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Nutritional, antioxidant and medicinal characteristics of flowers of *Moringa oleifera*: A review

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Abstract
Moringa oleifera flowers are emerging as a significant botanical resource owing to their exceptional nutritional, antioxidant, and medicinal properties. This review comprehensively explores the multifaceted health-promoting potential of these flowers, focusing on their biochemical composition and therapeutic applications. Rich in essential macronutrients, *M. oleifera* flowers offer high-quality proteins, unsaturated fatty acids (linoleic, oleic, and linolenic acids), and essential amino acids such as leucine, lysine, and methionine, contributing to cardiovascular, neurological, and immune health. The mineral content, including calcium, iron, selenium, and molybdenum in it, supports bone integrity, antioxidant defence, and metabolic functions. Phytochemically, the flowers contain flavonoids, phenolics, alkaloids, saponins, tannins, and terpenoids, all contributing to their strong antioxidant and anti-inflammatory activities. Antioxidant assays (DPPH, ABTS, nitric oxide scavenging) confirm potent free radical neutralizing capabilities, supported by the presence of β-sitosterol and other bioactive compounds. The medicinal properties attributes of *M. oleifera* flowers include antimicrobial, hepatoprotective, diuretic, and anti-aging effects. They are traditionally used in managing infections, digestive ailments, cardiovascular and liver disorders, and as a nutritional remedy during seasonal deficiencies. *Moringa oleifera* flowers exhibit notable anti-diabetic potential, evidenced by reduced oxidative stress and inhibition of α-amylase and α-glucosidase in experimental models. Their dose-dependent hypoglycemic effects indicate possible insulin-mimetic action or β-cell stimulation. The presence of pterygospermin, a natural antibiotic with antifungal properties, further enhances their medicinal value. With a strong safety profile and long-standing traditional use, these flowers present a promising natural alternative for developing nutraceuticals and functional foods. Their inclusion in diets supports sustainable, plant-based strategies to combat malnutrition and manage lifestyle-related diseases.

Keywords: *Moringa oleifera*, antioxidant, nutraceutical, phytochemical, antimicrobial, hepatoprotective

Introduction
Moringa oleifera, commonly referred to as the drumstick tree, benzolive, or sajna; is a fast-growing, drought-resistant species native to parts of Africa and Asia, particularly in the Indian subcontinent (Klimek-Szczykutowicz M. *et al*., 2024) [3]. It belongs to the *Moringaceae* family and is valued for its rich nutritional content and various therapeutic uses. Almost every part of the plant - leaves, seeds, pods, bark, and flowers is used in food and traditional medicine (Gopala krishnan L.P., 2016) [2]. Among these, the flowers of *Moringa oleifera* have recently attracted scientific interest due to their rich content of proteins, fibers, and several bioactive compounds (Leone A. *et al*., 2015) [3]. Often dubbed as tree of life or miracle tree, *Moringa oleifera* thrives in a wide range of climatic conditions, including arid zones and nutrient-poor soils, making it a resilient crop with immense potential for food security (Klimek-Szczykutowicz M. *et al*., 2024) [2]. Traditionally, its flowers have been employed in indigenous South Asian medicinal systems to address various health conditions such as infections, cardiovascular issues, digestive ailments, and disorders related to the liver and blood (Madhumitha K. & Krishna prabha V., 2019) [4]. These flowers are also known for their anti-aging, anti-inflammatory, and cooling effects. Typically consumed cooked or fried, they are sometimes combined with unripe mango to reduce body heat and address seasonal nutritional deficiencies (Kumar Y. *et al*., 2017) [5]. Due to their exceptional nutrient profile, the World Health Organization (WHO) recommends *Moringa* as a valuable supplement to combat malnutrition, especially in undernourished populations (Fuglie L.J., 2000) [6]. The presence of pterygospermin a natural antibiotic with antifungal properties further enhances the medicinal potential of the flowers (Madhumitha K. & Krishna prabha V., 2019) [4]. Additionally, flower extracts are used in remedies for acne, nasal ailments, and as nutritional support for infants (Madhumitha K. & Krishna prabha V., 2019) [4], (Gopalan C. *et al*., 2004) [7]. This review explores nutritional profile, antioxidant properties, and medicinal potential of the flower of *M. oleifera*. This study also highlighted various natural resource for pharmaceutical and therapeutic applications.

