WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
Coden USA: WJPRAP Impact Factor 8.63
Volume 15, Issue 21, 1395-1404. Review Article ISSN 2277–7105

NUTRITIONAL AND PHARMACOLOGICAL ROLE OF MORINGA OLEIFERA IN PRENATAL CARE: A COMPREHENSIVE REVIEW

Vaishali Gupta[1]*, Ritik Vaishy[1]

[1]*Student of Pharmacology, Kalinga University, Raipur, India.

[1]Student of Biotechnology, Jaypee Institute of Information and technology, Noida, U.P., India.

Article Received on 05 Oct. 2026,
Article Revised on 26 Oct. 2026,
Article Published on 01 Nov. 2026

https://doi.org/10.5281/zenodo.23910442

***Corresponding Author**
Vaishali Gupta
Student of Pharmacology, Kalinga University, Raipur, India.

How to cite this Article: Vaishali Gupta[1]*, Ritik Vaishy[1]. (2026). Nutritional and Pharmacological Role of Moringa Oleifera In Prenatal Care: A Comprehensive Review. World Journal of Pharmaceutical Research, 15(21), 1395–1404.
This work is licensed under Creative Commons Attribution 4.0 International license.

ABSTRACT

Maternal nutrition plays a significant role in maintaining healthy pregnancy outcomes and supporting fetal growth and development. Deficiency of essential nutrients during pregnancy is commonly associated with anemia, oxidative stress, gestational complications, and impaired neonatal health, particularly in developing countries. In recent years, Moringa oleifera has gained considerable scientific attention due to its rich nutritional profile and diverse pharmacological activities. The leaves of Moringa oleifera contain substantial amounts of proteins, essential amino acids, vitamins, minerals, flavonoids, and phenolic compounds that contribute to maternal well-being and fetal development. The present review critically summarizes the nutritional composition, therapeutic properties, molecular mechanisms, and prenatal health relevance of Moringa oleifera based on recent scientific evidence. Studies have demonstrated that Moringa oleifera exhibits antioxidant, anti-inflammatory, antihyperglycemic, and immunomodulatory properties through modulation of oxidative stress pathways and inflammatory mediators. Experimental and clinical findings indicate improvements in maternal hemoglobin levels, antioxidant defense mechanisms, glycemic regulation, and fetal growth outcomes following supplementation. Although current findings are promising, limitations including insufficient pregnancy-specific clinical studies and lack of standardized formulations remain major concerns.

KEYWORDS: *Moringa oleifera, prenatal care, maternal nutrition, oxidative stress, pregnancy, antioxidant activity, inflammation.*

INTRODUCTION

Maternal nutrition is considered one of the most important determinants of maternal and fetal health during pregnancy. Adequate intake of macro- and micronutrients is essential for fetal organ development, placental growth, hormonal regulation, and maintenance of maternal physiological functions. However, nutritional deficiencies during pregnancy continue to represent a major global public health concern, particularly in low- and middle-income countries where poor dietary practices, food insecurity, and inadequate healthcare services remain highly prevalent. Deficiency of iron, calcium, zinc, folic acid, and essential vitamins during pregnancy is strongly associated with adverse maternal and neonatal outcomes including anemia, preeclampsia, gestational diabetes mellitus, low birth weight, intrauterine growth restriction, and preterm birth.



Figure 1: Representative images of *Moringa oleifera*: flowering branches, fresh pinnate leaves on the plant, and dried leaf powder used for nutritional and pharmacological evaluation in prenatal health studies.

In recent years, increasing attention has been directed toward plant-based nutritional

supplements due to their accessibility, affordability, and lower incidence of adverse effects compared to synthetic therapeutic agents. Among these medicinal plants, Moringa oleifera has emerged as a highly promising nutritional and pharmacological candidate for maternal healthcare. Commonly referred to as the "miracle tree," Moringa oleifera belongs to the family Moringaceae and is widely cultivated in Asia, Africa, and tropical regions because of its remarkable nutritional value and medicinal applications.

