



**INTERNATIONAL JOURNAL OF
PHARMACEUTICAL SCIENCES**
[ISSN: 0975-4725; CODEN(USA): IJPS00]
Journal Homepage: <https://www.ijpsjournal.com>



Review Article

Exploring the Miracle Tree: Nutritional and Pharmacological Perspectives of *Moringa oleifera*

Snehal Vasagade*, Prajakta Devkate, Disha Chougule, Shraddha Patil, Harshad Narale, Sanika Vhasukle

Dr. Shivajirao Kadam College of Pharmacy, Kasabe-Digraj-416305, Sangli, India

ARTICLE INFO

Published: 7 Oct. 2026

Keywords:

Moringa oleifera; medicinal plant; phytochemicals; antioxidant activity; anti-inflammatory activity; antidiabetic effect; antimicrobial activity; anticancer potential; hepatoprotective activity; cardioprotective effect; immunomodulation; nutraceuticals.

DOI:

10.5281/zenodo.23211812

ABSTRACT

Moringa oleifera Lam., commonly known as the “miracle tree,” is a nutritionally rich and pharmacologically important medicinal plant extensively used in traditional medicine across tropical and subtropical regions. Owing to its remarkable adaptability and wide therapeutic applicability, *M. oleifera* has attracted significant scientific attention in recent decades. This review provides a comprehensive and updated overview of the existing literature on *Moringa oleifera*, with particular emphasis on its phytochemical composition, ethnomedicinal significance, and diverse pharmacological activities. Phytochemical investigations reveal that *M. oleifera* is a rich source of biologically active constituents, including flavonoids, phenolic acids, alkaloids, glucosinolates, isothiocyanates, vitamins, amino acids, and essential minerals. These compounds are responsible for the plant's broad spectrum of therapeutic effects. Numerous experimental and limited clinical studies have demonstrated that *M. oleifera* possesses potent antimicrobial, antioxidant, anti-inflammatory, immunomodulatory, antidiabetic, anti-ulcer, hepatoprotective, hypolipidemic, and cardioprotective activities. The underlying mechanisms of these effects are largely attributed to its ability to scavenge free radicals, modulate inflammatory mediators, regulate immune responses, improve lipid and glucose metabolism, and influence key molecular and cellular signaling pathways. Different parts of the plant, particularly the leaves, seeds, pods, and bark, have shown promising potential for use in nutraceuticals, functional foods, and pharmaceutical formulations. The high nutritional value of *M. oleifera* further supports its role in combating malnutrition and promoting overall health. Despite the substantial preclinical evidence supporting its medicinal benefits, challenges such as variability in phytochemical content, lack of standardization, limited bioavailability data, and insufficient large-scale clinical trials remain unresolved. In conclusion, *Moringa oleifera* represents a valuable natural resource with significant therapeutic

***Corresponding Author:** Snehal Vasagade

Address: Dr. Shivajirao Kadam College of Pharmacy, Kasabe-Digraj-416305, Sangli, India.

Email ✉: snehalvasagade26@gmail.com

Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.



and nutritional potential. Further well-designed clinical studies and standardization strategies are essential to validate its efficacy, ensure safety, and facilitate the development of scientifically substantiated *M. oleifera*-based products for modern healthcare applications.

INTRODUCTION

Medicinal plants have for a long time been an important part of healthcare systems all over the world and remain a significant source of bioactive substances for the management of disease. In recent years, because of growing worries about the side effects and the high price of synthetic drugs, there has been a revival of interest in natural treatments derived from plants. Of all the medicinal plants that have been investigated, *Moringa oleifera* Lam. has become a particularly notable species thanks to its excellent nutritional qualities and wide range of pharmacological effects.

Moringa oleifera, which belongs to the Moringaceae family, is a tree that grows quickly and is able to withstand drought conditions and is therefore commonly found in tropical and subtropical areas, especially in Asia, Africa and South America. It is frequently called a "miracle tree" since almost all of its parts—such as the leaves, seeds, flowers, pods, roots and bark—are used in traditional medicine and as dietary supplements. The plant is a rich source of phytochemicals including flavonoids, phenolic compounds, alkaloids, glucosinolates, isothiocyanates, vitamins and essential minerals, and it is these compounds that are responsible for its therapeutic effects.