Nutritive Composition
Moringa oleifera flowers possess a rich nutritive composition, offering essential macronutrients, micronutrients, and bioactive compounds beneficial to human health (Klimek-Szczykutowicz M. *et al*., 2024) [1], (Leone A. *et al*., 2015) [3], (Mbikay M., 2012) [8]. They feature a favourable fatty acid profile with high levels of unsaturated fatty acids like linoleic, oleic, and linolenic acids, which promote cardiovascular, anti-inflammatory, and neuroprotective benefits (Monteiro J. *et al*., 2022) [9]. Additionally, they provide essential amino acids such as leucine, lysine, Alanine, and Serine; vital for muscle repair, immune function, and detoxification (Innocent I.O. *et al*., 2017) [10]. The flowers are also abundant in minerals like calcium, iron, Phosphorus, Iron, and Magnesium; supporting bone health, antioxidant defence, and metabolic balance (Innocent I.O. *et al*., 2017) [10], (Kshirsagar R.B. *et*

al., 2017) [11]. Bioactive compounds such as flavonoids (15 - 17 mg RuE/100g), phenolics, alkaloids, saponins, tannins, and terpenoids contribute to antioxidant, anti-inflammatory, and pharmacological activities (Villegas-Vazquez E.Y. *et al*., 2025) [12], (Fahmy N.M. *et al*., 2024) [13], (Alhakmani F. *et al*., 2013) [14]. Antioxidant assays (DPPH, ABTS) confirmed strong radical scavenging activity, supported by phenolic content and β-sitosterol presence, emphasizing their value in health supplements and functional foods (Gopala krishnan L.P., 2016) [2], (Vats S. *et al*., 2017) [15].

Nutritional composition of *Moringa oleifera* Flower

Moringa oleifera flowers are a rich source of essential macronutrients and micronutrients beneficial to human health (Mbikay M., 2012) [8]. They possess a favourable fatty acid profile, dominated by unsaturated fatty acids such as linoleic and oleic acids, which help reduce LDL cholesterol and boost HDL levels, supporting cardiovascular health (Monteiro J. *et al*., 2022) [9]. Linolenic acid, an omega-3 fatty acid, adds anti-inflammatory and neuroprotective benefits. Saturated fatty acids like palmitic and stearic acids are present in lower amounts, reducing potential adverse effects on lipid profiles (Monteiro J. *et al*., 2022) [9]. Additionally, Moringa flowers provide essential amino acids including leucine, lysine, Alanine, and Serine which are important for muscle repair, immune function, collagen synthesis, and detoxification (Innocent I.O. *et al*., 2017) [10]. This nutritional richness highlights their value in balanced, plant-based diets and functional food development. A comprehensive macro and micro nutritional profile of *Moringa oleifera* flowers is presented in Table 1 and Table 2.

Table 1: Macronutrient Content of *Moringa oleifera* flowers

Macronutrients	Amount (Per 100g dry weight)	References
Protein	17.87 - 26.06 g	(Moyo B. *et al*., 2011) [16], (Innocent I.O. *et al*., 2017) [10]
Carbohydrate	62.04 g	(Kshirsagar R.B. *et al*., 2017) [11]
Lipid	2.91 - 2.95 g	(Moyo B. *et al*., 2011) [16], (Foidl N. *et al*., 2001) [17]
Ash	3.57 - 7.87 g	(Moyo B. *et al*., 2011) [16], (Innocent I.O. *et al*., 2017) [10]
Total Dietary Fiber	32.25 - 36.14 g	(Moyo B. *et al*., 2011) [16], (Foidl N. *et al*., 2001) [17]
Soluble Dietary Fiber	3.76 - 4.04 g	
Insoluble Dietary Fiber	31.42 - 33.06 g	
Crude fibre	5.2 g	(Kshirsagar R.B. *et al*., 2017) [11]

