JOURNAL OF NATURAL REMEDIES
DOI: 10.18311/jnr/2025/45035

SHORT REVIEW

Moringa oleifera: A Short Review of its Health Benefits

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Abstract

The drumstick or horseradish plant, *Moringa oleifera*, is important to people worldwide because of its ecological, nutritional, and cultural benefits. It originated in the north Indian Himalayan highlands and has since migrated to tropical and subtropical areas, thriving in diverse environments. Its resilience to drought and rapid growth rate makes it valuable for agriculture and conservation. *Moringa* leaves are a powerful nutritional supplement full of vital elements like calcium, potassium, vitamins A, C, and E, especially in combating malnutrition. They also contain bioactive compounds with antioxidant and anti-inflammatory properties, offering various health benefits. *Moringa* seeds produce ben oil, high in unsaturated fatty acids crucial for heart health, blood sugar regulation, and immune function. Beyond leaves and seeds, *Moringa*'s fruits, bark, roots, and flowers provide antioxidant, anti-inflammatory, antimicrobial, and digestive support, potentially aiding in managing diabetes, cardiovascular disorders, cancer, and skin ailments. However, further clinical research is needed to establish optimal uses and dosages. *M. oleifera* represents a "miracle tree," offering holistic wellness benefits and sustainable solutions to global health challenges. Ongoing research promises to unlock its full potential, yet individuals should consult healthcare professionals before incorporating it into their diets or wellness routines.

Major Findings: *Moringa oleifera* demonstrates a unique combination of high-value nutrients and bioactive compounds that support antioxidant, anti-inflammatory, and metabolic health, highlighting its potential as a sustainable nutritional supplement and therapeutic adjunct.

Keywords: Health Benefits, Nutritional, Resilience, Sustainability

1. Introduction

Moringa oleifera, the drumstick tree, is versatile for global cultural with ecological importance. Originating from the Himalayan foothills in northern India, it thrives in tropical and subtropical regions. This drought-tolerant tree with rapid growth is prized for its nutritional, medicinal and industrial properties.

Moringa oleifera leaves are abundant in essential nutrients like vitamins A, C, and E, calcium, potassium, and protein, making them an important nutritional component. and potential solutions to malnutrition[1]. *Moringa* leaves contain bioactive compounds with antioxidant and anti-inflammatory properties, offering health benefits[2]. *Moringa oleifera* seeds produce ben oil, rich in unsaturated fatty acids, with cooking, cosmetics, and pharmaceutical applications[3]. *Moringa* seed cake, a byproduct of oil extraction, can be used as a high-protein, nitrogen-fixing fertiliser[4]. *Moringa oleifera* is valuable for sustainable agriculture and conservation, preventing soil erosion with its deep roots and aiding reforestation and land reclamation in marginal lands[5]. Moringa trees provide livestock fodder and natural pesticides, with leaf and seed extracts showing insecticidal properties[6].

Here are the main components of this plant, particularly *Moringa oleifera*, which are utilized for their nutritional, medicinal, and industrial uses.

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Article Received on: 19.07.2024 Revised on: 07.03.2025 Accepted on: 10.03.2025

2. The Diverse Benefits of *Moringa* Plant Parts

2.1 Leaves

Moringa leaves from the *Moringa oleifera* tree are celebrated for their nutrient richness and health benefits. They provide essential vitamins A, C, and E, minerals like calcium and potassium, and are packed with antioxidants like flavonoids and polyphenols, which help fight Inflammation and oxidative damage[7]. This antioxidant activity supports cellular health and helps alleviate chronic conditions linked to inflammation, such as arthritis and inflammatory bowel diseases. According to studies, the leaves of *Moringa* may help control the level of blood sugar, which could be advantageous for people suffering from diabetes or people who are in need[8,9]. *Moringa* leaves offer diverse health benefits, including cholesterol reduction and neuroprotection. They boost immunity, support digestive health, aid wound healing, and assist in weight management. Further research is needed to optimise their use for specific health conditions. Consulting healthcare professionals is advised before incorporating *Moringa* leaves into diets or wellness routines[10].

2.2 Seeds

Moringa seeds provide a wealth of medicinal advantages because of their significant nutritional content and active components. They are particularly high in proteins, making them valuable for vegetarians and vegans looking to meet their protein needs[11]. Good fats such as omega-3 and omega-6 fatty acids, which are vital for cardiovascular wellness and general well-being, can be found in abundance in *Moringa* seeds[12]. Seeds are rich in vitamins such as A, C, and E, along with minerals like calcium, potassium, and magnesium, enhancing their nutritional value[13]. *Moringa* seeds are rich in antioxidants like phenolic compounds and flavonoids, which reduce the incidence of long-term illnesses including cancer and heart problems and fight free radicals[14]. Osteoarthritis and inflammatory bowel disorders may be lessened by the anti-inflammatory effects of the bioactive substances found in *Moringa* seeds[15]. Research also suggests that these seeds can reduce bad cholesterol, promoting cardiac wellness and lowering the chance of developing heart disease[16]. Because of the hypoglycaemic properties of *Moringa* seeds, those who are resistant to insulin might profit from improved control of blood sugar[17]. Rich in fibre, these seeds promote digestive health by regulating bowel movements and alleviating gastrointestinal disorders[18]. Nutrients and fatty acids in *Moringa* seeds support healthy skin and hair, this seed oil is used in skincare for its moisturizing and anti-ageing properties[19]. *Moringa* seeds' nutrient-rich content boosts immune function, enhancing the body's defences against infections and illnesses[20].

