture, aiding plant management and harvesting. *M. oleifera* nutrients vary across sites. Spacing is vital for commercial agriculture, aiding plant management and harvesting. *M. oleifera* nutrients vary across sites. Leaf extracts show dose-dependent antimigraine and analgesic effects like indomethacin. Leaf extract changes brain activity, protecting against Alzheimer's disease. Adding leaf extract to chick membrane had antiangiogenic effect. Both normal and diabetic rats' glucose levels were decreased by leaf extract. Ethanol-infused leaf extract demonstrated antibacterial action against all tested bacteria. It possesses neuropharmacological activity, anticancer activity, antioxidant property, antidiabetic property, antimicrobial activity, and effects on the reproductive system in addition to pharmacological activities like analgesic, anti-inflammatory, and antipyretic properties. Cardiovascular, anti-obesity, and gastroprotective and anti-ulcer properties.

Keywords: *Moringa Oleifera*, taxonomical classification, Nutritional compositions, Phyto- constituent's, Pharmacological activities

INTRODUCTION

In recent decades, the utilization of herbal therapy has expanded at a rapid pace. Due to its natural origin and lesser negative consequences, it is gaining appeal in developed as well as developing nations. Ayurveda, Yoga, Unani, Siddha, Homeopathy, and Naturopathy make up the majority of the officially recognized health systems in India, with the exception of Allopathy[(1)] .Often referred to as horseradish tree, ben oil tree, or benzoil tree,In many tropical places, *Moringa oleifera* Lam is the most commonly grown plant of the monogeneric family. The plant is native to northwestern India, and widely cultivated in tropical and subtropical area[(2)]. The tiny, deciduous *Moringa oleifera* tree has scant leaves. The tree may attain a height of 8 meters, and its wide, open crown contrasts with its seamless dark gray bark with slight golden slashes. The big, alternating leaves have opposing approximately 5 centimeters apart along the central stalk are pinnae, which are typically paired with an opposing has leaflets in opposing pairs and has pinnae. Leaflets are whitish on the underside and dark green on the underneath, varying in length and form but often round and elliptic, measuring up to 2.5 cm. All year, loose lateral panicles up to 15 cm long produce flowers with a nice aroma.The fruit is large and distinctive, with two grooves on each face and measuring up to 80 cm long and 12 mm diameter.It progressively taper to a point with three or four angles. It splits at each angle, exposing rows of cylindrical, oily, darkened seed having two papery wings on each[(3)]. As a folk remedy, it has historically been used to cure ulcers, wound healing, cancer, obesity, anemia, and liver illness [(4)]. Moringa is also considered essential due of the extraordinary drought and dryness tolerance of its tuberous roots. The stems, leaves, the roots, seeds, and green-colored pods of the plant known as Moringa have been shown to be effective in medical operations, nutraceuticals, and water and biodiesel filtration.Essential phytochemicals found in moringa include tannins, alkaloids, steroids and reducing sugar [(5)]. Furthermore, *Moringa oleifera* plants are high in nutrients, polyunsaturated fats, phenols as well glucosinolates, vitamin E, carotenoids, and ascorbic acid [(6)].

Fig. No. 1: Leaf of *Moringa oleifera*

Taxonomic classification of *M. oleifera*[7]

Table No. 1 Taxonomic classification of *M. oleifera*

Kingdom	**Plantae**
Superkingdom	Tracheobionta
Superdivsion	Spermatophyta
Division	Mangnoliophyta
Class	Mangnoliopsida
Subclass	Dilleniidae
Order	Capparales
Family	Moringaceae

Common Name of *M. oleifera* [8]

Table No. 2 Common Name of *M. oleifera*

Language	**Common Name**
Latin	*Moringa oleifera*
Sanskrit	Subhanjana
Hindi	Saguna, Sainjana
Marathi	Shevga
Gujarati	Suragavo
English	Drumstick tree, Horseradish tree, Ben tree