Table 2: Micronutrient Content of *Moringa oleifera* flowers

Micronutrients	Amount (Per 100g dry weight)	References
Vitamins		
Vitamin A	51 mg	(Kshirsagar R.B. *et al*., 2017) [11]
Vitamin B6 (Pyridoxine)	7.69 mg	S(Innocent I.O. *et al*., 2017) [10]
Vitamin C	398 - 459.21 mg	(Kshirsagar R.B. *et al*., 2017) [11] (Innocent I.O. *et al*., 2017) [10]
Vitamin E	98 mg	(Kshirsagar R.B. *et al*., 2017) [11]
Amino Acids		
Glutamic acid	3.5 - 5.0 g	(Moyo B. *et al*., 2011) [16], (Innocent I.O. *et al*., 2017) [10]
Aspartic acid	2.2 - 3.5 g	
Leucine	1.5 - 2.3 g	
Lysine	0.9 - 1.4 g	
Alanine	0.8 - 1.0 g	
Serine	0.6 - 1.0 g	
Fatty Acids		
Myristic acid (C14:0)	0.78 mg	(Monteiro J. *et al*., 2022) [9]
Palmitic acid (C16:0)	25.48 mg	(Monteiro J. *et al*., 2022) [9] (Sánchez-Machado D.I. *et al*., 2010) [18]
Palmitoleic acid (C16:1)	0.12 mg	(Monteiro J. *et al*., 2022) [9]
Stearic acid (C18:0)	6.09 mg	
Oleic acid (C18:1)	17.36 mg	(Monteiro J. *et al*., 2022) [9] (Sánchez-Machado D.I. *et al*., 2010) [18]
Linoleic acid (C18:2)	51.72 mg	
Linolenic acid (C18:3)	30.44 mg	

Mineral composition of *Moringa oleifera* flower

Moringa oleifera flowers are rich in essential minerals that support key physiological processes. They are an excellent source of calcium and iron, vital for bone health and the prevention of iron deficiency anemia. Trace minerals like magnesium serve as cofactors for antioxidant enzymes such as superoxide dismutase and glutathione peroxidase, aiding in cellular protection (Innocent I.O. *et al*., 2017) [10]. Though required in small amounts, these minerals are crucial for metabolic balance. Their presence enhances the nutritional and therapeutic value of Moringa flowers (Innocent I.O. *et al*., 2017) [10], (Kshirsagar R.B. *et al*., 2017) [11]. Table 3 provides a detailed analysis of the mineral composition present in Moringa oleifera flowers.

Table 3: Mineral Content of *Moringa oleifera* flowers

Mineral	Amount (Per 100g dry weight)	References
Calcium	2.32- 444mg	(Innocent I.O. *et al*., 2017) [10] (Kshirsagar R.B. *et al*., 2017) [11]
Sodium	120.93 mg	(Innocent I.O. *et al*., 2017) [10]
Potassium	3.02 - 1393 mg	(Innocent I.O. *et al*., 2017) [10] (Kshirsagar R.B. *et al*., 2017) [11]
Magnesium	270 mg	(Kshirsagar R.B. *et al*., 2017) [11]
Phosphorus	203 mg	
Iron	8.3 mg	

Phytochemical constituents of *Moringa oleifera* flower

Moringa oleifera flowers are rich in phytochemicals compounds such as flavonoids, phenolics, alkaloids, and saponins, which contribute to their antioxidant properties (Kumbhare M. R. and Sivakumar T., 2011) [19]. A comprehensive phytochemical constituentof *Moringa oleifera* flowers is presented in Table 4.