2.3 Fruits

Moringa fruits, also known as drumsticks or pods, are nutritious green pods from the *Moringa oleifera* tree. They are rich in essential nutrients including vitamins C, A, E, and K, minerals like calcium, potassium, and magnesium, and proteins crucial for muscle repair and growth. These fruits also boast antioxidant properties from vitamin C and flavonoids, oxidative stress and lowering the possibility of long-term illnesses[21]. *Moringa* fruits, rich in vitamin C, strengthen the immune response to improve the body's response against diseases[22]. High in fibre, *Moringa* fruits aid digestion, support regular bowel movements and may alleviate digestive disorders[23]. Minerals like calcium and phosphorus in *Moringa* fruits contribute to bone health, preventing conditions like osteoporosis[24]. Studies suggest these fruits may help to regulate glucose levels, helping those who have diabetes or are in need[25]. Compounds in *Moringa* fruits may lower cholesterol levels, reducing the risk of cardiovascular diseases[26]. Vitamins and antioxidants in *Moringa* fruits protect skin from oxidative damage, reduce inflammation, and support collagen production[27].

2.4 Bark

The bark of the *Moringa oleifera* tree contains bioactive compounds offering several health benefits, compounds like flavonoids and phenolic acids in *Moringa* bark reduce inflammation associated with conditions such as arthritis and inflammatory bowel diseases[28]. Extracts from bark have antimicrobial properties, inhibiting harmful bacteria and supporting immune function[29]. Antioxidants found in this bark counteract free radicals, thereby preventing oxidative harm and reducing the incidence of persistent illnesses[30]. Applied

topically, *Moringa* bark extracts accelerate wound healing and promote tissue repair[31]. Blood sugar-regulating properties found in this bark might help people who have diabetes or are at risk for it[32].

2.5 Root

Moringa roots comprise of bioactive molecules such as phenolic acids, flavonoids, alkaloids and glucosinolates, known for their anti-inflammatory properties. These properties may help alleviate conditions associated with inflammation, such as arthritis and inflammatory bowel diseases[33]. Compounds in roots exhibit antimicrobial effects against bacteria, fungi, and other microorganisms, supporting immune function and reducing infection risk[34]. Additionally, these roots contain antioxidants that protect cells from oxidative stress, decreasing the chances of long-term illnesses such as malignancy and heart problems[35]. Studies suggest extracts from roots have hepatoprotective properties, benefiting liver health[36]. They are also traditionally used to promote digestive health, potentially alleviating digestive disorders[37].

2.6 Flowers

Moringa flowers, also called drumstick flowers, are rich in essential nutrients, antioxidants, and vitamins like C and A. They are valued in traditional medicine and cooking across cultures for their health benefits and delicate flavour[38]. *Moringa* flowers are rich in antioxidants like flavonoids, phenolic acids, and ascorbic acid, which neutralize free radicals and decreases oxidative damage, lowering the risk of long-term illness[39]. They also exhibit anti-inflammatory properties, beneficial for conditions such as arthritis and inflammatory bowel diseases[40]. Traditionally used to promote digestive health, these flowers contain fibre and bioactive compounds that aid digestion and maintain gastrointestinal function[41]. Initial evidence indicates that they may help manage glucose levels and enhance the insulin response, possibly aiding those suffering from diabetes or related metabolic conditions[42].

3. Chemical Profile of *Moringa oleifera*

Moringa oleifera is a highly nutritious plant with various chemical constituents that provide numerous health benefits. The leaves are rich in essential amino acids such as tryptophan and glutamic acid, vitamins (A, C, E, K), minerals (calcium, potassium, iron, and magnesium), and antioxidants like quercetin and chlorogenic acid. The seeds contain monounsaturated and polyunsaturated fats, amino acids like cysteine and methionine, and antioxidants such as quercetin and kaempferol. The roots are rich in alkaloids like spirochin and pterygospermin and phenolic compounds such as flavonoids and tannins. The flowers contain phenolic acids like chlorogenic acid and gallic acid and flavonoids such as quercetin and rutin. The pods are a good source of vitamin C and minerals like calcium and magnesium. Specific compounds such as moringyne, niazimicin, and linoleic acid further enhance its medicinal properties. These components contribute to *Moringa*'s antioxidant, anti-inflammatory, and nutrient-rich profile, making it a valuable dietary and medicinal resource[43-45]. The Chemical constituents of *Moringa* plants are illustrated in Figure 1[46].

