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SPINACIA OLERACEAE LINN: A REVIEW BASED ON PHARMACOLOGICAL ACTIVITIES

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ABSTRACT

Natural plant extracts of folk medicine have been used worldwide because of their beneficial activities. *Spinacea oleracea* well-known as spinach, Palak is a commonly used green leafy vegetable in diet, belongs to family Chenopodiaceae. It is often used as nutritious food because of its rich, diverse nutritious composition like phytoconstituents namely vitamins, minerals, carotenoids, flavonoids. Research suggests that Spinach has been used in the treatment of diabetes, heart disorders, neurological disorders, endocrine disorders, cancer and various diseases. The objective of this article is to explore various pharmacological studies of the *Spinacia oleraceae* plants. Compilation of Pharmacological studies of this plant support its uses in traditional medicine.

Keywords: - *Spinacia oleraceae*, spinach, antioxidant, flavonoids

INTRODUCTION

Natural plant products, or their extract, in the form of pure compounds or as standardized extracts, deliver indefinite openings for novel drug discoveries because of the accessibility of chemical diversity. As reported by the World Health Organization (WHO), more than 80% of the world's population depends on traditional herbal plant products for their prime medical care necessity because of their beneficial effects. In Asia the use of herbal plant medicines indicates a long history of interlinkage of human being with the nature. Traditional herbal medicines contain a diverse nutritious content that can be convenient in chronic and infectious diseases treatment¹. Plants therapeutic value relies on chemical constituents that elicit a specific physiological action on the humans. The flavonoids, alkaloids, tannins and phenolic compounds are some significant bioactive constituents present in plants². Scientist are still planning to extract from secondary metabolic type materials from probiotics like lactobacillus. Previously, many lactobacillus genera as antioxidant and anticancer agent^{2,20-37}. *Spinacia oleracea* is nutritive flowering plant belonging to family of Amaranthaceae. It is commonly known as Palak and spinach³. At first *S. oleracea*, was considered within Chenopodiaceae family, while later, that family was merged with the Amaranthaceae family in the order Caryophyllales⁴. Spinach (*Spinacia oleracea* L.) is a leafy vegetable commonly used as fresh products containing vitamin C [28.1 mg/100 g of fresh weight (FW)], vitamin A (9377 IU/ 100 g of FW), carotenoids (17.8 mg/100 g of FW), flavonoids (5.99 mg/100 g of FW), folic acid (194 µg/100 g of FW), calcium and magnesium minerals along with high content of nitrate (average of 217 mg/100 g of FW in U.S. spinach) and oxalate (400–900 mg/100 g of FW)⁵.

Botanical description

Plant is erect, grows up to 30-60 cm height. The leaves are simple, smooth, alternate, having ovate to triangular – based shape, varying in size from 2–30 cm long and 1–15 cm broad. At the base of plant have larger leaves and on the flowering stem smaller leaves are present. The flowers are inconspicuous, yellowish green, 3–4 mm in diameter, maturing into a small, rigid, dry, lumpy fruit cluster about 5–10 mm covering several seeds⁶⁻⁸. Apex of leaf is oval in shape, base is symmetrical in shape, vein islets are alternate with smooth upper surface and rough lower surface⁷.

The plant is having cooling, carminative, laxative, useful in blood and brain diseases, urinary calculi treatment, antiasthmatic, antileprotic, causes “kapha” (Ayurveda). Research studies revealed that, it is having antidiabetic activity. The leaves are having cooling,

emollient, antipyretic, diuretic, laxative, digestible, anthelmintic effect, useful in urinary concretion, inflammation of the lungs and the bowels, sore throat, pain in joints and lumbar region, thirst, cold and sneezing, sore eye, ring worm scabies, leukoderma, arrest vomiting, biliousness, flatulence. The seeds are also having laxative and cooling effect and useful in the treatment of fevers, leucorrhoea, urinary discharges, lumbago, brain and heart diseases, difficulty in breathing, liver inflammation, jaundice and urinary calculi⁹.

CNS effects:

CNS depressive effect:

Das et al investigated CNS depressant effect of aqueous extract of *Spinacia oleracea* leaves in albino rats at higher dose 250,300,350,400,450 mg/ kg for a duration of 14 days. Extract significantly decreases locomotor activity, grip strength; sleep latency period and increases pentobarbitone induced sleeping time, gives protection against PTZ induced seizures. Alteration in essential brain neurotransmitter observed in different brain parts after treatment with aqueous *S. oleraceae* extract signifying its CNS depressive effect.^[10]

Schizophrenia

Yadav et al., studied effect of *Spinacia oleracea* seed extract on behavior, biochemical, neurochemical and cellular alterations in experimental schizophrenia models in mice at dose 50, 100, 200 mg/kg for 15 days. Results indicated the decreased lipid peroxidation, glutathione, and dopamine levels, restored total brain proteins, acetyl-cholinesterase activity & inflammatory surge, and increased GABA levels indicating a protecting effect useful in the treatment of schizophrenia¹¹.

CVS Effects

Cardioprotective effect

Panda et al., investigated NAO (Natural antioxidant) rich extract of *Spinacia oleracea* and rutin for its cardioprotective effect on isoproterenol induced myocardial infarction by assessing hemodynamic, biochemical and histological parameters at the dose of NAOE 400, NAOE 800 and Rutin 50 mg/kg for 30 days. The results demonstrated that NAO (Natural antioxidant) rich extract of *Spinacia oleracea* attenuated the raised levels of AST, LDH, and CPK, troponin I, CRP, IL-6, TNF- α , total cholesterol, triglycerides, uric acid, and malondialdehyde, restored the Isoprenaline induced ECG abnormalities, systolic blood pressure, marker enzymes indicating cardioprotective effect. In conclusion, at the dose of 800mg/kg, extract reduced the myocardial damage and the oxidative stress¹².