Despite the comparatively low flavonoid content of 15 - 17 mg RuE/100g, these phytochemicals indicate strong therapeutic potential (Fahmy N.M. *et al*., 2024) [13]. Phenolics and flavonoids help protect against oxidative stress and chronic diseases. Alkaloids and saponins show antimicrobial and immune-modulatory effects, while tannins provide anti-inflammatory and anti-parasiticbenefits (Fahmy N.M. *et al*., 2024) [13]. Terpenoids further support pharmacological uses, particularly in anti-cancer and hepatoprotective treatments (Alhakmani F. *et al*., 2013) [14]. The diverse phytochemical composition makes Moringa flowers valuable in traditional remedies and promising for modern nutraceutical applications.

Table 4: Phytochemical constituents of *Moringa oleifera* flowers

Phytochemical constituents	Amount (Per 100g dry weight)	References
Total Phenolics	1931 - 1949 mg GAE	(Alhakmani F. *et al*., 2013) [14], (Madane P. *et al*., 2019) [20]
Total Flavonoids	15 - 17 mg RuE	(Fahmy N.M. *et al*., 2024) [13]
Alkaloids	3.87 - 5.36 g	(Don-lawson C. and Okah R., 2019) [21], (Kshirsagar R.B. *et al*., 2017) [11]
Saponins	15.20 - 250mg	(Kshirsagar R.B. *et al*., 2017) [11], (Innocent I.O. *et al*., 2017) [10]
Tannins	60 - 119 mg	

Antioxidant composition of *Moringa oleifera* flower

Moringa oleifera flowers are rich in antioxidants, as demonstrated by various assays. The DPPH and ABTS radical scavenging assays revealed antioxidant activity equivalent to 2.71 mg trolox and 2.34 mg TE/g, respectively (Gopala krishnan L.P., 2016) [7]. The flowers exhibited notable levels of total phenolics and flavonoids, contributing to their strong antioxidant potential, which is further supported by their significant DPPH radical scavenging activity, confirming their role as a natural antioxidant source. GC–MS analysis identified β-sitosterol as the major antioxidant constituent (Vats S. *et al*., 2017) [15]. A comprehensive antioxidant profile of *Moringa oleifera*flower is presented in Table 5.

Table 5: Antioxidant Content of *Moringa oleifera*Flowers

Antioxidants	Amount (Per 100g dry weight)	References
Flavonoids	2.16- 3.5 g	(Vats S. *et al*., 2017) [15], (Bibi N. *et al*., 2023) [22], (Jaglan P. *et al*., 2023) [23],
Polyphenol	2.13g	(Bibi N. *et al*., 2023) [22], (Jaglan P. *et al*., 2023) [23]
β-sitosterol	1.54 g	(Vats S. *et al*., 2017) [15]
Anthocyanin	5.28 g	
Aldehydes	1.55- 6.47 g	(Fahmy N.M. *et al*., 2024) [13]

Medicinal characteristicsof moringa flower

Moringa oleifera, known as the drumstick tree, has been an essential part of traditional South Asian medicine for centuries. Its flowers are used to treat various conditions, including infections, cardiovascular and gastrointestinal disorders, and also offer haematological and liver-protective (hepatoprotective) benefits (Madhumitha K. & Krishna prabha V., 2019) [4]. *Moringa oleifera*flowers are valued for their anti-aging and anti-inflammatory properties. Consumed cooked or fried, they are often prepared with unripe mango to reduce body heat and prevent nutrient deficiencies during summer (Kumar Y. *et al*., 2017) [5]. Their exceptional nutritional profile has led the World Health Organization (WHO) to promote Moringa as a natural supplement to combat malnutrition, especially in developing regions (Fuglie L.J., 2000) [6].