4. Role of *Moringa* in Various Diseases

4.1 Diabetes

Moringa leaves contain bioactive compounds like quercetin, chlorogenic acid, and isothiocyanates, which have demonstrated antidiabetic reduces glucose levels in the blood and improves sensitivity to insulin. Research indicates significant reductions in blood glucose levels with *Moringa* leaf extracts in hyperglycaemic rats, suggesting potential antidiabetic activity. Additionally, plant extracts may improve lipid metabolism, reducing cholesterol and triglyceride levels and lowering cardiovascular risks in diabetic individuals[47]. *Moringa* extracts show potential insulin-sensitizing properties, enhancing insulin effectiveness to lower blood sugar levels in diabetes. Its antioxidants like vitamins C and E, flavonoids, and phenolic acids protect pancreatic beta cells from oxidative damage associated with diabetes[48].

4.2 Cardiovascular Disease

Moringa, rich in antioxidants like vitamin C, flavonoids, and phenolic acids, reduces oxidative stress, critical in cardiovascular disease development by damaging blood vessels and causing inflammation[49]. Studies

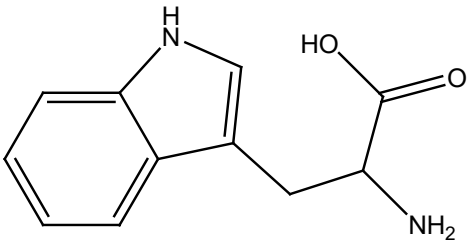
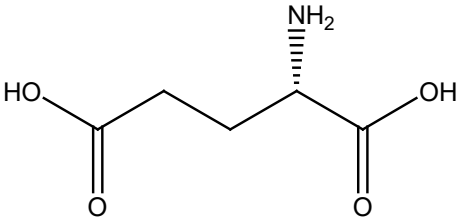
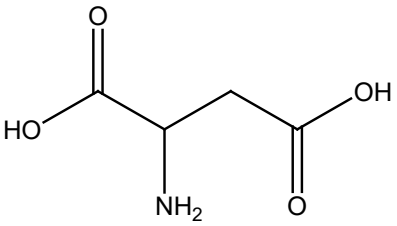
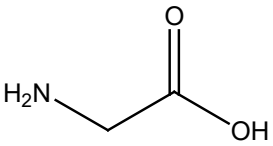
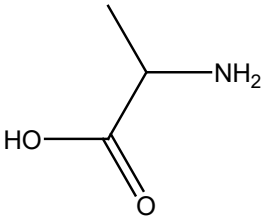
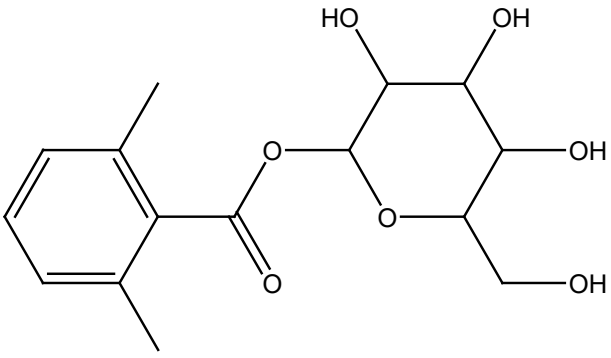
Sr. No.	Name	Structure
1	Tryptophan	
2	Glutamic acid	
3	Aspartic acid	
4	Glycine	
5	Alanine	
6	Moringyne	

Figure 1. Chemical constituents of *Moringa oleifera*.

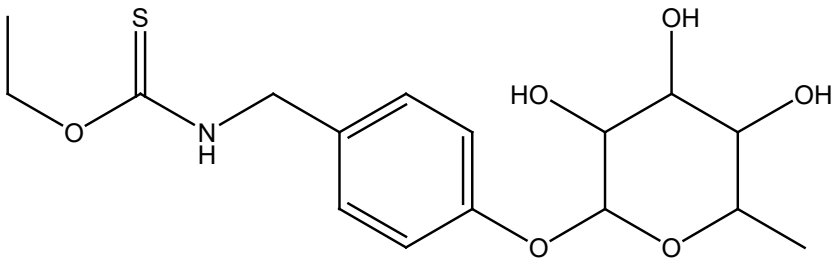
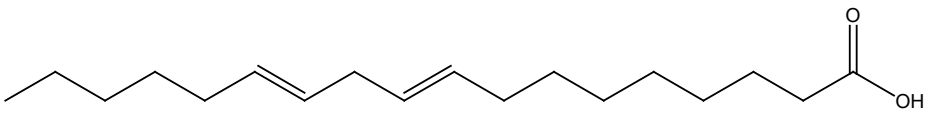
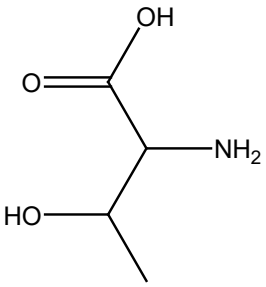
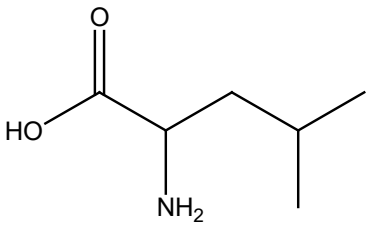
Sr. No.	Name	Structure
7	Niazimicin	
8	Linoleic acid	
9	Threonine	
10	Leucine	