An increasing amount of experimental and clinical research has pointed to the wide range of biological properties of *Moringa oleifera*, such as antioxidant, anti-inflammatory, antidiabetic, antimicrobial, anticancer, hepatoprotective, cardioprotective, immunomodulatory, anti-ulcer,

and hypolipidemic effects. These pharmacological actions are mainly due to the plant's capacity to influence oxidative stress, inflammatory responses, metabolic pathways, and cellular signalling mechanisms. As a result, *Moringa oleifera* is becoming more and more widely regarded as a promising natural option for the creation of functional foods, nutraceuticals, and new therapeutic agents[1]

1. Taxonomical information [2]

Kingdom – Plantae

Sub kingdom – Tracheobionta **Super Division** – Spermatophyta **Division** – Magnoliophyta

Class – Magnoliopsida **Sub class** – Dilleniidae
Order – Capparales **Family** – Moringaceae **Genus** – *Moringa* **Species** – *oleifera*

Vernacular names of *Moringa oleifera* Latin:
Moringa oleifera

Sanskrit: Subhanjana **Hindi:** Saguna, Sainjna
Gujarati: Suragavo **Tamil:** Mulaga, Munaga

Malayalam: Murinna, Sigru **Punjabi:** Sainjna, Soanjna **Unani:** Sahajan

Ayurvedic: Haritashaaka, Raktaka, Akshiva

Arabic: Rawag

French: Morungue

Spanish: Angela, Ben, Moringa

Chinese: La ken

2. PLANT DESCRIPTION

2.1 Roots

The root system of the *Moringa oleifera* is mostly represented by a taproot, which is spongy, white,



and thick, and at the stage of the seedling, it is more developed and bushy. The taproot has an intense odor and has few lateral roots. A large, strong taproot allows the plant to survive periods

of drought because it can reach water deeper in the soil. However, it is not recommended to use this type of roots for medicinal purposes because of the presence of certain toxins in them.^[3]



Fig No.1 Root of Moringa oleifera

2.2 Stem

The stem of Moringa oleifera is soft, lightweight, and fast-growing. The bark is thick, whitish-gray in color, and exhibits a fissured, corky, and warty

texture that becomes rough with age. When injured, the bark exudes a gum that appears white initially but gradually darkens to reddish-brown or brownish-black upon exposure to air. The wood is soft and porous, with a



Fig no .2 Stem of Moringa oleifera

density ranging from 0.5 to 0.7 g/cm³, making it unsuitable for heavy construction but useful for paper pulp and light wood products^[2]

2.3 Leaves

The leaves are alternate, large, and typically measure between 7 and 60 cm in length. They are

tripinnately compound, with each pinna bearing 4–6 pairs of small leaflets. The leaflets are dark green, elliptical to obovate in shape, and approximately 1–2 cm long. Moringa leaves are highly valued for their exceptional nutritional profile, being rich in proteins, vitamins (A, C, and B-complex), minerals such as calcium and iron, and various antioxidants. Due to these properties,

the leaves are widely used as food, nutraceuticals, and in traditional medicine.^[4]



Fig no.3 Leaves of Moringa oleifera

2.4 Flowers

The flowers of *Moringa oleifera* are small, measuring about 2 cm in diameter, and are borne in loose, drooping clusters along the branches. Each flower consists of five thin, delicate white petals, often tinged with pale yellow, which spread irregularly and give the flower an asymmetric appearance. The central region contains slender

stamens with bright yellow pollen-bearing anthers. The flowers are aromatic, emitting a pleasant, fresh green fragrance, and possess a mild, subtly sweet flavor. Younger flowers are preferred for culinary use due to their tender texture and superior taste. When cooked, they develop a flavor reminiscent of asparagus combined with mushrooms.^[2]



Fig no.4 Flower of Moringa oleifera

2.5 Pods (Fruits)

The fruit of *Moringa oleifera* is a long, slender, pendulous pod commonly referred to as a

“drumstick.” These green pods typically range from 15 to 45 cm (6–18 inches) in length and contain three longitudinal ridges. Inside the pod are round, pea-sized seeds embedded in a soft,

fleshy pulp. The pods are widely consumed as a vegetable in many tropical regions and are known for their high fiber content, vitamins, and essential minerals. Mature seeds extracted from the pods

are also utilized for oil extraction and water purification due to their natural coagulant properties.^[2]