Myocardial necrosis:

Vutharadhiet al., investigated *Spinacia oleracea* methanolic leaf extract (SoLE) for its atherogenic, anti-apoptotic and anti-inflammatory activity in ISO induced MI in rats at 200, 400, 600, 800 and 1000 mg/ kg dose for a period of 15 days through stimulation of pro-inflammatory signaling pathway that initiates myocardial necrosis. The results demonstrated that *Spinacia oleracea* methanolic leaf extract (SoLE) shows normalized activities of both PON and LCAT, decrease in heart CRP levels, heart tissue MPO, caspase-3 activity and pro-inflammatory markers (TNF-a, IL-1b and IL-6) in Isoproterenol injected rats. Pretreatment administration of SoLE (100, 200, and 300 mg/kg bw) with positive control drug gallic acid, significantly prevented all the adverse effects in ISO treated rats dose dependently¹³.

Anti-psoriatic effect

Siddiqui et al., evaluated anti-psoriatic effects of aqueous extract *S. oleracea* leaves at therapeutic and preventive doses in rats. Aqueous extract of *S. oleraceae* at curative dose shows reduction psoriatic patch as compare to control group. They conclude that this anti-psoriatic effect of extract may be due to antioxidant, anti-proliferative, anti-inflammatory and skin-strengthening contents in it¹⁴.

Antioxidant potential

Kumar et al examined phytochemical and antioxidant activity using different solvent extracts viz Petroleum ether, Chloroform, Methanol, Ethanol and Acetone leaf extracts of *Spinacia oleraceae*. The results demonstrated that phytochemical like alkaloids, glycosides, carbohydrates, phytosterols, saponin, phenolic compounds, tannins, proteins, amino acids are present in above extracts. Physicochemical properties of *Spinacia oleraceae* leaves indicates that oil of *Spinacia oleracea* is safer for human ingestion. The phenolic component like gallic acid, rutin, tannic acid in ethanolic extract is responsible for the antioxidant properties¹⁵.

Inflammatory bowel disease

Otari et al., investigated the protective effect of *Spinacia oleracea* aqueous extract leaves at 250, 500 and 1000 mg/kg dose for 11 days in experimental paradigm of inflammatory bowel disease along with preliminary phytochemical and HPTLC analysis. Phytochemical analysis showed presence of tannins and flavonoids in AESO. AESO treatment decreased the IBD symptoms including bloody diarrhea, malondialdehyde content in serum, ileum, or colon, and reduced the intensity of mucosal injury in experimental paradigm, revealing protective effect in inflammatory bowel disease¹⁶.

Chronic restraint stress

Pezeshki-Niaand his research team investigated the effect of spinach hydro-alcoholic extract (SHE) in dose 200 and 400 mg/kg for 21 days on TNF- α and IL-1 β expression in hippocampus of male Wistar rats exposed to chronic restraint stress. The above study results showed inhibitory effects of SHE on inflammation and neuronal death in the hippocampus, amelioration of the expression of IL-1 β and TNF- α in the hippocampus and suppressed neuronal death in CA1 area of the hippocampus¹⁷.

Anti-tumor effect

Maeda et al., examined antitumor effect of different spinach glycolipid fractions (0-100ug/ml) in BALB/c nu/nu mice. The results revealed that glycolipid fractions, mono galactosyldiacylglycerol (MGDG), digalactosyldiacylglycerol (DGDG), and sulfoquinovosyldiacylglycerol (SQDG) of spinach produces inhibitory effect on replicative pols α , δ , and ϵ (replicative DNA polymerases). Spinach glycolipid fractions inhibited the cell proliferation in cancer cells (human cervix carcinoma cell line, HeLa). These fractions inhibit pol α , δ , and ϵ activities by penetrating into nucleus in dose dependent manner. In in-vivo study, glycolipid fraction at dose 50 mg/kg shows antitumor activity. Histological findings with respect to mass area and tumor area revealed that these fractions produce suppressive effect on tumors¹⁸.

Metabolic syndrome

Panda et al observed the useful effect of *Spinacea oleracea* and aerobic exercise in fructose-induced abnormalities associated with Metabolic Syndrome in rats at the dose level 200 and 400 mg/kg. Evaluation of antioxidant-rich extract of *Spinacea oleracea* using HPTLC, revealed the presence of a high content of antioxidants like flavonoids, phenolic acids in it.

The results showed an aerobic exercise and NAOEAE (natural antioxidants -rich extract of *Spinacia oleracea* with aerobic exercise) treatments for 45 days changes the lipid profile and reduced the fructose-elevated levels of uric acid, homocysteine, C-reactive protein, and marker enzymes (AST, LDH, and CK-MB) in serum and malondialdehyde and restored the fructose-depleted glutathione levels and antioxidant enzymes (superoxide dismutase, catalase, glutathione peroxidase, and glutathionereductase)¹⁹.

CONCLUSION

Spinacea oleracea is often used as nutritious food because of its rich, diverse nutritious composition like phytoconstituents namely vitamins, minerals, carotenoids, flavonoids.

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HUMAN