Figure 1. *(Continued).*

show plant extracts lower blood lipid levels, including total cholesterol, LDL cholesterol, and triglycerides, key risk factors for atherosclerosis and coronary artery disease[50]. Its anti-inflammatory compounds can reduce inflammation in blood vessels and the heart, crucial in cardiovascular disease progression[51]. *Moringa*'s hypotensive effects reduce hypertension, which is an important risk indicator for coronary artery disease and stroke, with potential direct protective effects on heart muscle function[52].

4.3 Inflammatory Disease

Moringa oleifera shows promise in mitigating inflammation, making it potentially beneficial for inflammatory diseases. *Moringa*, which is high in bioactive ingredients such as phenolic compounds, flavonoids, and alkaloid, has considerable anti-inflammatory qualities by blocking inflammatory messengers and catalysts[53]. These properties may help alleviate symptoms of rheumatoid arthritis by reducing joint pain and swelling[54]. Studies suggest plant extracts could aid in managing inflammatory bowel diseases like Crohn's disease and ulcerative colitis, reducing inflammation in the gastrointestinal tract[55]. *Moringa*'s anti-inflammatory effects may also alleviate asthma symptoms by reducing airway inflammation and oxidative stress[56]. Topical application of *Moringa* oil or extract may resolve skin problems such as eczema and psoriasis, due to its anti-inflammatory and moisturizing effect[57].

4.4 Cancer

Studies highlight *Moringa oleifera's* potential in combating cancer. Research in "Food and Chemical

Toxicology" (2018) showed *Moringa* leaf extracts inducing apoptosis in lung cancer cells[58]. "PLOS ONE" (2013) demonstrated *Moringa* seeds' antiangiogenic properties, crucial in inhibiting tumour growth[59]. In the "Asian Pacific Journal of Cancer Prevention" (2014), *Moringa* leaf extract reduced skin cancer incidence in mice. Additionally, "PLoS ONE" (2015) revealed *Moringa* leaf extract's apoptosis induction in melanoma and colorectal carcinoma cells. Furthermore, in "BMC Complementary and Alternative Medicine" (2018), *Moringa* leaf extract inhibited breast cancer cell metastasis[60-62].

4.5 Digestive Disorders

Moringa's bioactive compounds, including flavonoids and phenolic acids, offer gastro-protective benefits by reducing inflammation and shielding the gastric mucosa, potentially easing conditions like gastritis and peptic ulcers[63]. Its leaves, rich in dietary fibre, aid digestion and regulate bowel movements, providing relief from indigestion and constipation[64]. *Moringa*'s anti-inflammatory properties may alleviate symptoms of Inflammatory Bowel Diseases (IBD) such as Crohn's disease and ulcerative colitis[65]. Additionally, its antioxidants and anti-inflammatory traits could help alleviate dyspepsia symptoms and combat gastrointestinal infections, reducing discomfort associated with abdominal pain, bloating, and diarrhoea[66-68].

4.6 Anemia

Moringa's role in treating anaemia is due to its high iron content, essential for red blood cell production and haemoglobin synthesis. Its leaves are particularly rich in iron, surpassing levels found in spinach and meat. The iron in *Moringa* is highly bioavailable, easily absorbed and utilized by the body, making it effective in addressing iron deficiency anaemia. Clinical trials have shown that its leaf powder supplementation significantly increases haemoglobin levels, particularly in vulnerable populations like pregnant women and children, thereby reducing the prevalence of anaemia[69].

4.7 Skin Disease

Moringa shows promise in treating skin diseases like eczema, psoriasis, and dermatitis due to its anti-inflammatory properties. Compounds like flavonoids and phenolic acids found in this plant help in reduce inflammation associated with these conditions. Its extracts exhibit antimicrobial activity against bacteria and fungi, beneficial for treating skin infections such as acne and fungal infections. Antioxidants like vitamin C and beta-carotene protect skin from oxidative damage, slowing ageing. *Moringa* promotes wound healing by aiding tissue formation and collagen deposition, useful for cuts and burns. Plant oil, rich in fatty acids, moisturizes and nourishes skin, aiding conditions like dry skin and eczema[70].

