World Journal of Pharmaceutical Science and Research
www.wjpsronline.com
Review Article
ISSN: 2583-6579
SJIF Impact Factor: 5.111
Year - 2025
Volume: 4; Issue: 5
Page: 528-533

A REVIEW ON MEDICINAL USES OF SPINACIA OLERACEA

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Article Received: 04 September 2025 | | Article Revised: 25 September 2025 | | Article Accepted: 16 October 2025

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DOI: https://doi.org/10.5281/zenodo.17483978

How to cite this Article: Sree Mahalakshmi Pasumarthy, S. Poojitha, Ch. Maneesh, A. Mydhili, G. Muni Lakshmi, Ch. Nikitha (2025) A REVIEW ON MEDICINAL USES OF SPINACIA OLERACEA. World Journal of Pharmaceutical Science and Research, 4(5), 528-533. https://doi.org/10.5281/zenodo.17483978

ABSTRACT

Spinach (Spinacia oleracea), a member of the Amaranthaceae family, is a widely consumed leafy green vegetable known for its nutritional and medicinal value. It is rich in vitamins A, C, E, K, folate, and essential minerals such as iron, calcium, magnesium. Beyond its nutritional content, spinach contains bioactive compounds including flavonoids, carotenoids, phenolic acids, and antioxidants, which contribute to its health-promoting properties. The strong antioxidant potential of spinach helps to reduce oxidative stress, a key factor in the development of cardiovascular, metabolic, and neurodegenerative diseases. It also exhibits anti-inflammatory and lipid-lowering effects that support heart health, Studies have shown that spinach may have anticancer effects, promote bone health, and enhance reproductive function. Additionally, its high fiber content and low-calorie value makes it useful in managing obesity and maintaining overall health. Spinach is increasingly recognized as a functional food, with potential applications in nutraceuticals and pharmaceuticals. Overall, the combination of nutrients and bioactive compounds in spinach works as a dietary vegetable but also as a promising natural therapeutic agent for the prevention and management of chronic lifestyle-related diseases, making it a potential candidate for future research in health and medicine.

KEYWORDS: Nutraceuticals, Phytochemicals, Antioxidants, Anti-inflammatory, Antidiabetic.

INTRODUCTION

Spinacia oleracea, known as spinach is a nutrient-rich leafy green vegetable from Amaranthaceae family. It is believed to have originated in Central and Southwest Asia, spinach has now spread worldwide and is among the most consumed greens. It is especially valued for its excellent nutritional profile, providing essential vitamins (A, C, E, K, and folate),

minerals (such as iron, calcium, magnesium, and potassium), dietary fiber, and a wide range of bioactive compounds like flavonoids, carotenoids (lutein, zeaxanthin, β-carotene), and phenolic acids. These compounds not only boost its nutritional value but also add strong health-promoting properties. It has high nutrient density and rich phytochemicals, spinach is often considered a functional food, meaning it provides health benefits that go beyond basic nutrition. Regular consumption of spinach supports vision, bone health, blood pressure regulation, immune system strength, and protection against oxidative stress. Its lutein and zeaxanthin content make it particularly beneficial for eye health, while vitamin K and calcium contribute to bone strength. The iron in spinach also plays a key role in preventing anemia.[1] Research has shown that spinach has antioxidant, anti-inflammatory, hypoglycemic, hypolipidemic, neuroprotective, cardioprotective, and anticancer properties. Studies suggest that the bioactive compounds in spinach can help reduce the risk of chronic illnesses such as diabetes, cardiovascular diseases, obesity, age-related degeneration, and some cancers. Its neuroprotective properties may also aid in preventing cognitive decline and neurodegenerative disorders. Beyond its health benefits, It is enjoyed in a variety of forms raw in salads, blended into smoothies, or cooked into soups, curries, and other dishes. Traditional medicine systems like Ayurveda, Unani, and Traditional Chinese Medicine (TCM) have long used spinach for treating indigestion, purifying blood, reducing inflammation, and as a general health tonic. Its availability, affordability, and adaptability to diverse cooking styles have made spinach a beloved food across many cultures.[2]

Taxonomy

Kingdom: Plantae

Subkingdom: Tracheobionta (Vascular plants)

Super division: Spermatophyta (Seed plants)

Division: Magnoliophyte (Flowering plants)

Class: Magnoliopsida (Dicotyledons)

Subclass: Caryophyllidae

Order: Caryophyllales

Family: Amaranthaceae (formerly Chenopodiaceae)

Genus: Spinacia

Species: Spinacia oleracea L.

Figure 1: Spinacia Oleracea.