Ayurveda	Haritashaaka Tikshnagandhaa
Unani	Sahajan

PLANTATION AND SOIL CONDITION

Temperatures between 25 and 35 degrees Celsius are ideal for growing *M. oleifera*throughout all of the world's tropical and subtropical areas planet. It requires 250–3000 mm of net rainfall and loamy or sandy soil with a pH range of moderately acidic to slightly alkaline. Because direct seeding has a high percentage of germination, it is used. Moringa seeds can be inserted into the ground at a depth of 2 cm, and they are predicted to sprout 5 to 12 days after being planted. Containers can also be used to spread moringa. Sand or loamy soil is put into plastic bags with the seedlings. It can be moved once it reaches a height of around 30 cm. The tap roots are delicate and prone to damage, thus great caution must be used while transplanting.The tree can also be grown from cuttings that are 4-5 cm in diameter and 1 m long, however these plants might not have strong, deep roots. Usually, these plants are vulnerable to wind and dryness. Commercial uses are possible for large-scale, intense, and semi-intensive moringa plantations. In commercial agriculture, spacing is essential because it makes managing plants and harvesting easier. The total quantity of nutrients present in M. oleifera differs depending on where it is grown [9].

NUTRITION COMPOSITION OF LEAVES [10]

Table No. 3 Nutrition composition of leaves

Nutrition	Fresh Leaves	Dry leaves
Calories (cal)	92	329
Proteins (g)	6.7	29.4
Fat (g)	1.7	5.2
Carbohydrate (g)	12.5	41.2
Fibre (g)	0.9	12.5
Vitamin B1 (mg)	0.06	2.02
Vitamin B2	0.05	21.3

(mg)		
Vitamin B3 (mg)	0.8	7.6
Vitamin C (mg)	220	15.8
Vitamin E (mg)	448	10.8
Calcium (mg)	440	2185
Magnesium (mg)	42	448
Phosphorus (mg)	70	252
Potassium (mg)	259	1236
Copper (mg)	0.07	0.49
Iron (mg)	0.85	25.6

PHYTOCONSTITUENTS IN *M.OLEIFERA* LEAF

The major phytochemical are carotenoids [11], tocopherols [12], flavonoids, phenolic acids [13], folate [14], polyunsaturated fatty acids [15], and various minerals [16]. A total of 35 compounds were found in a study on the plant's leaf using gas chromatography–mass spectrometry. Gamma-sitosterol, beta-1-rhamnofuranoside, n-hexadecanoic acid, tetradecanoic acid, cis-vaccenic acid, octadecanoic acid, palmitoyl chloride, and 5-O-acetyl-thio-octyl were among the significant chemicals found [17]. It was discovered that the most prevalent carotenoid in leafage was e-lutein. [18]

PHARMACOLOGICAL ACTIVITIES

Anti-inflammatory, Antipyretic and Analgesicactivities

Leaf extracts demonstrated dose-dependent antimigraine effects [19] and analgesic effectiveness comparable to indomethacin [20]. Topical treatment shown effectiveness against neuropathic pain brought on by multiple sclerosis [21]. Significant antipyretic efficacy was demonstrated by leaf extract in a model of pyrexia caused by Brewer's yeast [22]. A paw edema model created by carrageenan has been used to demonstrate the anti-inflammatory qualities of leaf extract [23].

Neuropharmacological activity

Leaf extract has been shown to protect against Alzheimer's via changing the electrical activity and monoamine levels in the brain [24]. A different study found that the toluene-ethyl acetate constituent of the methanolic extract of leaves had strong nootropic effect. Both Vitamins C and E, found in leaf extract, are crucial for improving cognition in Alzheimer's patients [25].

Anticancer activity

In research using mouse melanoma tumor models, fruits and extracts from leaf, both alcoholic and hydro-methanolic, exhibited a considerable growth delay in tumor kinetics [26]. On A549 lung cells, the leaf extract also shown antiproliferative action [27]. Examining the impact on the conditions needed for cancer metastasis revealed that adding leaf extract to the chick chorioallantoic membrane produced a dose-dependent antiangiogenic effect, demonstrating their amazing anti-cancer potential [28].This plant is thought to have anticancer properties due to phytoconstituents such kaempferol and quercetin, as well as niazimicin, carbamates, thiocarbamates, and nitrile glycosides [29].

Anti-oxidant Property

Leaves of *M. oleifera* possess antioxidant properties. Free radicals were effectively eliminated by fruit extract, iron was markedly reduced by root extract, and glutathione and malondialdehyde were shown to increase and decrease in concentration-dependent manner in leaf extract. $FeSO_4$-induced microsomal lipid peroxidation was also significantly reduced by extract of roots [30]. Antioxidant effects have been demonstrated to be contributed by triterpenoids, beta-carotene, campesterol, stigmasterol, β-sitosterol, avenasterol, monopalmitic and di-oleic triglycerides, and vitamin A [31].