5. Conclusion

Moringa oleifera stands as a remarkable botanical treasure, offering a plethora of nutritional, medicinal, and industrial benefits. Originating from the Himalayan region, this versatile plant has proliferated across tropical and subtropical regions, thriving in diverse environments and soil conditions. Its various parts, including leaves, seeds, fruits, bark, roots, and flowers, are utilized for their rich nutritional profiles and bioactive compounds. *M. oleifera* leaves are packed with essential nutrients and antioxidants, offering potential health benefits such as anti-inflammatory, antioxidant, and immune-boosting effects. Similarly, the seeds provide a source of high-quality oil and essential nutrients, contributing to heart health, blood sugar regulation, digestive health, and immune function. The fruits, bark, roots, and flowers provide a variety of health advantages, including antiviral, anti-inflammatory, antibacterial, and digestive aid. Furthermore, research reveals that *M. oleifera* may assist with the management and prevention of a variety of ailments, including cardiovascular illness, diabetes, inflammatory conditions, cancer, problems with digestion, anaemia, and skin conditions. Its bioactive compounds exhibit therapeutic effects that target multiple pathways involved in these conditions, making it a potential adjunctive therapy or preventive measure. However, while the evidence supporting the health benefits of *M. oleifera* is compelling, Additional studies, including clinical trials in humans, must be conducted to verify these findings and discover the best dosages and preparations for use in therapy. Additionally, individuals should exercise caution and consult healthcare professionals, especially those with pre-existing medical conditions or taking medications,

before incorporating *Moringa* into their diets or wellness regimens. Overall, *M. oleifera*'s diverse array of nutrients and bioactive compounds, coupled with its adaptability and sustainability, solidify its status as a "miracle tree" with profound implications for global health and well-being. As we continue to unravel its potential, *Moringa* remains a beacon of hope for addressing nutritional deficiencies, combating diseases, and promoting holistic wellness across diverse populations and environments.

6. Author Contribution

Dilsar Gohil conceptualized the review, performed the literature search, and drafted the manuscript; Megha Kokas prepared all figures and tables; Rajesh Maheshwari supervised the work and critically revised the draft. All authors have read and agreed to the published version of the manuscript.

7. References

1. Fuglie LJ. The miracle tree: *Moringa oleifera*: natural nutrition for the tropics. Dakar: Church World Service; 2001.
2. Anwar F, Latif S, Ashraf M, Gilani AH. *Moringa oleifera*: a food plant with multiple medicinal uses. Phytother Res. 2007; 21(1):17-25. https://doi.org/10.1002/ptr.2023
3. Makkar HPS, Francis G, Becker K. State-of-the-art on detoxification of *Jatropha curcas* products aimed for use as animal and fish feed: a review. J Anim Physiol Anim Nutr (Berl). 2009; 93(5):646-71.
4. Ndabikunze BK, Masambu BN, Tiisekwa BPM. Evaluation of *Moringa oleifera* as a dietary supplement on performance, carcass characteristics and meat quality of indigenous poultry in Tanzania. Livest Res Rural Dev. 2015; 27(7).