Fig no.5 Pods of Moringa oleifera

3. PHARMACOLOGICAL ACTIVITIES :

a) ANTIOXIDANT ACTIVITY

(MO), widely referred to as the “miracle tree,” is a member of the Moringaceae family within the order Brassicales. Of the thirteen species belonging to this family, *M. oleifera* is the most extensively cultivated and researched. The plant originated in the sub-Himalayan regions of northern India, where it was first valued for its medicinal properties. Owing to its remarkable adaptability to different environmental conditions, it later spread to Africa, Ethiopia, Latin America, and the Pacific Islands. In African traditional medicine, MO is considered a panacea and is used in the prevention and treatment of more than 300 ailments, including cancer, diabetes, malaria, asthma, Parkinson’s disease, and cardiovascular conditions. Additionally, it has played a significant role in alleviating childhood malnutrition.^[5]

Among the various parts of the plant, the leaves are the most widely consumed and nutritionally important. MO leaves are rich sources of macro- and micronutrients, particularly proteins, which makes them a valuable component of the human diet. They also contain abundant antioxidant compounds, especially isothiocyanates, which are recognized for their antimicrobial and anticarcinogenic properties. The levels of anti-nutritional constituents such as tannins, lectins, and protease inhibitors are minimal, allowing the leaves to be safely consumed in their entirety.^[6]

The leaves of *M. oleifera* offer a well-balanced composition of essential amino acids, including methionine, phenylalanine, threonine, leucine, valine, histidine, isoleucine, lysine, and tryptophan. With crude protein contents ranging between 23.0% and 30.3%, the leaves represent a high-quality plant-based protein source. Furthermore, they are rich in vitamins A and C, along with other antioxidant substances that contribute to immune support and overall health.

Recent studies have emphasized the significance of bioactive peptides derived from MO leaf proteins. These peptides are generated during gastrointestinal digestion and exhibit diverse biological activities, such as antioxidant, antihypertensive, antithrombotic, immunomodulatory, and anticancer effects. Considering the growing concern over oxidative stress—caused by excessive production of reactive oxygen species and associated with chronic diseases including cancer, cardiovascular ailments, and neurodegenerative disorders—natural antioxidants derived from MO have attracted increasing scientific interest.

Moreover, protein hydrolysates obtained from MO leaves have shown hypoglycemic properties, indicating potential applications in the management of metabolic disorders. Although further research is required to fully elucidate their bioactive potential, *Moringa oleifera* leaves demonstrate outstanding nutritional and functional qualities, positioning them as a promising natural resource for enhancing human nutrition, disease prevention, and potentially mitigating food spoilage.

b) ANTI-HYPERTENSIVE ACTIVITY

The mechanism of action of *Moringa oleifera* is complex and involves various active components. The active compounds of *M. oleifera* upregulate endothelial nitric oxide synthase (eNOS), leading to an increase in endothelial nitric oxide (NO), which relaxes vascular smooth muscles and causes vasodilation. In addition, the active components of *M. oleifera* inhibit the angiotensin-converting enzyme, thus reducing the levels of angiotensin II, which causes vasoconstriction [7].

Moringa oleifera contains various phytochemicals, which makes it one of the most useful medicinal plants. It grows

abundantly in tropical and warm climates, and its leaves, fruits, flowers, and pods are used for food and medicine. *Moringa* leaves have the advantage of being highly nutritious, easily digested, and containing essential protein, minerals, vitamins, carotenoids, polyphenols, isothiocyanates, and tannins. *M. oleifera* has a diverse range of pharmacological activities and is used for the treatment of aging-related illnesses, infections, and liver disorders. Moringin, one of the isothiocyanates found in *M. oleifera*, is a potent ACE inhibitor with a remarkable ability to induce vasodilation and lower blood pressure [8].