The leaves of Moringa oleifera are considered particularly valuable because they contain high concentrations of proteins, essential amino acids, vitamins A, C, and E, calcium, potassium, magnesium, zinc, and iron. These nutrients are critically important during pregnancy as they contribute to fetal skeletal development, immune function, hematopoiesis, and antioxidant protection. Iron-deficiency anemia remains one of the most common complications observed among pregnant women worldwide, and several community-based studies have suggested that Moringa oleifera supplementation may significantly improve maternal hemoglobin levels with comparatively fewer gastrointestinal side effects than conventional iron preparations.

Apart from its nutritional richness, Moringa oleifera contains numerous bioactive phytochemicals including flavonoids, polyphenols, glucosinolates, alkaloids, tannins, and isothiocyanates which exhibit diverse pharmacological activities **(Panova et al., 2025)**. Experimental studies have demonstrated antioxidant, anti-inflammatory, antihyperglycemic, antimicrobial, and immunomodulatory properties that may provide protective benefits during pregnancy-associated complications **(Ramesh et al., 2025)**.

1. Nutritional Composition of Moringa oleifera

Beyond its nutritional value, *M. oleifera* possesses a diverse array of bioactive phytochemicals, including flavonoids (quercetin, kaempferol), phenolic acids (chlorogenic and caffeic acids), glucosinolates, and isothiocyanates. These compounds have been extensively studied for their antioxidant, anti-inflammatory, anti-diabetic, antihypertensive, antimicrobial, and immunomodulatory properties.

Such pharmacological activities are particularly relevant to prenatal care, as oxidative stress, chronic low-grade inflammation, insulin resistance, and endothelial dysfunction are key pathological processes underlying pregnancy-related disorders such as preeclampsia and gestational diabetes. By mitigating oxidative damage and modulating inflammatory and metabolic pathways, *M. oleifera* supplementation may offer dual benefits—nutritional

repletion and therapeutic risk reduction **(Chiș et al., 2023; Satapathy et al., 2024)**.