5. Arora M, Kaur P, Das Gupta N. Potential of *Moringa oleifera* Lam. for restoration of degraded and denuded lands. Int J Bot. 2011; 7(4):409-14.
6. Sarker U, Islam MT, Rabbani MG, Oba S. The potential of *Moringa oleifera* for agricultural and industrial uses. In: Book of Abstracts: International Conference on Biodiversity, Climate Change Assessment and Impacts on Livelihood; 2017.
7. Fahey JW. *Moringa oleifera*: a review of the medical evidence for its nutritional, therapeutic, and prophylactic properties. Part 1. Trees Life J. 2005; 1(5):1-15.
8. Moyo B, Masika PJ, Hugo A, Muchenje V. Nutritional characterization of Moringa (*Moringa oleifera* Lam.) leaves. Afr J Biotechnol. 2011; 10(60):12925-33. https://doi.org/10.5897/AJB10.1599
9. Stohs SJ, Hartman MJ. Review of the safety and efficacy of *Moringa oleifera*. Phytother Res. 2015; 29(6):796-804. https://doi.org/10.1002/ptr.5325
10. Tugume P, Kakudidi EK, Buyinza M, Namaalwa J, Mukadasi B. The *Moringa* genus: indigenous knowledge, genetic resources and potential utility for improved human nutrition and health. Sustain Agric Rev. 2017; 23:211-47.
11. Rivera CG, Hernandez LR, Santos MJ. Evaluation of the medicinal properties of *Moringa oleifera*: a review of the current evidence. Evid Based Complement Alternat Med. 2019.
12. Al-Asmari AK, Albalawi SM, Athar MT, Khan AQ, Al-Shahrani H. *Moringa oleifera* as an anti-cancer agent against breast and colorectal cancer cell lines. PLoS One. 2015; 10(8):e0135814. https://doi.org/10.1371/journal.pone.0135814
13. Jahn SA. Using Moringa seeds as coagulants in developing countries. J Am Water Works Assoc. 1988;80(6):43-50. https://doi.org/10.1002/j.1551-8833.1988.tb03052.x
14. El Rabey HA, Khan JA, Almutairi FM, Elbakry MA. The low dose of drumsticks (*Moringa oleifera* L.) seed powder ameliorates blood cholesterol in hypercholesterolemic male rat.
15. Khalafalla MM, Abdellatef E, Dafalla HM, Nassrallah AA, Aboul-Enein KM, Lightfoot DA, *et al*. Active principle from *Moringa oleifera* Lam leaves effective against two leukemias and a hepatocarcinoma. J Med Food. 2020; 23(3):326-35.
16. Kooltheat N, Sranujit RP, Chumark P, Potup P. *Moringa oleifera* seeds enhance protein concentration of yogurt and reduce yogurt post-acidification. Food Chem. 2014; 151:544-9.
17. Leone A, Spada A, Battezzati A, Schiraldi A, Aristil J, Bertoli S. *Moringa oleifera* seeds and oil: characteristics and uses for human health. Int J Mol Sci. 2015; 16(6):12791-800. https://doi.org/10.3390/ijms160612791
18. Krishnaswamy K, Purushothaman M. *Moringa oleifera*: a review of the medical evidence for its nutritional, therapeutic, and prophylactic properties. Part 2. Trees Life J. 2008; 1(5):1-15.
19. Mehta K, Balaraman R, Amin AH, Bafna PA, Gulati O. Effect of fruits of *Moringa oleifera* on the lipid profile of normal and hypercholesterolaemic rabbits. J Ethnopharmacol. 2003; 86(2-3):191-5. https://doi.org/10.1016/S0378-8741(03)00075-8
20. Nagar PK, Iyer RI, Sircar PK. Cytokinins in developing fruits of Moringa pterigosperma Gaertn. Physiol Plant. 1982; 55(1):45-50. https://doi.org/10.1111/j.1399-3054.1982.tb00283.x
21. Mahmood KT, Mugal T, Haq IU. *Moringa oleifera*: a natural gift—a review. J Pharm Sci Res. 2010; 2(11):775.
22. Mishra G, Singh P, Verma R. A review on *Moringa oleifera*: a multipurpose tree. Int J Pharma Bio Sci. 2011; 2(1):528-39.