Since hypertension is becoming a major public health problem, especially in developing countries, because of the limited availability of antihypertensive drugs and the high cost of available drugs. *M. oleifera* has been used in traditional medicine to cure hypertension, and there is some evidence that it may be effective. Experimental and a few clinical studies support the antihypertensive effect of *M. oleifera*. *M. oleifera* has been shown to have antihypertensive effects when administered to hypertensive animals and humans, according to experimental investigations. Moreover, leaf aqueous extracts caused a significant decrease in blood pressure when assessed in vivo and induced an endothelium-dependent vascular relaxation when tested in vitro. The mechanism of action was found to be mediated through the production of nitric oxide because pretreatment of the animals with nitric oxide synthase inhibitors significantly reduced the antihypertensive effect of leaf extract. However, it is still unclear exactly what causes the drop in blood pressure. Thus, additional investigations, such as randomized controlled trials, are needed to fully assess the antihypertensive effects of *M. oleifera* and establish the particular component(s) responsible for the observed effects.



c) ANTI- INFLAMMATORY ACTIVITY

Moringa oleifera demonstrates marked anti-inflammatory activity due to its abundant phytochemicals, particularly flavonoids such as quercetin and kaempferol, along with phenolic compounds and isothiocyanates. These constituents reduce the production of major pro-inflammatory cytokines, including TNF- α , IL-6, and IL-1 β , and suppress key inflammatory signaling pathways, especially NF- κ B. Extracts obtained from various plant parts—most notably the leaves, seeds, and roots—have shown pronounced anti-inflammatory and immunomodulatory effects in experimental animal models such as paw edema and arthritis.^[9]

Persistent inflammation plays a central role in the development of several metabolic and degenerative disorders, including cardiovascular diseases, type 2 diabetes, enterocolitis, and non-alcoholic fatty liver disease (NAFLD). In view of the adverse effects associated with conventional anti-inflammatory drugs, plant-derived therapies like *M. oleifera* are considered safer alternatives. Its phytochemical constituents influence multiple stages of the inflammatory response and related metabolic pathways, underscoring their potential as therapeutic targets.

Experimental evidence, including studies involving topical application of *M. oleifera* leaf extracts in Wistar rats, supports its anti-inflammatory effectiveness. Sophisticated analytical methods such as HPLC–UV–ESI–MSD have enabled the identification and quantification of key flavonoids and their derivatives, revealing that anti-inflammatory activity can vary with plant variety and source. Collectively, these findings highlight *M. oleifera* as a promising candidate for the development of functional foods and pharmacological agents for chronic inflammatory conditions, although further research is required to

conclusively validate its mechanisms and clinical benefits

d) HEPATOPROTECTIVE ACTIVITY

demonstrates potent liver-protective effects mainly due to its strong antioxidant and anti-inflammatory properties. The plant is rich in bioactive constituents such as flavonoids and polyphenols, including quercetin, caffeic acid, and gallic acid, which effectively scavenge reactive oxygen species, inhibit lipid peroxidation, and support endogenous antioxidant systems like glutathione, superoxide dismutase, and catalase.^[10]

Experimental evidence shows that *M. oleifera* significantly reduces elevated liver enzymes (ALT, AST, ALP, GGT), improves lipid metabolism by lowering total cholesterol, triglycerides, LDL, and VLDL while increasing HDL, and restores normal liver histology by decreasing steatosis, inflammation, necrosis, and fibrosis. In animal models of non-alcoholic fatty liver disease induced by a high-fat diet, supplementation with *M. oleifera* leaf and stem preparations markedly reduced fat accumulation and inflammatory changes in liver tissue. Similarly, in carbon tetrachloride–induced hepatotoxicity, treatment with *M. oleifera* leaf extract decreased oxidative stress markers such as malondialdehyde, enhanced total antioxidant capacity and glutathione levels, and normalized antioxidant enzyme activity, leading to clear histological improvement.^[11]

Collectively, these findings indicate that *Moringa oleifera* has considerable potential as a natural hepatoprotective agent capable of preventing and alleviating liver damage associated with oxidative stress, inflammation, chemical toxicity, and metabolic disorders like NAFLD.



e) ANTI- CANCER ACTIVITY

Moringa oleifera has shown notable anticancer activity in numerous studies. Extracts obtained from its leaves, bark, seeds, and flowers have been reported to suppress the growth of different cancer cell lines, including breast, lung, colon, oral, and sarcoma cancers. These anticancer effects occur mainly through the induction of programmed cell death (apoptosis), inhibition of cell proliferation, reduction of cell migration and colony formation, and arrest of the cell cycle, particularly at the G2/M phase.^[12]

The anticancer potential of *M. oleifera* is largely attributed to its diverse phytochemical composition, which includes phenolic compounds, flavonoids, isothiocyanates, glucosinolates, and other bioactive constituents such as eugenol. Studies on leaf extracts demonstrated dose-dependent inhibition of cancer cell growth, along with clear apoptotic changes such as cell shrinkage, membrane blebbing, chromatin condensation, and nuclear fragmentation. Molecular analyses further confirmed apoptosis through altered expression of key regulatory genes, including increased Bax and decreased Bcl-2.