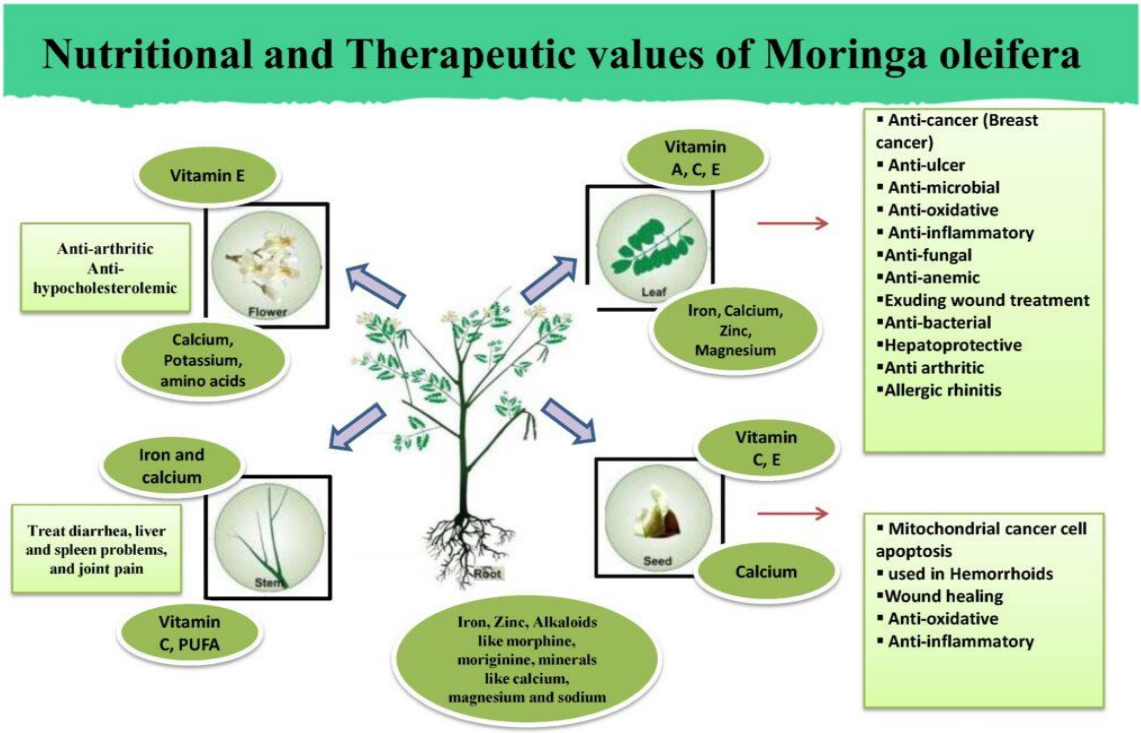


Figure 2: Schematic representation of the nutritional composition and therapeutic potential of different parts of *Moringa oleifera* (leaves, flowers, seeds, stem, and roots), highlighting their key vitamins, minerals, bioactive constituents, and associated pharmacological activities relevant to antioxidant, anti-inflammatory, metabolic, antimicrobial, and wound-healing effects.

Importantly, *M. oleifera* is widely consumed as a food in many cultures, suggesting a favorable safety profile when used within appropriate dietary limits. Nevertheless, despite its widespread traditional use and growing scientific interest, a comprehensive and systematic pharmacological evaluation of *M. oleifera* in the context of prenatal care remains insufficient **(Amqam et al., 2025)**.

2. Antioxidant and Anti-inflammatory Activities

From a pharmacological perspective, extensive preclinical evidence underscores the potent antioxidant and anti-inflammatory properties of *M. oleifera.* In vitro and in vivo studies have demonstrated that its polyphenol-rich extracts scavenge reactive oxygen species (ROS), enhance endogenous antioxidant enzyme systems such as superoxide dismutase (SOD), catalase, and glutathione peroxidase, and reduce lipid peroxidation markers including malondialdehyde (MDA). Mechanistically, these antioxidant effects have been strongly

associated with the activation of the nuclear factor erythroid 2–related factor 2 (Nrf2) signaling pathway, leading to upregulation of cytoprotective genes such as heme oxygenase-1 (HO-1) and NAD(P)H quinone oxidoreductase 1 (NQO1). Given that oxidative stress plays a central role in the pathophysiology of pregnancy-related disorders such as preeclampsia, intrauterine growth restriction, and preterm birth, these findings are highly relevant to prenatal care **(Hegazy et al., 2025; Manjunath et al., 2023; Pareek et al., 2023).**

In parallel, anti-inflammatory effects of *M. oleifera* have been extensively documented. Multiple animal models and cell-based studies report inhibition of nuclear factor kappa B (NF-κB) activation, resulting in suppressed expression of pro-inflammatory cytokines including tumor necrosis factor-alpha (TNF-α), interleukin-6 (IL-6), and interleukin-1β (IL-1β). Chronic low-grade inflammation is increasingly recognized as a hallmark of several gestational complications, including gestational diabetes mellitus (GDM) and preeclampsia; therefore, the immunomodulatory properties of *M. oleifera* provide a strong pharmacological rationale for its evaluation in pregnancy-specific contexts **(Attia et al., 2025; Rotella et al., 2023)**.

3. Antihyperglycemic Effects

The antihyperglycemic potential of *M. oleifera* has also attracted increasing research attention, particularly with relevance to gestational diabetes management. Preclinical studies demonstrate that *M. oleifera* extracts improve insulin sensitivity, enhance glucose uptake in peripheral tissues, and inhibit key carbohydrate-digesting enzymes such as α-amylase and α-glucosidase. Clinical studies in non-pregnant populations with type 2 diabetes have reported reductions in fa fasting blood glucose and postprandial glucose levels following *M. oleifera* supplementation. Although pregnancy-specific clinical data remain limited, these findings suggest a plausible role for *M. oleifera* as an adjunct nutritional strategy for glycemic control in GDM, warranting further targeted investigation **(Azad et al., 2017; Tran et al., 2024)**.

