ROLES OF MORINGA OLEIFERA IN MEDICINE - A REVIEW

Tejashree S. Masurekar¹, Vilasrao Kadam², Varsha Jadhav¹*

¹,²Department of Quality Assurance, Mumbai University, Bharati Vidyapeeth’s College of Pharmacy, sector 8 C.B.D. Belapur, Navi Mumbai-400614, Maharashtra, India.

ABSTRACT

Moringa oleifera (Horseradish Tree) are widely used in the Indian Ayurvedic system of medicine and believed to be used as neutraceutical as well as it increases defence against diseases. This article discusses important Phytochemistry, medicinal values, analytical evaluation of Moringa oleifera (MO). In this communication, we reviewed the applications of MO in as anti-inflammatory, antioxidant, liver treatment, heart disease, ulcer, anaemia and various other diseases. The use of MO as antioxidant, immunosuppressive, and gastro protective are also reviewed. Its applications for protective effects on nephrotoxicity, arsenic induced toxicity are focused. This paper also review the retrospective studies on the Moringa oleifera at molecular level.

KEYWORDS: Moringa oleifera, Diseases, Medicinal value, Formulation.

1. INTRODUCTION

Moringa oleifera (MO) has an important position in Ayurveda- an Indian indigenous system of medicine. It belongs to family Moringaceae. It is also named as Horse-radish tree, Drumstick tree. Other vernacular names of MO have been listed in the Table 1. It is a small, fast growing, evergreen, or deciduous tree that usually grows up to 10 or 12 m in height. The species is native to India and also grows in tropical and subtropical regions it is distributed among Sub Himalayan Tracts, Assam, Bengal and Peninsular India. It has its beneficial role in cancer, diabetes, liver treatment, ulcer, and various other diseases. Similarly, it has application as antioxidant, immunosuppressant, cytoprotective, and gastro protective. Additionally, it is useful in lowering cholesterol level. [¹-⁵] A general description about MO has been summarized in Table 2.
Table 1: Vernacular names of *Moringa oleifera*.

<table>
<thead>
<tr>
<th>SR.NO</th>
<th>VERNACULAR NAMES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Sanskrit: Subhanjana, sohijan</td>
</tr>
<tr>
<td>2.</td>
<td>Hindi: Saguna, Sainjna</td>
</tr>
<tr>
<td>3.</td>
<td>English: Drumstick tree, Horseradish tree, Ben tree</td>
</tr>
<tr>
<td>4.</td>
<td>Gujarati – Suragavo</td>
</tr>
<tr>
<td>5.</td>
<td>Tamil – Morigkai</td>
</tr>
<tr>
<td>6.</td>
<td>Kannada: nugge</td>
</tr>
<tr>
<td>7.</td>
<td>Malayalam: murinna, sigru</td>
</tr>
<tr>
<td>8.</td>
<td>Nepali: shobhanjan, sohijan</td>
</tr>
<tr>
<td>9.</td>
<td>Chinese: la ken</td>
</tr>
<tr>
<td>10.</td>
<td>Spanish: ángela, ben, moringa</td>
</tr>
<tr>
<td>11.</td>
<td>French - Moring à graine ailée, Morungue</td>
</tr>
<tr>
<td>12.</td>
<td>Portuguese: moringa, moringueiro</td>
</tr>
</tbody>
</table>

Table 2: General description of *Moringa oleifera*.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Specification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Habitat</td>
<td>India, Pakistan, Uzbekistan, Srilanka, China, Malaysia, Southeast Asia, West Asia, the Arabian peninsula, East and West Africa</td>
</tr>
<tr>
<td>2.</td>
<td>Used Parts</td>
<td>Fresh fruit, Dried fruits, Seed, Leaves, Root, Bark, Flowers</td>
</tr>
</tbody>
</table>
| 3.      | Fruits        | 1. Ripen from November to February  
2. Nearly spherical or globular, wider than long and with a small and slight conic depression on both apexes  
3. Fruit is 18-25mm wide and 15-20mm long |
| 4.      | Leaves        | 0.9-1.8*0.5-1.2 cm glabrous, spirally arranged, crowded at the end, leaflets stalked, ovate or obovate. |
| 5.      | Flowers       | Bisexual, oblique, stalked, 0.7-1 cm long. Sepals unequal in size 0.7-1.4*0.25-0.5 cm. Petals 5, unequal yellowish white with greenish base. |
| 6.      | Seeds         | Numerous, globular about 1 cm diameter, 3-winged. Wings are produced at the base and apex 2-2.5 cm long, 0.4-0.7cm wide, scarios. |
| 7.      | Bark          | The bark is grey or dark green and rough externally, internally light brown or cream coloured and smooth the pieces of 5-8 cm wide and 10-20 cm in length. |

2. Chemical Constituents of *Moringa oleifera*

MO primarily contains tannins, alkaloids, phenolic compounds, amino acids, sterols and carbohydrates. This plant family is rich in compounds containing the simple sugar, rhamnose, and it is rich in a fairly unique group of compounds called glucosinolates and isothiocyanates. [6-15]

The chemical constituents of MO are summarized in table 3.
Table 3: Chemical Constituents of *Moringa oleifera*.