The flowers possess powerful medicinal properties. They contain pterygospermin, a natural antibiotic with fungicidal activity, effective in treating colds and anemia. Flower juice, when mixed with lime, is used to treat acne and blackheads, keeping the skin fresh. It is also used nasally to stop bleeding caused by heat and to eliminate unpleasant nasal odors (Madhumitha K. & Krishna prabha V., 2019) [4], (Gopalan C. *et al*., 2004). Feeding infants with milk mixed with Moringa flower juice is believed to promote healthy growth, strengthen bones and immunity, and prevent malnutrition (Madhumitha K. & Krishna prabha V., 2019) [4].

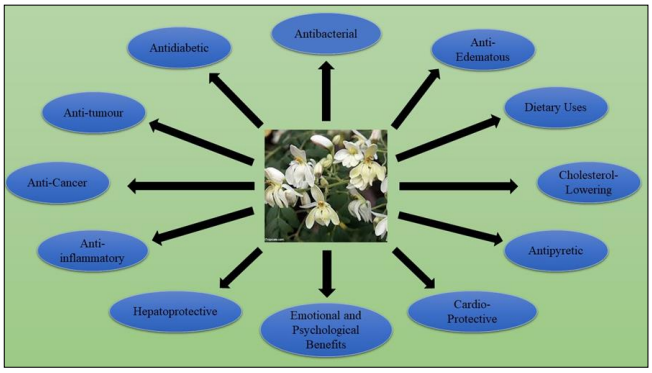

Fig 1: Medicinal Characteristics of *Moringa oleifera* flower

Moringa flower extracts have shown potential in managing a variety of health conditions including fever, ulcers, enlarged spleen, nervous disorders like hysteria, and even in cancer therapy due to their antitumor effects (Gopala krishnan L.P., 2016) [6], (Guiguer L. *et al*., 2016) [24]. Their diuretic and anti-rheumatic properties further enhance their therapeutic value. Moringa flowers are also used to prepare herbal tea with cholesterol-lowering benefits and provide a rich nectar source for honeybees, supporting apiculture and promoting sustainable agriculture (Rajbhar Y.P. *et al*., 2018) [25], (Pareek A. *et al*., 2023) [26]. Several types of medicinal properties of Moringa flower are reviewed in the following.

Antidiabatic Activity

Diabetes mellitus is a long-term disorder resulting from insulin deficiency or resistance, causing elevated blood sugar levels and various metabolic complications (Kashyap P. *et al*., 2022) [27], (Lin M. *et al*., 2018) [28]. If untreated, it can cause retinopathy, neuropathy, nephropathy, cardiovascular problems, and ulcers. The WHO estimates 150 million global cases, expected to double to 300 million by 2025 (Shaw J.E. *et al*., 2010) [29]. *Moringa oleifera* flowers exhibit potent anti-diabetic properties, primarily attributed to their antioxidant and free radical scavenging abilities. Studies using streptozotocin (STZ)-induced diabetic rats demonstrated that oral administration of ethanolic extracts of *M. oleifera* flowers significantly reduced malondialdehyde concentrations in the liver, kidney, and pancreas, indicating reduced oxidative stress (Arise R.O. *et al*., 2016) [30]. The extract also showed a notable decrease in superoxide dismutase (SOD) activity, suggesting improved antioxidant defence in diabetic conditions. Furthermore, the extract effectively inhibited α-amylase and α-glucosidase enzymes, which are key in carbohydrate metabolism, thereby contributing to blood glucose regulation (Rode S.B. *et al*., 2022) [31].

A dose-dependent glucose-lowering effect was observed at 100, 200, and 300 mg/kg doses, resulting in over 70% reduction in fasting blood glucose levels within two weeks (Arise R.O. *et al*., 2016) [30]. This hypoglycemic action is believed to result from stimulation of pancreatic β-cells or insulin-like activity that enhances glucose uptake in peripheral tissues These findings highlight the therapeutic potential of *M. oleifera* flower extracts as a natural alternative for managing non-insulindependent diabetes mellitus (NIDDM) (Arise R.O. *et al*., 2016) [30], (Rode S.B. *et al*., 2022) [31].