Research comparing different plant parts revealed that leaf and bark extracts exhibit stronger anticancer activity than seed extracts, significantly reducing cell viability, motility, and colony formation in breast and colorectal cancer cell lines. In vivo investigations also support these findings, showing substantial tumor reduction with no evident toxicity in treated animals. Collectively, these results highlight *Moringa oleifera* as a promising natural source for anticancer drug development and health-promoting functional foods, although further clinical validation is required.^[13]

f) ANTI-MICROBIAL ACTIVITY

Moringa oleifera demonstrates notable antimicrobial properties against a wide range of microorganisms, including bacteria, fungi, viruses, and parasites. These effects are mainly attributed to its rich content of bioactive compounds such as phenolics, flavonoids, alkaloids, and isothiocyanates. Extracts from the leaves and seeds are especially effective against pathogenic organisms like *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Salmonella typhi*, and *Candida albicans*. The level of antimicrobial activity depends on the plant part used, the extraction method, and the target microorganism, with aqueous and alcoholic extracts generally showing stronger effects than oil-based extracts.^[14]

One of the key mechanisms involves the conversion of the glucosinolate glucomoringin into the active isothiocyanate moringin when plant tissues are damaged, forming part of the plant's innate defense system. However, moringin is not the sole contributor, as multiple compounds act together to produce antimicrobial effects. Research also highlights the effectiveness of *M. oleifera* against antibiotic-resistant bacteria, including MRSA, and its ability to disrupt microbial cell membranes and inhibit biofilm formation. In particular, seed extracts have been shown to significantly reduce *Staphylococcus* biofilms on industrial surfaces, supporting the potential of *Moringa oleifera* as a natural antimicrobial agent, food preservative, and a promising alternative to conventional antibiotics.^[15]

e) ANTI-ULCER ACTIVITY

The plant *Moringa oleifera* has been reported to have anti-ulcer and gastroprotective potentials using various parts of the plant such as leaves,



roots, flowers, and seeds. The extracts of *M. oleifera* have demonstrated protective effects against gastric and peptic ulcers by various mechanisms of action including reducing acid content in the stomach, raising the gastric pH level, strengthening gastric mucosal defenses, and healing processes in the ulcers. Some of the constituents of the extracts of *Moringa Oleifera* are flavonoids, quercetin, rutin, polyphenols, and alkaloids.

Moringa oleifera extracts exert various beneficial effects in the body which are responsible for their anti-ulcer potentials. They reduce the production of reactive oxygen species by increasing levels of glutathione and superoxide dismutase while also lowering levels of malondialdehyde. The extracts also lower the pro-inflammatory cytokines TNF- α , and IL-6 while elevating anti-inflammatory cytokines, IL-10, and prostaglandin E2. In addition to that, they also reduce cell death processes in the ulcers. Moreover, the *Moringa*

oleifera extracts increase mucus production and the thickness of the mucous membrane in the stomach lining. In various animal studies involving ethanol, pylorus ligation, indomethacin, and bisphenol A-induced ulcers, the anti-ulcer effects of *Moringa* extracts were proven comparable to standard anti-ulcer drugs like ranitidine, cimetidine, and omeprazole

In conclusion, *Moringa oleifera* has been demonstrated to have anti-ulcer effects in animal studies and is worth exploring as a treatment for ulcers due to its antioxidant, anti-inflammatory, and gastroprotective properties.