Antidiabetic Property

Leaf extract significantly reduced blood sugar levels in both normal and alloxan-induced diabetic rats. The influence of an aqueous extract of leaves on the levels of lipids, body weight, glucose, plasma insulin, examination of the homeostatic model, along with oral glucose tolerance test in insulin-resistant (IR) as well as type 1 diabetic rat models were carefully investigated.High-fructose diets were given to IR rats, while rats with type 1 diabetes received 55 mg/kg of streptozotocin (STZ) treatment. In contrast to STZ-induced diabetic rats, which displayed hyperglycemia and hyperinsulinemia, IR rats gained weight, had hyperinsulinemia, or both. After 60 days of ingesting leaf extract, all of the abnormal parameters returned to normal [32] [33].

Antimicrobial activity

A leaf extract infused with ethanol shown antibacterial action against every tested bacterium. Pathogens such as S. typhi, P. aeruginosa, E. coli, and V. cholerae have been shown to be vulnerable to chloroform extract action [34]. Ethanolic extracts of the roots and bark were found to be antifungal against A. niger, N.crassa, Rhizopus stolonifer, and Microsporum, as well as inhibiting Leishmania donovani. Numerous studies indicate that because seed extracts impededBacterial development in agar as well as nutrient media, they would be a viable choice for purifying water sources [35]. A methanolic leaf extract reduced urinary tract infections caused by Escherichia coli, Staphylococcus aureus, Klebsiella pneumoniae, & Staphylococcus saprophyticus [36]. The antifungal effect was found to be attributed to Pteridosperm, whereas the antibacterial activity was linked to tannins, flavonoids, steroids, alkaloid substances, saponins and and benzyl isothiocyanate [37] [38].

Reproductive system

Testicular weight, seminal vesicle weight, epididymis weight, and scores for epididymal maturity and lumen formation all increased significantly in response to leaf extract (all doses) [(39)]. There has been reports of leaf extract having an abortive effect on rats injected for 10 days after insemination. The extract exhibited an inhibitory effect with progesterone and a synergistic effect with estradiol. About 11,300–23,000 IU of vitamin A may be found in fresh leaves of MO. Vitamin A is important for several anatomical processes, including cell differentiation, immune development, growth and development of the embryo, and reproduction [(40)].

Gastroprotective and anti-ulcer property

In both the pyloric ligation tests along with the ibuprofen-induced stomach ulcer model, leaf extract dramatically reduced the ulcer index. It also reduced the ulcer index in cysteamine-induced duodenal ulcer stress ulcers. Flavonoids and bisphenols may be involved in this characteristic [(41)].

Cardiovascular property

An extract derived from M. oleifera leaf significantly reduced cholesterol and shown protective benefits against hyperlipidemia caused by iron deficiency in male Wistar rats.In addition to reducing the effects of chronotropy and inotropy in frog hearts that were isolated, in rats with spontaneous hypertension, leaf extract was demonstrated to possess an antihypertensive effect. Three substances—niazinin A, niazinin B, and niazimicinare active in the hypotensive activity. [(42)] [(43)].

Anti-obesity activity

When comparing to an obese control group, there was a significant drop in body mass index after ingesting leaf powder orally. After administering an methanolic extract of *M. oleifera*leaf to rats with hypercholesterolemia for 49 days, significant reductions were observed in blood glucose levels, liver biomarkers, triglycerides, and total cholesterol as well as body weight [(44)].

Cosmetic Use

The application of moringa extract topically has the power to revitalize skin and lessen indications of aging [(45)]. The antioxidant and moisturizing properties of a novel skin medication delivery method based on moringa formulation [(46)]. Skin irritation may be decreased by using extract from Moringa oleifera leaves in the model cosmetic formulation [(47)].

CONCLUSION

This article's main goals were to examine the morphology of the *Moringa oleifera* plant, the nutritional elements found in the leaves, and the different pharmacological activities, including those that are antipyretic, analgesic, anti-inflammatory, neuropharmacological, anticancer, antioxidant, antidiabetic, antimicrobial, and beneficial to the reproductive system, cardiovascular, anti-ulcer, and anti-obesity. The phytoconstituents found within the roots, stems, tree bark, leaves, flowers, pod, and seeds may be responsible for these functions.*Moringa oleifera* needs to be used to improve public health because it has a lot of potential as a basis for medicine supplementation. Numerous topical cosmetic properties have also been demonstrated by the *M. oleifera* extract.

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