<table>
<thead>
<tr>
<th>Sr.No.</th>
<th>Part of the plant</th>
<th>Chemical constituents</th>
</tr>
</thead>
</table>
3. Pyrrole alkaloid (pyrroleumarine 400-O-a-L-rhamnopyranoside) and 40-hydroxyphenylethanamide (marumosides A and B)  
4. a and y-tocopherol. |
| 2.     | Pods              | 1. The polysaccharide d-galactose, 6-O-Me-D-galactose, D-galacturonic acid, l-arabinose, and l-rhamnose in a molar ratio of 1:1:1:1  
2. Nitriles, an isothiocyanate and thiocarbamates |
| 3.     | Seeds             | 1. 4-(alpha-l-rhamnopyranosyloxy)-benzylglucosinolate  
2. vitamin-E (0.01%) and Beta carotene (0.014%)  
3. A Glycoside having molecular formula C₁₅H₂₀O₇ named as moringyne. |
| 4.     | Bark              | Moringine And Moringinine  
Phytosterols like Beta-sitosterol, Beta –sitosterone 
Glucosinolates like 4-(α-L-rhamnopyranosyloxy) benzyl glucosinolate. |
| 5.     | Root              | 1. 4-(alpha-l-rhamnopyranosyloxy)-benzylglucosinolate and benzyl Glucosinolate. |

3. Pharmacological Studies

3.1 Antibacterial Activity

The ethanolic, methanolic, chloroform extract of leaves, fruits, seeds, root bark were investigated for the antibacterial, antifungal activity. M. Mashiar Rahman *et al* were investigated the leaf juice and extract for its antibacterial activity against Gram negative bacteria: *Shigella shinga*, *Pseudomonas aeruginosa*, *Shigella sonnei and Pseudomonas* spp. and six Gram-positive bacteria: *Staphylococcus aureus*, *Enterobacter aerogenes*, *Escherichia coli*, *Salmonella typhi*, *Streptococcus-B- haemolytica*, *Bacillus subtilis*, *Sarcina lutea* and *Bacillus megaterium*. The extract of leaves also found to be active against various strains of fungus as *Alternaria* species (sp), *Colletotrichum* sp, *Curvularia* sp and *Fusarium* sp.

Doughari, J. H. *et al* were demonstrated the aqueous and organic leaves extracts of M.O. for the treatment of infectious disease were tested for their activity against *Salmonella typhi* isolated from blood clot culture using the disc diffusion method.
Mohammed Abu Sayeed et al showed that the methanolic extract of M.O. fruit has a broad-spectrum antibacterial activity and antifungal activity. M.O. was assayed for its antibacterial antifungal activity in nine pathogenic bacteria as *Staphylococcus aureus, Bacillus subtilis, Vibrio cholera, Bacillus cereus, Salmonella typhi, Shigella dysenteriae, Pseudomonas aeruginosa, Klebsiella species* and *Proteus species* and antifungal activity against four pathogenic fungi-*Alternaria* Sp, *Colletotrichum* Sp, *Curvularia* Sp and *Fusarium* Sp at different concentrations of the extract to understand the most effective activity.

Anthonia Olufunke Oluduro evaluated the leaf extract of M.O. for certain enteropathogenic and orthopaedic’s wounds bacteria and fungi. Pure cultures of microorganisms used include enteropathogenic (*Escherichia coli, Salmonella typhi, Staphylococcus aureus, Enterococcus sp.* and *Pseudomonas aeruginosa*) and orthopaedics’s wounds bacterial (*Klebsiella pneumoniae, Proteus vulgaris, Providencia stuartii, Escherichia coli, Streptococcus sp, Pseudomonas fluorescens, Acinetobacter baumanii, Burkholderia cepacia, Yersinia enterocolitica, Proteus mirabilis, Serratia rubidae, Salmonella pullorum, and Klebsiella oxytoca*) and fungal isolates which include *Aspergillus flavus, candida albicans, Penicillium sp, Pullarium sp, Trichophyton mentagrophyte, Fusarium sp and Trichophyton sp.*

Bukar A. et al were demonstrated the chloroform and ethanol extracts of seeds and leaf of M.O. against some selected food – borne microorganisms *Escherichia coli, Pseudomonas aeruginosa, Staphylococcus aureus and Enterobacter aerogenes.*

Farjana nikkon et al investigated the chloroform extract of M.O. root bark possesses the antibacterial anti-fungal activity against Gram-positive bacteria: *Staphylococcus aureus, Enterobacter aerogenes, Escherichia coli, Salmonella typhi, Streptococcus-B- haemolytica, Bacillus subtilis* and Gram negative bacteria: *Shigella shinga, Pseudomonas aeruginosa, Shigella sonnei, shigella flexneri, shigella boydii, shigella dysenteriae.* The activity of plant is comparable to synthetic antibiotic kanamycin.