Anti-tumour Activity

A tumour is an abnormal tissue mass formed when cells grow excessively or fail to die as needed. Moringa oleifera flower trypsin inhibitor (MoFTI) has shown promising anti-tumour activity in mice bearing sarcoma 180, highlighting its potential as a therapeutic agentTreated animals showed a significant reduction in tumour vascularization, with reduced secondary vessels and smaller primary vessels relative to the controls (Barhoi D. *et al*., 2021) [32]. Importantly, there were no adverse effects on food and water intake, body or organ weights, and histopathological analysis confirmed no damage to the liver, kidneys, or spleen. These findings suggest that MoFTI demonstrates anticancer activity without causing toxicity, reinforcing its potential as a safe and natural therapeutic option (Rode S.B. *et al*., 2022) [31], (Barhoi D. *et al*., 2021) [32].

Anti-cancer Activity

Cancer accounts for one in seven global deaths, with 2.4 million cases in India (Gopala krishnan L.P., 2016) [5]. Risk factors include smoking, inactivity, and radiation. Conventional treatments are costly and have side effects. *Moringa oleifera* offers a natural, safe, and effective anticancer alternative with fewer adverse effects, making it a promising, affordable option for cancer management (Balogun T.A. *et al*., 2021) [33].

Moringa oleifera flower extract exhibits significant anti-cancer properties, particularly against prostate cancer. Studies on PC3 cells (androgen-independent prostate cancer model) demonstrated that treatment with *M. oleifera* flower extract at 25 µg/mL for 24 and 48 hours led to a strong, time-dependent cytotoxic effect, as shown by MTT assay (Meireles D. *et al*., 2020) [34], (Ju J. *et al*., 2018) [35]. The extract inhibited cancer cell proliferation by inducing apoptosis and modulating apoptotic signalling pathways. Specifically, it reduced levels of phosphorylated AKT (p-AKT), implicating the involvement of AKT signalling in the anti-proliferative effect. Overexpression of AKT was found to protect cells, further confirming its role (Ju J. *et al*., 2018) [35].

A methanolic extract of *M. oleifera* flowers selectively inhibited PC3 cancer cells without harming normal cells (Meireles D. *et al*., 2020) [34]. Additionally, phytochemicals such as thiocarbamates and isothiocyanates present in Moringa contribute to its tumour-inhibiting potential (Pareek A. *et al*., 2023) [26], validating its use in cancer prevention and therapy.

Anti-inflammatory Activity

Inflammatory diseases affect global health, while NSAIDs (non-steroidal anti-inflammatory drugs) often cause organ toxicity (Kashyap P. *et al*., 2022) [27]. *Moringa oleifera* flowers possess strong anti-inflammatory properties, primarily mediated through the inhibition of key inflammatory pathways. An 80% hydroethanolic extract of *M. oleifera* flowers was shown to suppress lipopolysaccharide-induced inflammation in RAW 264.7 macrophages by down regulating the NF-κB pathway. This led to a significant reduction in pro-inflammatory cytokines such as TNF-α, IL-6, and IL-1β (Tan W.S. *et al*., 2015) [36].

Flavonoids like quercetin and kaempferol present in the flowers inhibit STAT-1 and NF-κB signalling, further supporting their anti-inflammatory potential (Akter T. *et al*., 2021) [37]. Additionally, the compound 4-[2-O-acetyl-α-L-rhamnosyloxy) benzyl] thiocyanate, isolated from *M. oleifera*, demonstrated nitric oxide inhibitory activity in RAW 264.7 cells, confirming its effectiveness (Pareek A. *et al*., 2023) [26]. These findings highlight the flower's role not only in inflammation control (Velaga V.S.A.R. *et al*., 2017) [38].

