

Pharmacological Active Potential of *Moringa oleifera*

Abhilasha Gupta¹, Bobby Prasad^{1,*}, Ajay Singh²

Abstract

Moringa oleifera is one of the most important herbal plants which has wide potential of pharmacological activity. Its extract has good potential of curing many diseases. Nowadays *Moringa Oleifera* have been essential for daily use because of its multiverse's utilization. *Moringa oleifera* has many bio- active constituents like alkaloids, tannins, chlorogenic acid, flavonoids in various parts of this plants which provide various pharmacological activities in the body. Such bio-active components are found in leaves, stem, flowers as well as in roots, so every part of this plant is very useful. In this study numerous features of *Moringa oleifera*, with an emphasis on its therapeutic potential has been done in brief. Extract of the plant has very good potential for use as anti-aging, antioxidant, antimicrobial as well as anti-diabetic. We believe it is a promising subject for future experimental and clinical research.

Keywords: *Moringa oleifera*, Pharmacological activity, Medicinal, Antioxidant, Antimicrobial activity, Ecology

INTRODUCTION

Plants have always been essential to humanity, despite age or location, since the beginning of time. Plants have various bioactive compounds like alkaloids, tannins, flavonoids, citrate salts and many other chemical constituent which have excellent source of antioxidant, antimicrobial, anti-inflammatory or anti-diabetic agents. Ginger, garlic, cardamom, onion and many other herbal plants are part of kitchen ingredient because of not only taste but also due to their valuable pharmacological activities. *Moringa Oleifera* is a special type of herbal plants which is found to have very active bio-constituents like chlorogenic acid, alkaloids, tannins, flavonoids in various parts of this plants which provide various medicinal activities. Extract of any part of this plant has these bio-active compounds which can provide a vital role in prevention of many diseases as well as in curing of many diseases due to which it has been used in treatment of skin diseases, anxiety, asthma, black heads, proper regulation of blood in veins, cough problem etc [1]. *Moringa* is a kind of indigenous Indian plant that has become well-known in tropical and subtropical regions. *Moringa oleifera* belongs to class of Magnoliopsida, Order: Brassicales, Family: *Moringaceae*, Genus: *Moringa* [2]. The extraordinary medical properties of *Moringa*, which have been claimed by many tribes and societies based on real-life experiences, are now being steadily proven by science. Extract of leaves as well as powder of flowers have been observed to show broad range of vital nutrients, including minerals, vitamins, omega-3, fatty acids, essential amino acids and other antioxidants and antimicrobial agents [3].

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Plant extract as solution of its powder has been used for skin diseases as well for cosmetic uses and hair problems also. Khawaja et al. declared that the *Moringa* was the “most nutrient-rich plant ever discovered” [4]. It is small, simple to maintain, grows fast, and does not drop leaves during the dry season. Its leaves are also highly nutritional, including amino acids, vitamins, minerals, and

natural antioxidants [5]. This study has focussed on application of various parts of *Moringa oleifera* in treatment of various diseases and important pharmacological properties.

Leave extract of *Moringa oleifera* has various bioactive compounds which can cure chest congestion as well as tiredness or aging problem. Seeds of this plant are rich in omega-3, minerals and fatty acids which can play vital role in neurological treatment [6, 7].

Flower extract as well as stem of *Moringa oleifera* have very vital bio-active compounds which are useful in treatment of asthmatic problem or tumor treatment of diabetic treatment [8]. Almost every component of this “miracle tree” has been shown to have analgesic action in several animal models [9].

PHARMACOLOGICAL ACTIVITIES

Anti-oxidant Activity

Many publications on the pharmacological activity of *M. oleifera* focused on its antioxidant and free radical scavenging properties. Antioxidants, such as ascorbic acid, thiols, and polyphenols, can decrease ageing and the risk of heart attacks and strokes [10]. According to reviewed articles, *M. oleifera* contains antioxidants and phenolics that stabilise free radicals in cells, allowing them to withstand electrons. Recent research found that methanolic leaf and root extracts significantly decreased mechanical signs of pain and inflammation in mice with induced arthritis [11]. *M. oleifera* portions have analgesic and anti-inflammatory properties, making them a potentially cost-effective medication source for pain relief and inflammation-related illnesses. *M. oleifera* leaf extract has been shown to have antioxidant, hypolipidemic, and anti-atherosclerotic properties, making it an effective treatment for cardiovascular disorders in rats [12] (Table 1).