### 3.2 Anti-inflammatory Activity

Prashant Kumar et al tested the anti-inflammatory action of methanolic leaf extract of M.O. in rats with formalin induced paw edema. A maximum inhibition (50.85%) of formalin induced paw edema was shown by methanolic leaf extract. Steroidal fraction SF (18.64%) and coumarin fraction CF (44.06%) from leaves also showed response showing to possess antiproliferative and antiarthritis activities similar to indomethacin, a cyclooxygenase inhibitor.
Sarot Cheenpracha *et al* tested the ethyl acetate extract from M.O. fruits showed NO inhibition with an IC50 value of 0.136 lg/mL.

Manoj Kumbhare *et al* investigated the anti-inflammatory activity and analgesic activities of stem bark of M.O. Petroleum ether and Methanolic extracts of *Moringa oleifera* at the dose level of 100, 200 and 400 mg/kg, p.o. were tested. Treatment with Methanol extract showed significant (p<0.01) inhibition of carrageenan induced rat paw edema and Maximum inhibition was observed at 400 mg/kg dose as compared to the control.

Gurvinder pal singh *et al* evaluated the anti-inflammatory activity of leaf extract of M.O. he showed the significant decrease in the paw oedema which was induced by carrageenan (p<0.0001).

Koneni V. Sashidhara *et al* isolated and characterised the bioactive compounds from the roots of Moringa oleifera aurantiamid acetate and 1,3-dibenzyl urea which was tested to inhibited the production of TNF-a and IL-2 and urea derivative showed to control of activated mast cells on inflammatory conditions like arthritis, for which the crude extract has been used.

### 3.3 Antioxidant Activity

Arti R. Verma *et al* evaluated the antioxidant potency of different fractions of M.O. leaves polyphenolic fraction of M.O. leaves was chosen as the potent fraction and used for the DNA nicking and in vivo antioxidant properties. These fractions shows concentration dependent protection of oxidative DNA damage induced by HO and also found to inhibit the toxicity produced by CCl4 administration as seen from the decreased lipid peroxides (LPO) and increased glutathione (GSH) levels.

Pilaipark Chumark *et al* demonstrated the *in vitro* and *ex vivo* antioxidant properties of water extract of M.O. leaves the scavenging activity of the extract on 1,1-diphenyl-2-picrylhydrazyl radicals (DPPH), and the inhibitory effect on Cu2+-induced low-density lipoprotein (LDL) oxidation were determined in *in vitro* experiment. They found that in scavenging DPPH radicals the extract and Trolox® had IC50 of 78.15±0.92 and 2.14±0.12_g/ml, respectively.

Brahma N. Singh *et al* examined the aqueous extract of leaf, fruit and seed of M.O. for its antioxidant, anti-quorum sensing (QS) potentials along with the ability to inhibit the oxidative DNA damage. They found that these extracts could significantly inhibit the OH dependent damage of pUC18 plasmid DNA and also inhibit synergistically with trolox. They also found that
the leaf extract of M.O. has higher phenolic content than the fruit and seed thus possess higher antioxidant activity.

Vusumzi Pakade et al investigated the antioxidant activity of the leaves and flowers of the M.O. and these results are compared to those of selected vegetables (cabbage, spinach, broccoli, cauliflower and peas). The total phenolic content (TPC) and total flavonoid content (TFC) of dried moringa leaf samples was observed that the TPC of the moringa samples was almost twice those of the selected vegetables, whilst the TFC of moringa was almost three times more than those of the selected vegetables. Therefore, moringa exhibited greater antioxidant activity than the selected vegetables.

Andréa F. S. Santos et al evaluated the Antioxidant activity of M.O. ethanolic and saline extracts from flowers, inflorescence rachis, seeds, leaf tissue, leaf rachis and fundamental tissues of stem extracts.