Moringa Oleifera exhibits various immunomodulatory properties by enhancing the function of innate and cellular immunity mechanisms while also stimulating the production of antibodies. It increases the production of

Immunoglobulins such as IgM, IgA, and IgG while also boosting the production of immune cells such as lymphocytes, natural killer cells, and macrophages. Moreover, it also modulates the production of cytokines by elevating protective and regulatory cytokines such as IL-2, IL-10, and INF- γ , while reducing the levels of pro-inflammatory cytokines such as TNF- α and IL-6. The immunomodulatory properties of *Moringa oleifera* have been demonstrated by the active constituents that it contains such as phenolic acids and flavonoids.

The Lactic acid bacteria used to ferment the leaves of *M. oleifera* enhance nutritional and phytochemical properties of the leaves and reduce the level of anti-nutritional factors. This makes them a suitable candidate for functional food production. The fermentation of *M. oleifera* using *L. plantarum* improves the therapeutic efficacy of the plant extract by lowering the chances of infection by bacterial strains such as *Salmonella typhi* and *Escherichia coli*. Studies indicate that the fermented extract of *M. oleifera* is efficient at increasing expression levels of CD4⁺IFN- γ ⁺, CD4⁺TNF- α ⁺, and CD11b⁺IL-6⁺ cells in *Salmonella*-infected mice.

Moreover, according to various research experiments conducted in vitro, crude extracts of leaves of *Moringa oleifera* are efficient at stimulating normal lymphocytes while inhibiting abnormal lymphocytes such as leukemic lymphocytes. Various in-silico studies have also demonstrated that *M. oleifera* extract modulates immunity by targeting various molecular interactions in innate and cellular immunity mechanisms of the immune system such as those of SRC, HIF1A, STAT3, EP300, among others. Therefore, *Moringa oleifera* in general and fermented *Moringa* extract in particular would be



an excellent functional food candidate owing to its immunomodulatory properties.^[17]

f) CARDIOPROTECTIVE ACTIVITY

Moringa oleifera shows cardioprotective effects by its antioxidant and anti-inflammatory activities and abilities to reduce apoptosis. Hence, it can protect the heart from the damage that can be caused by toxic agents like doxorubicin and hypertension. *Moringa oleifera* is effective in protecting the heart due to its content of various antioxidants, including flavonoids, phenolic compounds, and quercetin, and other compounds such as isothiocyanates and N- α -rhamnopyranosyl vincosamide. It can also lower cholesterol levels, improve the production of endogenous antioxidants such as superoxide dismutase and catalase, reduce necrosis, and restore the functions of the heart. Thus, *M. oleifera* has cardioprotective effects due to the presence of various antioxidant components.

The cardioprotective effect is mainly achieved through antioxidant mechanisms, such as free radical scavenging, reducing lipid peroxidation, and boosting the levels of endogenous antioxidants, including glutathione and catalase, during the development of oxidative stress. In addition, it has anti-inflammatory activity by inhibiting pro-inflammatory pathways, such as those of tumor necrosis factor- α and nuclear factor kappa-beta, and reducing the production of inflammatory mediators. *M. oleifera* also has anti-apoptotic effects, which reduces the activity of pro-apoptotic proteins such as Bax and caspase-3 and increases the levels of anti-apoptotic proteins such as Bcl-2. *Moringa oleifera* lowers blood pressure and modulates lipid metabolism by reducing cholesterol levels. It also reduces cholesterol levels and improves the lipid profile in patients with hypercholesterolemia and hypertension by affecting cholesterol absorption

and bile acid binding. Finally, it reduces cardiac necrosis and maintains the normal architecture of the myocardium by reducing fibrosis and promoting tissue restoration. [18]

Moringa oleifera and *Curcuma longa* are effective in the treatment of hypercholesterolemia as they are capable of reducing cholesterol levels. For instance, the leaves of *moringa oleifera* contain polyphenols and flavonoids, which reduce total cholesterol and non-HDL cholesterol levels and increase HDL cholesterol levels. It also lowers triglyceride levels by inhibiting the absorption of cholesterol in the intestine and enhancing bile acid secretion. On the other hand, *Curcuma longa* (turmeric) contains phytochemicals and

curcumin, which lowers total cholesterol, low-density lipoprotein-cholesterol levels, and high-density lipoprotein levels. It also reduces cholesterol biosynthesis in the liver and protects against LDL-oxidation, which plays a major role in the pathogenesis of atherosclerosis. Notably, combining *moringa* and *turmeric* can result in enhanced health benefits as they have a synergistic effect on reducing cholesterol levels, as well as exerting cardioprotective effects beyond the effect caused by either of them alone. [19]