Anti-microbial Activity

Plant-based antibiotics are garnering scientific interest as a cost-effective and dependable solution for combating infectious illnesses in humans and agriculture. This review found that *M. oleifera* is a plant species with significant antioxidant and antibacterial properties [13]. Researchers found that *M. oleifera*'s leaves, seeds, barks, and roots had anti-microbial properties against several microbes. The presence of 4-(alpha-L-rhamnosyloxy)benzyl isothiocyanate (1) and 4-(4'-O-acetyl-alpha-L-rhamnosyloxy)-benzyl isothiocyanate has been linked to the plant's antibacterial properties [14]. *M. oleifera* leaf extracts are effective against infectious illnesses caused by multidrug-resistant gram-negative bacteria [15]. Scientists discovered that *M. oleifera* seed lectins had antibacterial properties, inhibiting *S. marcescens* biofilm formation and bacterial growth. The lectin inhibited growth of *Bacillus* sp. A clinical experiment on 20 asthmatic patients found that the species' seed kernels were effective and safe for treating asthma [16] (Table 1).

Anti-fungal Activity

Many studies have investigated the fungicidal effect of *Moringa* extracts on several soil-borne fungi, such as *Rhizoctonia*, *Pythium*, and *Fusarium* [17]. The study conducted by Dwivedi and Enespa [18] revealed that a 75% extract of *Moringa Oleifera* (leaves, bark, and seeds) significantly inhibited the mycelial development of *Fusarium solani* and *Fusarium oxysporum f. sp.*

The study conducted by Patel and Mohan [19] revealed that different tissue extracts of *Moringa Oleifera* exhibited different patterns of inhibition against various strains of the fungal infection. The fungal strain used were *Aspergillus niger*, *Aspergillus paracitic*, *Candida albicans*, *Aspergillus flavus*, *Trichoderma harzanium*, *Alternata burnsi*, and *Fusarium oxysporum*.

Similarly, El-Mohamedy et al. [20] examined the fungicidal activity of extract from *Moringa Oleifera* plant parts, including roots, leaves, and pod coats, against seven phytopathogenic fungi, such as *Macrophomina phaseolina*, *Fusarium oxysporum*, *Fusarium solani*, *Alternaria solani*, *Rhizoctonia solani*, and *Sclerotium rolfsii*. The antifungal activity of *M. oleifera* extracts against the investigated

pathogens varied according to the fungal strain used. According to the result, the growth of fungal mycelia gradually decreased as the concentration of *Moringa* root extract increased. These findings revealed that the extract from *Moringa* roots, at all tested concentrations, had antifungal efficacy against the majority of the pathogens responsible for leaf disease and decay of the roots [21] (Table 1).

Anti-cancer Activity

M. oleifera has bioactive substances that can help cure and manage chronic illnesses such as cancer and HIV/AIDS [22]. *M. oleifera* leaf extracts effectively suppressed tumour development and induced apoptosis in Ehrlich's solid tumour implanted mice, indicating its anti-tumor and anti-cancer potential [23]. Pharmaceutical firms worldwide are interested in developing *Moringa*-based medications to treat cancer and other degenerative illnesses due to its anticancer properties (Table 1).

Anti-diabetic Activity

M. oleifera leaf extracts have been shown in animal experiments to lower plasma glucose levels and improve glucose tolerance, both in non-diabetic and diabetic populations [24]. Aqueous extract from *M. oleifera* leaves decreased hepatotoxicity and hyperglycemia in diabetic rats [25]. *M. oleifera* seed has been shown to improve human health by moderating blood pressure, blood sugar levels, and immune system function [26] (Table 1).

Cardioprotective Activity

Research has shown that *Moringa oleifera* stem bark possesses cardio-protective properties. A research used N, α -L-rhamnopyranosyl vincosamide (VR) from *M. oleifera* leaves to treat ISO-induced cardiotoxicity in rats, resulting in normal heart rate and decreased necrotic cells in the cardiac muscle [27] (Table 1).