Vinay Kumar Verma et al investigated that M.O. leaves has hepatoprotective as well as antioxidant activity. The alcoholic leaves extract of M.O. has shown ulcer protective effect as dose dependently against pylorus-ligation, ethanol, cold restraint stress, and aspirin-induced gastric ulcer in rats. The said extract of M.O. was found to decrease ulcer and acid pepsin secretion. The antioxidant property, of 50% ethanolic extract of M.O. was found to be changed in Superoxide Dismutase, Measurement of Catalase, and Lipid Peroxidation levels in rat gastric mucosa.

3.4 Hepatoprotective Activity

Alaaeldin A. Hamza et al investigated that the administration of M.O seed extract decreased the CCl4-induced elevation of serum aminotransferase activities and globulin level. The elevations of hepatic hydroxyproline content and myeloperoxidase activity were also reduced by M.O treatment. Liver fibrosis was induced by the oral administration of 20% carbon tetrachloride (CCl4), twice weekly and for 8 weeks. The biochemical and histological results showed that M.O. reduced liver damage as well as symptoms of liver fibrosis.

S. Fakurazi et al showed that initiation of acetaminophen toxicities is believed to be promoted by oxidative stress during the event of overdosage. MO showed that the hepatoprotective activity gives significant histopathological analysis and reduction of level of alanine aminotransferase (ALT), aspartate aminotransferase (AST), and alkaline phosphatase (ASP) in the group treated
with MO compared to those treated with acetaminophen alone. The level of glutathione (GSH) was found to be restored in MO treated animal.

Eshwar kumar et al showed that the in vitro antioxidant and in vivo hepatoprotective effects of crude ethanolic extracts of Moringa oleifera seeds were evaluated in male wistar rats against ethanol induced liver damage in preventive and curative model. The antioxidant activity of Moringa oleifera was assayed by DPPH, hydroxyl and superoxide radical scavenging activity.

3.5 Antiulcer Activity
Anti-ulcer study were conducted to test the methanolic extract of MO has ulcer protective effects as dose dependently against pyrolus- ligation, ethanol, cold resistant stress and aspirine induced gastric ulcer in rats (Vinay kumar verma et al, 2012). The aqueous extract of MO also has been studied for its protecting action against ulcer formation by modulating 5-HT secretion through EC cell count and mucosal thickness (Siddhartha debnath et al, 2011).

Devraj et al conducted a study which showed that the extract of leaves and fruits of MO has ability to heal acetic acid induced chronic gastric ulcers. The leaf extracts showed a significant reduction of stress induced gastric ulcers and cysteamine induced duodenal ulcers. Ankur Patel et al examined that the ethanol extract of roots of MO has protective effect against ethanol induced gastric mucosal injury in rats which showed that the MO has ability to act against gastric ulcer.

4. Toxicity
The popularity of using MO as a nutraceutical raises the question of possible toxicity at supra-supplementation levels. The hepatotoxicity and nephrotoxicity was observed as nil. It was supported findings that the aqueous extract of leaf is relatively safe when administered orally. Richa gupta et al showed that MO seed powder when it is given orally the significant inhibition of the δ-aminolevulinic acid dehydratase and decrease in the glutathione level and increase in reactive oxygen species in blood after arsenic exposure in rats. Oxidative stress due to abnormal production of reactive oxygen species has been implicated in neurotoxicity which is induced by gentamicine. Moustapha ouedraogo et al evaluated that the aqueous extract of Moringa oleifera leaves has the protective as well as reparative effects when it is given in dose of 150 and 300 mg/Kg.
5. CONCLUSION

MO is “The miracle tree” contains high percentage of alkaloids, flavonoids, anthocynins, proanthocyanidines etc. The pharmacological review confirms the therapeutic value of *Moringa oleifera*. Thus, activity guided phytochemical and phytoanalytical studies may lead to development of novel agents for various ailments. The available literature gives the total overview of the chemical constituents and pharmacological activities of the plant. Very less literature is available regarding the phytocconstituents of roots of this plant. The isolation, identification, standardization of plant extracts may be considered for detailed studies which can be useful for the further development of the promising pharmacological activity of the plant and development of the herbal formulation which can be useful for the treatment of various ailments.

REFERENCES


Varsha et al. World Journal of Pharmacy and Pharmaceutical Sciences


30. Hamza Alaaeldin, Ameliorative effects of Moringa oleifera Lam seed extract on liver fibrosis in rats, Food and chemical technology, 2010; 48: 345-355.


32. Kumar Eshwar, Harsha KN, Shaik Shabana, Rao Neelakanta, Evaluation Of In Vitro Antioxidant Activity And In Vivo Hepatoprotective Activity Of Moringa Oleifera Seeds


34. Debnath Siddhartha, Biswas Debasis, Ray Koushik, Moringa oleifera induced potentiation of serotonin release by 5-HT3 receptors in experimental ulcer model, Phytomedicine, 2011; 18: 91-95.