This study aimed to determine the effect of daily oral administration of aqueous extracts of *moringa oleifera* leaves and *Curcuma longa* on hypercholesterolemia. The study evaluated the impact of the treatment on lipid profile and total serum antioxidant levels, as well as the effect on the aortic and myocardium tissues. The study provides novel information on the effect of combining *moringa oleifera* and *curcuma longa* in the treatment of hypercholesterolemia. It is innovative because there is limited information on the effect of individual phytochemicals, as well as the combined effect of various medicinal plants, on the modulation of lipid metabolism and



antioxidant defense systems, as well as the reversal of the damage caused to the cardiovascular system by hypercholesterolemia. [18]

CONCLUSION

Moringa oleifera Lam. is an important medicinal plant recognized for its exceptional nutritional value and extensive pharmacological potential. This review compiles current knowledge on its phytochemical composition, traditional applications, and diverse biological activities, emphasizing its relevance in contemporary pharmaceutical research. The presence of bioactive constituents such as flavonoids, phenolic compounds, alkaloids, glucosinolates, isothiocyanates, vitamins, and minerals underpins the wide range of therapeutic effects exhibited by the plant.

Available scientific evidence confirms that *M. oleifera* possesses strong antimicrobial, immunomodulatory, antioxidant, anti-inflammatory, antidiabetic, anti-ulcer, hepatoprotective, hypolipidemic, and cardioprotective properties. These effects arise from its ability to regulate oxidative stress, inflammatory mediators, immune function, lipid homeostasis, and key cellular signaling pathways. Different parts of the plant, particularly the leaves and seeds, have demonstrated substantial potential for incorporation into functional foods, nutraceuticals, and pharmaceutical formulations.

Although preclinical findings strongly support its medicinal value, limitations such as lack of extract standardization, insufficient clinical validation, and uncertainty regarding optimal dosage and long-term safety persist. Future investigations should prioritize controlled clinical trials, bioavailability enhancement, mechanistic studies, and formulation development. In conclusion, *Moringa oleifera* represents a promising natural

therapeutic resource with the potential to integrate traditional medicinal knowledge into evidence-based healthcare applications.

REFERENCES

1. Anwar, F., Latif, S., Ashraf, M., & Gilani, A. H. (2007). *Moringa oleifera*: A food plant with multiple medicinal uses. *Phytotherapy Research*, 21(1), 17–25.
2. Parrotta JA. *Moringa oleifera*. In: Roloff A, Weisgerber H, Lang U, Stimm B, editors. *Enzyklopädie der Holzgewächse: Handbuch und Atlas der Dendrologie*. Weinheim: Wiley-VCH Verlag GmbH & Co. KGaA; 2005. p. 1–8.
3. Fahey, J. W. (2005). *Moringa oleifera*: A review of the medical evidence for its nutritional, therapeutic, and prophylactic properties. *Trees for Life Journal*, 1(5)
4. Aliyu JD, Abubakar I, Sahabi M, Abdullahi Z, Zubairu A, Umar AS, et al. Phytochemicals, nutrients and anti-nutrients composition of the aqueous roots and stem extracts of *Typha domingensis*. *IDUNAS Nat Appl Sci J*. 2025;8(1):1–17. doi:10.38061/idunas.1582691.
5. Avilés-Gaxiola S, León-Félix J, Jiménez-Nevárez YB, Angulo-Escalante MA, Ramos-Payán R, Colado-Velázquez J, Heredia JB. Antioxidant and anti-inflammatory properties of novel peptides from *Moringa oleifera* Lam. leaves. *S Afr J Bot*. 2021;141:466–473
6. El-Sherbiny GM, Alluqmani AJ, Elsehemy IA, Kalaba MH. Antibacterial, antioxidant, cytotoxicity, and phytochemical screening of *Moringa oleifera* leaves. *Sci Rep*. 2024;14:30485. doi:10.1038/s41598-024-80700-y.
7. Qadi WSM, Fadzel NT, Mediani A, Sarian MN, Tong X, Han R, et al. An insight review on the potential anti-hypertensive effects of *Moringa oleifera*. *Biomed Pharmacother*.