23. Alhakmani F, Kumar S, Khan SA. Estimation of total phenolic content, in-vitro antioxidant and anti-inflammatory activity of flowers of *Moringa oleifera*. Asian Pac J Trop Biomed. 2013; 3(8):623-7. https://doi.org/10.1016/S2221-1691(13)60126-4
24. Pal SK, Mukherjee PK. Studies on the antiulcer activity of *Moringa oleifera* leaf extract on gastric ulcer models in rats. Phytother Res. 2006; 20(9):806-10.
25. Adebayo IA, Arsad H, Samian MR, Sani NA. Effect of *Moringa oleifera* Lam. bark extracts on normal and ulcerated gastric mucosa of laboratory rats. J Integr Med. 2016; 14(2):95-105. https://doi.org/10.21010/ajtcam.v14i2.30
26. Hannan JM, Marenah L, Ali L, Rokeya B, Flatt PR, Abdel-Wahab YH. Insulin secretory actions of extracts of Asparagus racemosus root in perfused pancreas, isolated islets and clonal pancreatic β-cells. J Endocrinol. 2007; 192(1):159-68. https://doi.org/10.1677/joe.1.07084
27. Dewangan G, Koley KM, Vadlamudi VP, Mishra A, Poddar A, Hirpurkar SD. Antibacterial activity of *Moringa oleifera* (drumstick) root bark. J Chem Pharm Res. 2010; 2(6):424-8.
28. Kebede TG, Dube S, Mengistie AA, Nkambule TT, Nindi MM. Moringa stenopetala bark: a novel green adsorbent for the removal of metal ions from industrial effluents. Phys Chem Earth A/B/C. 2018; 107:45-57. https://doi.org/10.1016/j.pce.2018.08.002
29. Maurya SK, Singh AK. Clinical efficacy of *Moringa oleifera* Lam. stems bark in urinary tract infections. Int Sch Res Notices. 2014; 2014. https://doi.org/10.1155/2014/906843
30. Kumbhare M, Sivakumar T. Anti-inflammatory and analgesic activity of stem bark of *Moringa oleifera*. Pharmacologyonline. 2011; 3:641-50.
31. Atawodi SE, Atawodi JC, Idakwo GA, Pfundstein B, Haubner R, Wurtele G, *et al*. Evaluation of the polyphenol content and antioxidant properties of methanol extracts of the leaves, stem, and root barks of *Moringa oleifera* Lam. J Med Food. 2010; 13(3):710-6. https://doi.org/10.1089/jmf.2009.0057
32. Kumar NA, Parihar A, Singh AP. An overview of therapeutic and nutritional importance of *Moringa oleifera*. J Pharmacogn Phytochem. 2019; 8(5):1666-8.
33. Olson ME, Carlquist S. Stem and root anatomical correlations with life form diversity, ecology, and systematics in Moringa (Moringaceae). Bot J Linn Soc. 2001; 135(4):315-48. https://doi.org/10.1111/j.1095-8339.2001.tb00786.x
34. Giacoppo S, Rajan TS, Iori R, Rollin P, Bramanti P, Mazzon E. The isothiocyanate isolated from *Moringa oleifera* shows potent anti-inflammatory activity in the treatment of murine subacute Parkinson's disease. Rejuvenation Res. 2017; 20(1):50-63. https://doi.org/10.1089/rej.2016.1828
35. Ezeamuzie IC, Ambakederemo AW, Shode FO, Ekwebelem SC. Antiinflammatory effects of *Moringa oleifera* root extract. Int J Pharmacogn. 1996; 34(3):207-12. https://doi.org/10.1076/phbi.34.3.207.13211
36. do Nascimento KD, Reis IP, Augusta IM. Total phenolic and antioxidant capacity of flower, leaf and seed of *Moringa oleifera*. Nutr Res. 2017; 1(1):1-9.
37. Divya KG, Rubeena M, Andalil R, Erni B, Sundaramoorthy B, Kumar KN, *et al*. Identity profile of *Moringa oleifera* Lam. flower. Int J Bot Stud. 2019; 4(4).
38. Waterman C, Cheng DM, Rojas-Silva P, Poulev A, Dreifus J, Lila MA, *et al*. Stable, water extractable isothiocyanates from *Moringa oleifera* leaves attenuate inflammation *in vitro*. Phytochemistry. 2014; 103:114-22. https://doi.org/10.1016/j.phytochem.2014.03.028
39. Leone A, Spada A, Battezzati A, Schiraldi A, Aristil J, Bertoli S. Cultivation, genetic, ethnopharmacology, phytochemistry and pharmacology of *Moringa oleifera* leaves: an overview. Int J Mol Sci. 2015; 16(6):12791-835. https://doi.org/10.3390/ijms160612791
40. Mehta K, Balaraman R, Amin AH. Effect of fruits of *Moringa oleifera* on the lipid profile of normal and hypercholesterolaemic rabbits. J Ethnopharmacol. 2003; 86(2-3):191-5. https://doi.org/10.1016/S0378-8741(03)00075-8
41. Adinoyi SS, Oluwagbamila OB, Ademola AO. Role of *Moringa oleifera* on electrolytes levels and cardiovascular function in human. Ther Adv Cardiol. 2017; 1:80-6.
42. Nambiar VS, Guin P, Parnami S, Daniel M, Sharma R. Cardio-protective and anti-cancer therapeutic potential of *Moringa oleifera*. Indian J Pharmacol. 2009; 41(6):423-8.
43. Anwar F, Bhanger MI. Analytical characterization of *Moringa oleifera* seed oil grown in temperate regions of Pakistan. J Agric Food Chem. 2003; 51(22):6558-63. https://doi.org/10.1021/jf0209894
44. Leone A, Spada A, Battezzati A, Schiraldi A, Aristil J, Bertoli S. *Moringa oleifera* seeds and oil: characteristics and uses for human health. Int J Mol Sci. 2015; 16(6):12791-800.
45. Makkar HPS, Becker K, Schmook B. Edible provenances of *Moringa oleifera* from two West African countries have diverse antinutritional contents and rat toxicities. Plant Foods Hum Nutr. 1997; 51(1):21-9.
46. Mishra G, Singh P, Verma R, Kumar S, Srivastav S, Jha KK, *et al*. Traditional uses, phytochemistry and pharmacological properties of *Moringa oleifera* plant: an overview. Der Pharm Lett. 2011; 3(2):141-64.
47. Ercan K, Gecesefa OF, Taysi ME, Ali Ali OA, Taysi S. *Moringa oleifera*: a review of its occurrence, pharmacological importance and oxidative stress. Mini Rev Med Chem. 2021; 21(3):380-96. https://doi.org/10.2174/1389557520999200728162453
48. Gupta R, Mathur M, Bajaj VK, Katariya P, Yadav S, Kamal R. Evaluation of anti-inflammatory effect of *Moringa oleifera* in experimental animal. J Tradit Complement Med. 2012; 2(1):70-5.
49. Abou-Zeid SM, AbuBakr HO, Mohammed RS. The ameliorative effect of *Moringa oleifera* leaves against 2, 4,