4. Clinical Evidence in Prenatal Care

Clinical and observational studies further reinforce the potential benefits of *M. oleifera* supplementation during pregnancy. Several community-based interventions conducted in South Asia and Sub-Saharan Africa have reported significant improvements in maternal hemoglobin levels and reductions in the prevalence of iron-deficiency anemia among pregnant women receiving *M. oleifera* leaf powder or fortified foods. In some studies, the hematological improvements achieved with *M. oleifera* were comparable to, or better than,

those observed with conventional iron–folic acid supplementation, with fewer reported gastrointestinal side effects and improved compliance. These findings are particularly important in light of the high global burden of maternal anemia and the limitations associated with standard iron therapy.

5. Safety and Mechanistic Considerations

Animal studies provide additional insights into the safety and mechanistic effects of *M. oleifera* during pregnancy. Experimental models have demonstrated that administration of *M. oleifera* leaf extracts within nutritionally relevant doses does not produce teratogenic effects or adverse fetal outcomes. On the contrary, several studies report enhanced placental antioxidant capacity, improved uteroplacental blood flow, and reduced oxidative damage in maternal and fetal tissues. These findings are critical, as safety concerns often limit the use of phytochemicals during pregnancy, despite their potential benefits **(Anggraini et al., 2025).**

In summary, the literature strongly supports the nutritional richness and multifaceted pharmacological potential of *Moringa oleifera*, with accumulating evidence indicating benefits in maternal nutrition, oxidative stress reduction, inflammation modulation, and metabolic regulation. However, existing studies are fragmented and often lack the rigor required for clinical translation in prenatal care. These limitations underscore the need for a comprehensive, mechanism-oriented, and pregnancy-specific pharmacological investigation. The present study is therefore designed to systematically address these gaps by integrating nutritional profiling, pharmacodynamic evaluation, molecular mechanism analysis, and safety assessment of *M. oleifera* in the context of prenatal health, thereby strengthening the scientific foundation for its rational use in maternal care.

6. Research Gaps and Future Perspectives

Despite the growing evidence base, several critical research gaps remain. A major limitation across existing studies is the lack of standardization in *M. oleifera* preparations, including variability in plant source, cultivation conditions, processing methods, and extraction techniques. This heterogeneity complicates inter-study comparisons and hinders the establishment of evidence-based dosage recommendations.

Furthermore, most pharmacological investigations have been conducted in non-pregnant models, with limited exploration of pregnancy-specific pharmacodynamics, placental transfer, and maternal–fetal interactions. While improvements in hemoglobin levels,

antioxidant markers, and glycemic control have been reported, few studies have systematically linked these outcomes to defined molecular pathways relevant to prenatal complications.

In summary, while existing literature strongly supports the nutritional richness and multifaceted pharmacological potential of *Moringa oleifera*, current evidence is fragmented and insufficiently pregnancy-specific. These limitations underscore the need for a comprehensive, mechanism-oriented, and safety-focused investigation, which the present study is designed to address.

RESULT AND DISCUSSION

Available scientific evidence strongly supports the nutritional and therapeutic potential of Moringa oleifera in prenatal healthcare. The leaves of the plant possess substantial quantities of essential nutrients including proteins, vitamins, minerals, and antioxidant phytochemicals that are directly associated with maternal nutritional improvement and fetal growth support. Iron and calcium present in Moringa oleifera are particularly important during pregnancy because deficiency of these nutrients frequently contributes to maternal anemia, skeletal abnormalities, and impaired fetal development.

Several clinical and observational studies have reported positive hematological outcomes following supplementation with Moringa oleifera leaf powder among pregnant women. Increased maternal hemoglobin concentration and reduction in iron-deficiency anemia were observed in multiple community-based interventions. In some studies, the nutritional benefits achieved through Moringa oleifera supplementation were comparable to conventional iron-folic acid therapy while demonstrating improved gastrointestinal tolerance and better patient compliance.