- 2025;191:118500.
doi:10.1016/j.biopha.2025.118500
8. Pandey M, Bajpai M. Unveiling Antiarthritic Potential of *Moringa oleifera* Lam. Extract: Evaluation and Hydroxypropylmethylcellulose-Based Formulation. *Trad Integr Med*. 2024;9(3):267-274. doi:10.18502/tim.v9i3.16530
9. *Moringa oleifera*: A review of the medical evidence for its nutritional, therapeutic, and prophylactic properties. *Trees for Life Journal*, 1(5), 1–15.
10. Asgari-Kafrani A, Fazilati M, Nazem H. Hepatoprotective and antioxidant activity of aerial parts of *Moringa oleifera* in prevention of non-alcoholic fatty liver disease in Wistar rats. *S Afr J Bot*. 2020;129:82-90. doi:10.1016/j.sajb.2019.01.014.
11. Mthiyane FT, Dlodla PV, Ziqubu K, Mthembu SXH, Muvhulawa N, Hlengwa N, et al. A review on the antidiabetic properties of *Moringa oleifera* extracts: Focusing on oxidative stress and inflammation as main therapeutic targets.
12. Khor KZ, Lim V, Moses EJ, Abdul Samad N. The in vitro and in vivo anticancer properties of *Moringa oleifera*. *Evid Based Complement Alternat Med*. 2018;2018:1071243. doi:10.1155/2018/1071243.
13. Patriota LLS, Ramos DBM, Santos ACLA, Silva YA, Silva MG, Torres DJL, et al. Antitumor activity of *Moringa oleifera* (drumstick tree) flower trypsin inhibitor (MoFTI) in sarcoma 180-bearing mice. *Food Chem Toxicol*. 2020;145:111691. doi:10.1016/j.fct.2020.111691.
14. de Oliveira AM, Fernandes MS, de Abreu Filho BA, Gomes RG, Bergamasco R. Inhibition and removal of staphylococcal biofilms using *Moringa oleifera* Lam. aqueous and saline extracts. *J Environ Chem Eng*. 2018;6(2):2011-2016. doi:10.1016/j.jece.2018.02.043.
16. van den Berg J, Kuipers S. The antibacterial action of *Moringa oleifera*: A systematic review. *S Afr J Bot*. 2022;153:610-626. doi:10.1016/j.sajb.2022.11.021.
17. Hamid AK, Shariq B, Jiyauddin K, Kaleemullah M, Samer AD, Sakina R, et al. Anti-ulcer activity of *Moringa oleifera* leaves extract in Swiss albino mice against aspirin-induced peptic ulcer. *World Journal of Pharmaceutical Research*. 2015;4(5):406-421
18. Patel VK, Lariya NK. Evaluation of anti-ulcer activity of extract of *Moringa oleifera* Lam. using acetic acid induced ulcer model. *Journal of Drug Delivery and Therapeutics*. 2019;9(3-S):23-28. doi:10.22270/jddt.v9i3-s.2741.
19. Ramamurthy S, Varghese S, Sudarsan S, Muruganandhan J, Mushtaq S, Patil PB, et al. *Moringa oleifera*: Antioxidant, Anticancer, Anti-inflammatory, and Related Properties of Extracts in Cell Lines: A Review of Medicinal Effects, Phytochemistry, and Applications. *J Contemp Dent Pract*. 2021;22(12):1520–1527. doi:10.5005
20. Chiş A, Noubissi PA, Pop OL, Mureşan CI, Fokam Tagne MA, Kamgang R, et al. Bioactive Compounds in *Moringa oleifera*: Mechanisms of Action, Focus on Their Anti-Inflammatory Properties. *Plants (Basel)*. 2024;13(1):20. doi:10.3390/plants13010020

HOW TO CITE: Snehal Vasagade*, Prajakta Devkate, Disha Chougule, Shraddha Patil, Harshad Narale , Sanika Vhasukle, Exploring the Miracle Tree: Nutritional and Pharmacological Perspectives of *Moringa oleifera*, *Int. J. of Pharm. Sci.*, 2026, Vol 4, Issue 10, 1063-1074
https://doi.org/10.5281/zenodo.23211812