Antioxidant Potential against Oxidative Damage

Reactive oxygen species (ROS) impair the cell's antioxidant defences, leading to oxidative stress and contributing to diseases such as diabetes and heart failure (Zarina *et al*., 2024) [39]. *Moringa oleifera* flower extracts have shown strong potential in reducing oxidative stress in plants. According to research, flower extracts effectively minimized oxidative damage in shoot and root tissues, with the root showing a more pronounced response. The exogenous application of these extracts significantly reduced hydrogen peroxide (H_2O_2) and malondialdehyde (MDA) levels, key indicators of oxidative stress, while enhancing antioxidant synthesis (Batool A. *et al*., 2016) [40].

Antibacterial Activity

Moringa oleifera flowers have demonstrated notable antibacterial activity against various pathogens, as highlighted in research. The research confirms that different parts of the plant, including flowers, exhibit antimicrobial properties (Berga J.V.D. & Kuioers S., 2022) [41], (Farhan R.S. *et al*., 2021) [42]. However, it also emphasizes the need for standardized testing methods to accurately evaluate and

compare their antibacterial efficacy (Berga J.V.D. & Kuioers S., 2022) [41]. These findings support the potential use of Moringa flowers in natural antimicrobial therapies.

Hepatoprotective Activity

Moringa oleifera flowers exhibit significant hepatoprotective activity, primarily attributed to the presence of quercetina potent flavonoid known for its liver-protective effects (Pareek A. *et al*., 2023) [26]. Studies have shown that both aqueous and alcoholic extracts of Moringa flowers can effectively protect against liver damage. When administered intraperitoneally at doses of 400 mg/kg, *M. oleifera* flower extracts significantly reduced acetaminophen-induced hepatotoxicity without altering kidney function markers (Stohs S.J. & Hartman M.J., 2012) [43].

The flower extract's protective action is believed to stem from their antioxidant capacity and ability to reduce liver inflammation and cellular injury (Singh U. *et al*., 2017) [44]. These findings support the traditional use of Moringa flowers as a natural remedy for liver disorders and highlight their potential in hepatoprotective therapeutic applications.

Cardio-protective Activity

Cardiovascular diseases are a major global killer. *Moringa oleifera* supports heart health with its antioxidant, vasodilatory, and platelet-activating effects, offering natural protective benefits (Kashyap P. *et al*., 2022) [27]. *Moringa oleifera* flowers exhibit promising cardio-protective potential, primarily due to their antioxidant and anti-inflammatory properties. While most cardioprotective studies focus on the whole plant, emerging research suggests that the ethanolic extract of Moringa oleifera flowers may reduce the risk of cardiovascular complications, especially in diabetic conditions. By lowering elevated lipid levels associated with diabetes, the flower extract could help protect against diabetes-induced cardiac damage and vascular dysfunction, offering a potential natural therapeutic approach for managing heart health and preventing related complications in diabetic individuals (Arise R.O. *et al*., 2016) [30], (Alia F. *et al*., 2022) [45]. These effects support its potential as a natural approach for managing cardiovascular disease, particularly by reducing risks associated with diabetes-related cardiac damage and vascular dysfunction.

Antipyretic Activity

Although direct studies on the antipyretic effects of *Moringa oleifera* flowers are currently limited, findings from research on other parts of the plant, particularly the seeds, suggest promising feverreducing properties. According to research, various extracts of *Moringa oleifera* seedsincluding ethanolic, petroleum ether, solvent ether, and ethyl acetatewere tested using a yeast-induced hyperpyrexia model in rats. Among these, the ethanolic and ethyl acetate extracts demonstrated significant antipyretic activity, showing results comparable to standard paracetamol (200 mg/kg) (Pareek A. *et al*., 2023) [26], (Santos A.F. *et al*., 2012) [46].

Moreover, other studies have confirmed that ether and ethyl acetate fractions of the seeds exhibit notable fever-reducing effects similar to paracetamol (Pareek A. *et al*., 2023) [26]. Since *Moringa oleifera* flowers are known to contain bioactive compounds similar to those found in the seeds, it is likely that they may also possess antipyretic properties. However, further scientific studies and experimental validation are needed to confirm this potential and understand the underlying mechanisms.