Chemical constituents:

Phenolic acids:

- Ferulic acid
- caffeic acid
- J-coumaric acid

Carotenoids:

- B-Carotene
- Lutein
- Neoxanthin
- Zeaxanthin

Phytochemicals/Bioactive compounds:

- Flavonoids
- kaempferol
- Quercetin
- Spinacetin

Saponins:

- Triterpenoid saponins

Alkaloids:

- Spinacine

Minerals:

- Iron
- Calcium
- Magnesium
- Potassium
- Phosphorous
- Zinc

Vitamins:

- Vit-c (Ascorbic acid)
- Vit k_1 (Phylloquinone, quinone)
- Vit-E (Tocopherols)
- Vit-B9 (Folic acid)
- Vit B12 (Riboflavin)
- Vit B3 (Niacin)
- Vit B1 (Thiamine)

Therapeutic Uses of Spinacia oleracea

S. No.	Disease	Chemical Constituents	Mechanism	Reference
1	Alzheimer's	Polyphenols Alkaloids	Spinach decreases neuroinflammation in hippocampus of stressed rats, which may be due to its abundant anti-inflammatory and antioxidant phytochemicals. The result indicate that spinach could be useful in helping to prevent or manage brain related disorders like neurodegenerative disease.	[3]
			According to wang feeding rats, a spinach diet led to noticeable rich in decrease in brain damage within the cerebral cortex. The study also showed an enzyme linked reduced to levels of caspase 3, cell death in the affected part of brain and physical movement. The researchers suggested that spinach protect the brain not just through its antioxidant properties, and by reducing inflammation.	[4]
2	Depression	Flavonoids Folate Polyphenols	Researchers evaluated whether spinach extracts could reduce depression like symptoms in mice exposed to chronic immobilization stress. The stressed mice showed a noticeable drop in body weight and food intake compared to control group and were more immobile, indicating depressive behavior. The extracts helped to reduce depression like symptoms. This shows spinach extract	[5]

			supplements may reduce stress and related depressive behavior by lowering CORT Levels.	
			In animal studies, spinach supplemented diets reversed behavioral signs of depression such as reduced sucrose preference and immobility, indicating a mood increased stabilizing effect and improving Neurotransmitter balance.	[6]
			Spinacia oleracea may influence the levels of key neurotransmitters like serotonin, dopamine, and norepinephrine, which play crucial role in regulating mood, phytochemicals in spinach (like folate and polyphenols) support the synthesis and function of these neurotransmitters by maintain proper monoamine levels, spinach can help alleviate symptoms of depression and can improve emotional balance.	[7]
3	Hypertension	Protein	Research identified four peptides MRWRD, MRW, LRIPVA, and IAPAG from spinach Rubisco digest that can inhibit angiotensin-1 converting enzyme (ACE) with IC50 values of 21,0.6, 0.38 and 4.2 UM respectively when tested in hypertensive rats, MRW and MWRD significantly lowered blood pressure after oral administration, showing peak effects at 2 and 4 hours respectively, at doses of 20 mg/kg and 30mg/kg. IAYKPAG also reduce blood pressure but only at a higher dose of 100 mg/kg.	[8]
			Alcalase, treated rice protein yields strong ACE inhibitory bioactive peptides with activity. These peptides includes amino acids Thr-Glu-Val-Tyr, significantly reduce blood pressure in hypertensive rate indicating that rice protein hydrolysate could be developed as a functional food for managing Hypertension.	[9]
4	Atherosclerosis	Polyphenols	In the LDLR mouse model of atherosclerosis the pharmacological action is activation of x receptor in liver. Decreases cholesterol absorption in the intestine. Reverse cholesterol transport and decreases Atherosclerotic lesion progression ultimately, reduce plaque formation and inflammation in the mouse.	[10]
			The study showed that spinach, which contains high levels of polyphenols, has significant antioxidant activity. In hyperlipidemic rats fed a high fat, high cholesterol diet, spinach supplementation improved antioxidant defenses, such as increasing manganese superoxide dismutase activity, and reduced liver oxidative damage and DNA damage in blood cells. This suggests spinach can help protect oxidative stress caused by unhealthy diets.	[11]
5	Heart Diseases	Flavonoids	Ethanolic extract of spinach leaves protected rate from CCL4 induced liver injury by lowering liver enzymes and bilirubin, reducing lipid peroxidation, and restoring antioxidant levels. These effects confirmed by tissue examination, were dose-dependent and comparable to silymarin, likely due to spinach's rich anti-oxidant compounds.	[12]
			Spinach leaves contain natural antioxidants including flavonoid, glucuronic acid derivatives isolated using water and these compounds were	[13]

			water - acetone extraction, purified by reverse phase HPLC, and identified through NMR analysis, making the first confirmation of both flavonoids and P-coumaric acid derivatives as antioxidant component.	
6	Osteoporosis	Beta-Carotene Lutein	Spinach bioactive components (Especially carotenoids like B-carotene and lutein) suppress pro-inflammatory cytokines that trigger bone resorption.	[14]
			The research investigated the bone healing effects of dried Spinacia oleracea extract and its self-emulsifying form. Wing drill-hole fracture model in rats findings revealed that converting the extract into a self-emulsifying formulation enhance its regenerative activity, indicating its promising potential treatment for fracture repair.	[15]
7	Diabetes Mellitus	Polyphenols	Medicinal plants rich in bioactive compounds, can help manage diabetes by lowering blood sugar, protecting pancreatic cells, boosting antioxidants and supporting insulin production making them promise for new treatment.	[16]
			The study evaluated the antidiabetic activity of a phenolic rich aqueous extracts from spinach, alloxan-induced diabetic mice. HPLC analysis revealed phenolic compounds in spinach, some of these extracts improved body wt., fasting blood sugar, glutathione levels, liver and kidney functions, lipid profile, blood parameters, and tissue structure in diabetic mice. All these extracts reduced diabetic stress, with Spinacia oleracea showing the strongest protective effect.	[17]

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