Experimental investigations have shown that administration of Moringa oleifera extracts significantly increases endogenous antioxidant enzymes including superoxide dismutase, catalase, and glutathione peroxidase while decreasing malondialdehyde levels. Activation of the Nrf2 signaling pathway appears to be one of the principal molecular mechanisms involved in antioxidant regulation.

Studies have also demonstrated that Moringa oleifera suppresses inflammatory responses through inhibition of NF-κB signaling and reduction in pro-inflammatory cytokines including

tumor necrosis factor-alpha, interleukin-6, and interleukin-1β. These anti-inflammatory activities may provide protective effects against endothelial dysfunction and placental inflammation associated with preeclampsia and gestational diabetes mellitus.

Despite encouraging findings, several limitations continue to restrict the clinical translation of Moringa oleifera in prenatal medicine. Lack of standardized formulations, variations in phytochemical composition, insufficient pregnancy-specific randomized clinical trials, and inconsistent dosage protocols remain major concerns. Future research should therefore focus on large-scale controlled clinical investigations and safety assessment to establish evidence-based therapeutic guidelines.

CONCLUSION

Moringa oleifera possesses considerable nutritional and pharmacological importance in the field of prenatal healthcare. The plant contains essential nutrients, antioxidant phytochemicals, and bioactive compounds that collectively contribute to maternal well-being and fetal development. Available evidence indicates that supplementation with Moringa oleifera may improve maternal hemoglobin levels, reduce oxidative stress, regulate inflammatory responses, and support metabolic balance during pregnancy.

In addition, its affordability, accessibility, and traditional acceptance make Moringa oleifera a promising nutritional intervention, particularly in resource-limited populations where maternal malnutrition remains highly prevalent. However, despite encouraging experimental and clinical findings, current evidence remains limited by insufficient pregnancy-specific clinical trials, lack of standardized formulations, and incomplete long-term safety evaluation. Overall, Moringa oleifera demonstrates strong potential as a multifunctional nutraceutical supplement for improving prenatal health and supporting safer pregnancy outcomes.

REFERENCES

1. Amqam, H., Khuzaimah, A., Najamuddin, U., Ahmad, M., Muniroh, M., Marchianti, A. C. N., & Elias, S. M. Moringa oleifera Supplementation for Reducing Heavy Metal Toxicity and Oxidative Stress in Pregnant Women: Protocol for a Nonrandomized Trial Study. *JMIR Research Protocols*, 2025; *14:* e73201. doi: 10.2196/73201
2. Anggraini, N. W. P., Sulistyowati, S., Soetrisno, Purwanto, B., & Dirgahayu, P. Effect of Moringa oleifera Leaves on the Expression of NFκβ, E-Selectin, and Superoxide

Dismutase in the Placental of Preeclamptic Mouse Model. *Tropical Journal of Natural Product Research*, 2025; *9*(4): 1800–1805. doi: 10.26538/TJNPR/V9I4.52