Cholesterol-Lowering Activity

Moringa oleifera has demonstrated lipid-lowering properties, primarily due to bioactive compounds like β-sitosterol found in its leaves. Although direct studies on the flowers are limited, their comparable phytochemical composition suggests a similar potential to reduce serum cholesterol levels (Jain P.G. *et al*., 2010) [47]. This indicates that *M. oleifera* flowers may contribute to managing hyper-lipidemia and improving cardiovascular health, making them a promising natural source for cholesterol-lowering therapies (Singh S.K. *et al*., 2021) [48].

Dietary Uses

Moringa oleifera flowers are commonly consumed in diets and used to prepare infusions known for their hypo-cholesterolemic properties, helping to lower cholesterol levels naturally (Gopala krishnan L.P., 2016) [4]. In addition to their nutritional value, the flowers serve as a rich source of nectar, supporting honey production (Meireles D. *et al*., 2020) [34], making them valuable in both culinary and apicultural applications.

Effect on Body Weight

In diabetic rats, a significant reduction in body weight was observed post-STZ induction, with a loss of 35.6 g by day 21, while non-diabetic rats gained 79.2 g. Treatment with ethanolic extract of *Moringa oleifera* flower, similar to glibenclamide, significantly improved body weight gain, bringing it close to control levels (Arise R.O. *et al*., 2016) [30]. Additionally, Moringa extract helped improve lipid profiles and prevent unhealthy weight gain (Guiguer L. *et al*., 2016) [24].

Anti-edematous Activity

Edema, characterized by swelling, arises from an increased volume of interstitial fluid within tissues or an organ. Its presence across various clinical conditions renders it a crucial feature in diagnostic medicine (Lent-Schochet D. & Jialal I., 2023) [49]. Experimental studies have demonstrated that *Moringa oleifera* flower extracts, prepared using three different solvents, exhibit significant anti-edematous activity.

In carrageenan-induced hind paw edema models in mice, the flower extracts effectively reduced inflammation when compared to the control group. The anti-inflammatory response was comparable to that of clinically established drugs. Phytochemical analysis suggests that the presence of active compounds in the flowers contributes to their anti-edematous properties, indicating their therapeutic potential in managing inflammation-related conditions (Velaga V.S.A.R. *et al*., 2017) [38].

Emotional and Psychological Benefits

Moringa oleifera flowers are traditionally believed to aid in the release of traumatic memories, emotional wounds, guilt, and phobias. They are thought to promote positive thinking and help renew one's outlook on life, uplifting the spirit and encouraging mental clarity (Meireles D. *et al*., 2020) [34], (Singh S.K. *et al*., 2021) [48], (Innocent I.O. *et al*., 2017) [10].

Conclusion

The flowers of *Moringa oleifera* stand out as a highly nutritious and medicinally potent botanical component, offering a rich profile of macronutrients, micronutrients, and bioactive compounds. Their favourable fatty acid composition, essential amino acids, and diverse mineral content contribute to numerous physiological benefits, including cardiovascular support, immune modulation, and metabolic regulation. Furthermore, their phytochemical richnesscomprising flavonoids, phenolics, alkaloids, and saponinsunderpins significant antioxidant and anti-inflammatory activities, validated by DPPH and ABTS assays. Medicinally, Moringa flowers possess impressive therapeutic value, with traditional and modern studies supporting their use in managing infections, skin ailments, gastrointestinal issues, and chronic conditions such as diabetes. Their anti-diabetic efficacy, marked by enzyme inhibition and blood glucose regulation, highlights their promise in addressing non-insulin dependent diabetes mellitus (NIDDM). The presence of pterygospermin, with its natural antibiotic and antifungal properties, further amplifies their health-promoting potential. With diverse bioactive compounds and a strong safety profile, *Moringa oleifera* flowers offer great potential for nutraceuticals and functional foods. Their inclusion in diets and therapies can significantly boost nutrition in undernourished populations and aid in the natural management of lifestyle-related health conditions.

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