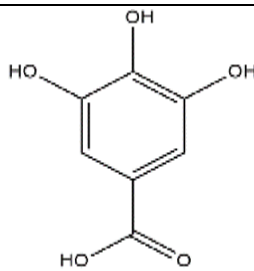
Wound Healing Activity

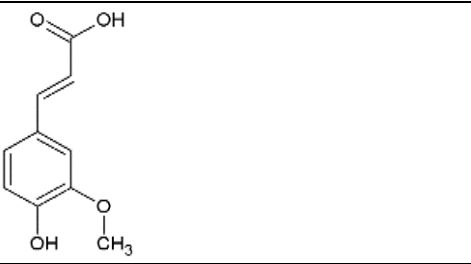
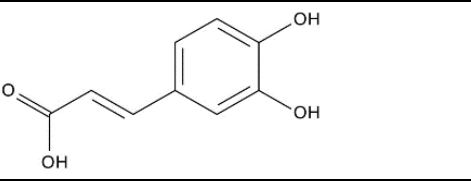
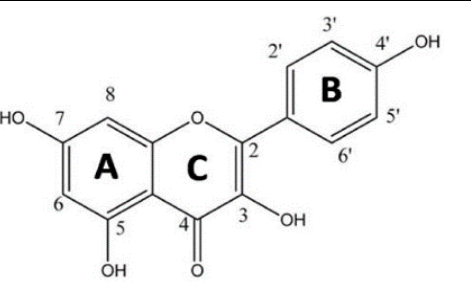
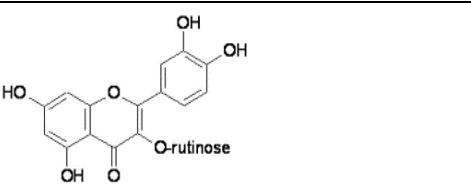
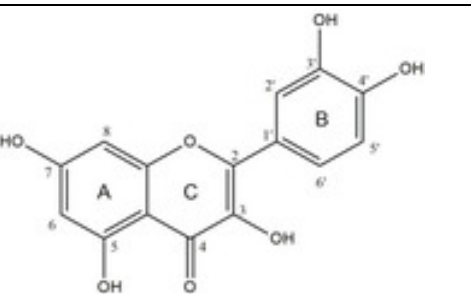
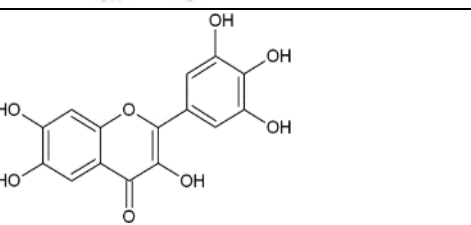
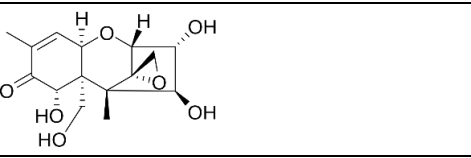

M. oleifera has been shown to have wound healing properties due to its high phytochemical content, including alkaloids and antioxidants [28]. An aqueous fraction of *M. oleifera* was shown to cure wounds on diabetic Wister rats generated with STZ and nicotinamide (NAD) [29]. Alcoholic preparation of *M. oleifera* leaves effectively heals skin wounds and promotes fibroblast proliferation and dissemination, leading to faster wound closure rates [30] (Table 1).

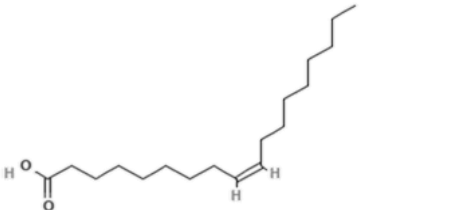
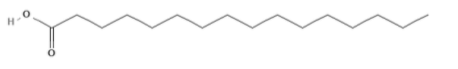
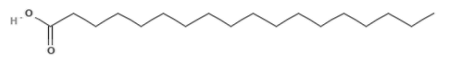
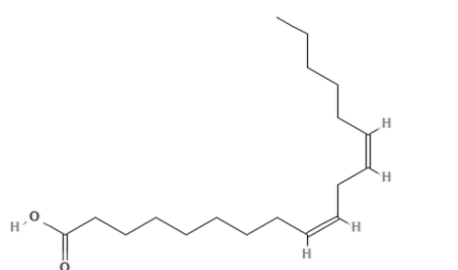
Anti-malaria Activity

Aqueous crude extracts of *M. oleifera* leaves were shown to have substantial antimalarial activity. *M. oleifera* leaf extracts, when combined with artesunate, show great promise for development as antimalarial combination therapies [31, 32]. The study found that the aqueous crude extract of *M. oleifera* leaves effectively suppressed and cured PbANKA infection in mice. Further research might identify this plant as a potential source of novel antimalarial leads and medicines for malaria therapy [33-34] (Table 1).