6-trinitrobenzene sulfonic acid-induced experimental colitis in rats. J Med Food. 2017; 20(10):954-60.
50. Mahajan SG, Mehta AA. Immunosuppressive activity of ethanolic extract of seeds of *Moringa oleifera* Lam. in experimental immune inflammation. J Ethnopharmacol. 2007; 121(2):278-83.
51. Srivastava P, Yadav RS. Treatment of inflammatory skin conditions with *Moringa oleifera* extract cream. Clin Pharmacol Biopharm. 2017; 6(2):1000182.
52. Parvathy KS, Negi PS, Srinivas P. Anticancer activity of *Moringa oleifera* mediated silver nanoparticles on human lung adenocarcinoma A549 cell line. Food Chem Toxicol. 2018; 121:214-22. https://doi.org/10.1016/j.fct.2018.08.032
53. Jaiswal D, Rai PK, Kumar A, Mehta S, Watal G, Sharma SK. Effect of *Moringa oleifera* Lam. leaves aqueous extract therapy on hyperglycemic rats. J Ethnopharmacol. 2013; 148(2):618-23. https://doi.org/10.1016/j.jep.2013.04.051
54. Arulselvan P, Tan WS, Gothai S, Muniandy K, Fakurazi S, Esa NM, *et al*. Anti-inflammatory potential of ethyl acetate fraction of *Moringa oleifera* in downregulating the NF-κB signaling pathway in lipopolysaccharide-stimulated macrophages. Molecules. 2014; 19(9):14520-33.
55. Samarakoon SR, Thabrew I, Galhena PB, De Silva D. The potential of *Moringa oleifera* leaf extract in the regulation of thyroid hormone status in adult male Wistar rats. Res Vet Sci. 2015; 102:202-8. https://doi.org/10.1016/j.rvsc.2015.09.020
56. Medhi B, Patyar S, Rao RS, Byrav DS, Prakash A. Pharmacokinetic and pharmacodynamic study of *Moringa oleifera* Lam. leaves in a rat model of obesity. BMC Complement Altern Med. 2018; 18(1):303.
57. Reda F, Borjac J, Fakhouri R, Usta J. Cytotoxic effect of *Moringa oleifera* on colon cancer cell lines. Acta Hortic. 2017; 1158:45-54. https://doi.org/10.17660/ActaHortic.2017.1158.30
58. Mbikay M. Therapeutic potential of *Moringa oleifera* leaves in chronic hyperglycemia and dyslipidemia: a review. Front Pharmacol. 2012; 3:24. https://doi.org/10.3389/fphar.2012.00024
59. Tiloke C, Anand K, Gengan RM, Chuturgoon AA. *Moringa oleifera* and their phytonanoparticles: potential antiproliferative agents against cancer. Biomed Pharmacother. 2018; 108:457-66. https://doi.org/10.1016/j.biopha.2018.09.060
60. Galuppo M, Giacoppo S, De Nicola GR, Iori R, Navarra M, Lombardo GE. Antiinflammatory activity of glucomoringin isothiocyanate in a mouse model of experimental autoimmune encephalomyelitis. Fitoterapia. 2018; 125:20-8. https://doi.org/10.1016/j.fitote.2017.10.004
61. Leone A, Spada A, Battezzati A, Schiraldi A, Aristil J, Bertoli S. Cultivation, genetic, ethnopharmacology, phytochemistry and pharmacology of *Moringa oleifera* leaves: an overview. Int J Mol Sci. 2015; 16(6):12791-835. https://doi.org/10.3390/ijms160612791
62. Arise AK, Arise RO, Oyeyinka AT. Comparative study of iron content of *Moringa oleifera* (LAM) and selected green leafy vegetables consumed in Lagos, Nigeria. Int J Curr Microbiol Appl Sci. 2016; 5(5):655-60.
63. Kumari DJ, Sairam M, Hemalatha S. Efficacy of *Moringa oleifera* (Lam.) against arsenite induced toxicity in mice. Asian Pac J Trop Med. 2006; 148-52.
64. Anitha S, Bhaskar A. Effect of *Moringa oleifera* on hematological parameters of anemic adolescent girls. Int J Sci Res Pub. 2014; 4(3):1-4.
65. Ijarotimi OS, Keshinro OO, Akintayo CO. Comparative study on chemical composition, nutritive and functional properties of three different forms of *Moringa oleifera* leaf flour. Int J Food Sci Nutr Eng. 2015; 5(2):57-63.
66. Mun'im A, Puteri MU, Sari SP. Anti-anemia effect of standardized extract of *Moringa oleifera* Lamk. leaves on aniline induced rats. Pharmacogn J. 2016;8(3). https://doi.org/10.5530/pj.2016.3.14
67. Faizi S, Siddiqui BS, Saleem R, Siddiqui S, Aftab K. Isolation and structure elucidation of new nitrile and mustard oil glycosides from *Moringa oleifera* and their effect on blood pressure. J Nat Prod. 1995;58(5):710-5.
68. Suzana D, Suyatna FD, Andrajati R, Sari SP, Mun'im A. Effect of *Moringa oleifera* leaves extract against hematology and blood biochemical value of patients with iron deficiency anemia. J Young Pharm. 2017; 9(1 Suppl):S79. https://doi.org/10.5530/jyp.2017.1s.20
69. Makkar HP, Becker K. Nutritional value and antinutritional components of whole and ethanol extracted *Moringa oleifera* leaves. Anim Feed Sci Technol. 1997; 67(2-3):233-49.
70. Al-Malki AL, El Rabey HA. The antidiabetic effect of low doses of *Moringa oleifera* Lam. seeds on streptozotocin induced diabetes and diabetic nephropathy in male rats. Biomed Res Int. 2015;2015:381040:1-13.