3. Attia, S. L., Owuor, P. M., Odhiambo, S. A., Mogaka, J. N., Ondondo, R., Navarro, I. C., Schadler, A., McQuerry, K., Fuchs, G. J., Williams, J. E., Scarrow, K. N., McGuire, M. A., McGuire, M. K., & Waterman, C. Effect of Maternal Moringa oleifera Leaf Supplementation on Maternal and Infant Nutritional Status and Human Milk Output: A Pilot Single-Blinded Cluster-Randomized Trial. *Current Developments in Nutrition*, 2025; *9*(11): 107568. doi: 10.1016/J.CDNUT.2025.107568
4. Azad, S. Bin, Ansari, P., Azam, S., Hossain, S. M., Shahid, M. I. Bin, Hasan, M., & Hannan, J. M. A. Anti-hyperglycaemic activity of Moringa oleifera is partly mediated by carbohydrase inhibition and glucose-fibre binding. *Bioscience Reports*, 2017; *37*(3). BSR20170059. doi: 10.1042/BSR20170059
5. Chiș, A., Noubissi, P. A., Pop, O. L., Mureșan, C. I., Fokam Tagne, M. A., Kamgang, R., Fodor, A., Sitar-Tăut, A. V., Cozma, A., Orășan, O. H., Hegheș, S. C., Vulturar, R., & Suharoschi, R. Bioactive Compounds in Moringa oleifera: Mechanisms of Action, Focus on Their Anti-Inflammatory Properties. *Plants*, 2023; *13: 20*. doi: 10.3390/PLANTS13010020
6. Hegazy, R. A., Abdulbaqi, A. A., Hassani, R., El-kholy, S. S., Farrag, F. A., & El-Magd, M. A. Cytoprotective impact of Moringa oleifera leaf extract on liver damage and insulin resistance in diabetic rats. *Journal of Radiation Research and Applied Sciences*, 2025; *18*(2): 101532. doi: 10.1016/J.JRRAS.2025.101532
7. Manjunath, S. H., Nataraj, P., Swamy, V. H., Sugur, K., Dey, S. K., Ranganathan, V., Daniel, S., Leihang, Z., Sharon, V., Chandrashekharappa, S., Sajeev, N., Venkatareddy, V. G., Chuturgoon, A., Kuppusamy, G., Madhunapantula, S. R. V., & Thimmulappa, R. K. Development of Moringa oleifera as functional food targeting NRF2 signaling: antioxidant and anti-inflammatory activity in experimental model systems. *Food and Function*, 2023; *14*(10): 4734–4751. doi: 10.1039/D3FO00572K
8. Panova, N., Gerasimova, A., Gentscheva, G., Nikolova, S., Makedonski, L., Velikova, M., Beraich, A., Talhaoui, A., Petkova, N., Batovska, D., & Nikolova, K. (2025). Moringa oleifera Lam.: A Nutritional Powerhouse with Multifaceted Pharmacological and Functional Applications. *Life, 2025; 15(881) 15*(6): 881. doi: 10.3390/LIFE15060881
9. Pareek, A., Pant, M., Gupta, M. M., Kashania, P., Ratan, Y., Jain, V., Pareek, A., & Chuturgoon, A. A. Moringa oleifera: An Updated Comprehensive Review of Its Pharmacological Activities, Ethnomedicinal, Phytopharmaceutical Formulation, Clinical,

Phytochemical, and Toxicological Aspects. *International Journal of Molecular Sciences*, 2023; *24*(3): 2098. doi: 10.3390/IJMS24032098

10. Ramesh, B., Chauhan, R., Don, P. M. U., Joshi, R., Pansare, S., Modi, Z., Verma, A., Abdur Rahim Imthiaz, F. R., Chaudhary, P., Vashisht, P., Modak, B., Gandhi, G., & Rathnakumar, K. Moringa oleifera: a comprehensive review of its nutritional benefits, functional applications, and future potential in food science. *Journal of the Science of Food and Agriculture*, 2025. doi: 10.1002/JSFA.70388;WEBSITE:WEBSITE:SCIJOURNALS;PAGE:STRING:ARTICLE/CHAPTER
11. Rotella, R., Soriano, J. M., Llopis-González, A., & Morales-Suarez-Varela, M. The Impact of Moringa oleifera Supplementation on Anemia and other Variables during Pregnancy and Breastfeeding: A Narrative Review. *Nutrients*, 2023; *15*(12): 2674. doi: 10.3390/NU15122674
12. Satapathy, T., Sahu, H., Gupta, P. P., & Roy, A. Therapeutic Potential and Benefits of Moringa oleifera: An updated Overview. *Research Journal of Pharmacy and Technology*, 2024; *17*(8): 4089–4096. doi: 10.52711/0974-360X.2024.00634.
13. Tran, T. T. L., Ly, H. T., Le, T. K. O., & Le, V. M. Anti-hyperglycemic effect of herbal formula of Moringa oleifera, Vernonia amygdalina and Centella asiatica extracts in streptozotocin-induced hyperglycemic mice. *Pharmacological Research - Modern Chinese Medicine*, 2024; *11:* 100428. doi: 10.1016/J.PRMCM.2024.100428