Table 1. Major bioactive compounds of moringa oleifera.

Compounds name	Chemical structure	References
Gallic acid	 <p style="text-align: center;">Gallic acid</p>	Bhuia, M. S., Rahaman, M. M., Islam, T., Bappi, M. H., Sikder, M. I., Hossain, K. N., ... & Sharifi-Rad, J. (2023). Neurobiological effects of gallic acid: Current perspectives. <i>Chinese Medicine</i> , 18(1), 27.

Ferulic acid		Zhou, S., & Dong, X. (2023). Neuroprotective Properties of Ferulic Acid in Preclinical Models of Alzheimer's Disease: A Systematic Literature Review. <i>Current Medicinal Chemistry</i> , 30(24), 2796-2811.
Caffeic acid		Teng, Y. N., Wang, C. C., Liao, W. C., Lan, Y. H., & Hung, C. C. (2020). Caffeic acid attenuates multi-drug resistance in cancer cells by inhibiting efflux function of human P-glycoprotein. <i>Molecules</i> , 25(2), 247.
Kaempferol		Simunkova, M., Barbierikova, Z., Jomova, K., Hudecova, L., Lauro, P., Alwasel, S. H., ... & Valko, M. (2021). Antioxidant vs. prooxidant properties of the flavonoid, kaempferol, in the presence of Cu (II) ions: A ROS-scavenging activity, fenton reaction and DNA damage study. <i>International journal of molecular sciences</i> , 22(4), 1619.
Rutin		Al-Dhabi, N. A., Valan Arasu, M., Park, C. H., & Park, S. U. (2015). An up-to-date review of rutin and its biological and pharmacological activities.
Quercetin		Zieliński, M., Burnat, B., & Miękoś, E. (2020). Effects of a constant magnetic field on the electrochemical reactions of quercetin. <i>ChemistryOpen</i> , 9(12), 1229-1235.
Myricetin		Kang, K. A., Wang, Z. H., Zhang, R., Piao, M. J., Kim, K. C., Kang, S. S., ... & Hyun, J. W. (2010). Myricetin protects cells against oxidative stress-induced apoptosis via regulation of PI3K/Akt and MAPK signaling pathways. <i>International journal of molecular sciences</i> , 11(11), 4348-4360.
Moringinine		Amin, M. F., Ariwibowo, T., Putri, S. A., & Kurnia, D. (2024). <i>Moringa oleifera</i> : A Review of the Pharmacology, Chemical Constituents, and Application for Dental Health. <i>Pharmaceuticals</i> , 17(1), 142.
Spirochin		National Center for Biotechnology Information (2024). PubChem Compound Summary for CID 66854, Benzyltrimethyl ammonium hydroxide.

<p>Oleic acid (Omega-9)</p>		<p>National Center for Biotechnology Information (2024). PubChem Compound Summary for CID 445639, Oleic Acid.</p>
<p>Palmitic acid</p>		<p>National Center for Biotechnology Information (2024). PubChem Compound Summary for CID 985, Palmitic Acid.</p>
<p>Stearic acid</p>		<p>National Center for Biotechnology Information (2024). PubChem Compound Summary for CID 5281, Stearic Acid.</p>
<p>Linoleic acid (Omega-6)</p>		<p>National Center for Biotechnology Information (2024). PubChem Compound Summary for CID 5280450, Linoleic Acid.</p>

CONCLUSION

This study highlights *M. oleifera*'s pharmacological potential as a versatile medicinal plant that can aid in the development of more effective medications to combat ailments. Preclinical research showed that this plant has anti-inflammatory, anticancer, antioxidant, hepatoprotective, cardiovascular, anti-allergic, wound healing, antibacterial, and immunomodulatory properties. These functions may be linked to phytoconstituents found in the root, stem, bark, leaf, flower, pod, and seeds. *M. oleifera* has enormous value and should be utilised to promote public health. It may also be used as a medication supplement. It might potentially be used as an alternative therapy for a variety of ailments. Overall, from the study can be concluded that *Moringa oleifera* is an excellent herbal medicinal plant which have vital components to cure many diseases.

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