



ORIGINAL RESEARCH PAPER

Pharmaceutical Science

A REVIEW ON SPINACIA OLARACEA

KEY WORDS: Spinach, Medicinal plant, Natural drug, Spinach activities, Cartenoids.

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ABSTRACT
 The family Chenopodiaceae includes the annual herb spinach (*Spinacia oleracea*). Due to its great nutritional content, it is widely spread and farmed around the world, including Iran, where it is a native of South-West Asia. Minerals like iron, copper, phosphorus, zinc, and copper are abundant in spinach. β -carotene, lutein, vitamin B complex (niacin and folic acid), selenium, ascorbic acid, and Zeaxanthin, phenols (flavonoids, p-coumaric acid), apocynin, and Omega-3 fatty acids are some of these components. It is a Vegetable that grows quite quickly, is simple to maintain, and can be distinguished by its color green. as oblong, smooth leaves that might be either smooth or crinkled. Moreover, the entire plant is medicinally significant and has several therapeutic uses in conventional medicine. 81 spinach landraces were grown during 2-years according to randomized complete block design with four replications.

INTRODUCTION

In order to achieve the UN Sustainable Development Goals of no poverty, zero hunger, and good health and wellbeing for all, sustainable food production is of the utmost importance, especially in emerging nations where the population is expanding at an exponential rate^[1]One of the healthiest vegetables consumed worldwide is cultivated spinach^[2,3]. Although monoecious plants are also present, spinach is a dioecious species that is pollinated by the wind. It is a green vegetable from the Amaranthaceae family, which also includes beet, quinoa, and amaranth, three other significant crops^[3,4] Additionally, spinach contains a lot of nitrate, which when digested becomes nitrite, which when combined with hemoglobin forms methaemoglobin and may result in methaemoglobinemia. *Spinacia oleracea* is commonly known as Spinach (English), Palakh (Kashmiri), Mathrubhumi (Telugu) Chhurika (Sanskrit), Palang (Bangla), Palak (Hindi; Gujarati; and Marathi), and Pasalai (Tamil)^[5] With a global production of about 26 million tons on over 921000 acres, spinach is a vital crop for both food and medicine. Asia produced around 25 million tons of spinach in 2016, with China leading the way with roughly 24 million tons, and Iran coming in at number six with about 117,000 tons^[6,7]. According to research, fruits and vegetables account for 95% of the country's total -carotene availability, with green leafy vegetables accounting for 52%. The low fat content of spinach varieties makes them a healthy option for diabetics and obese people^[8].

The *Spinacia oleracea* Linn of the Chenopodiaceae family is an annual herb that is grown in India up to an altitude of 2100 meters. It is erect and has alternating, ovate-oblong, obtuse or acute, variably lobed, smooth, soft, and succulent leaves^[9].

Breeding

The main goals of spinach breeding programs are to create varieties with traits such as increased disease resistance and abiotic stress tolerance, such as heat stress, drought stress, and interactive salinity and water stress as well as improved yield and quality, such as decreased levels of nitrate and oxalate, and increased levels of folate in spinach leaves.^[7]

Botany and Distribution

One of the most significant plants is spinach (*Spinacia oleracea*), which is a member of the Chenopodiaceae family. It is a green, cool-season vegetable grown throughout the

world that is typically eaten after boiling fresh or frozen leaves or raw in a salad. It is a native of Southwest Asia and is believed to have come from Iran. It has been cultivated in China since at least the 7th century and utilized in Europe since at least the 13th century.^[10] Numerous spinach cultivars are categorized according to the shape and position of the leaves, the texture of the seeds [round or prickly], the length of the petiole, and the smoothness or crinkling of the leaves.

Flowers

Male: Flowers are many, sessile, long terminal glomerate spikes with 4 stamens and twin, enormously sized anthers, as well as shorter ones from the axial direction.

Female: Axillary, sessile, and clustered flowers. When the seed is ready, the two-tipped calyx's protruding horns on each side turn into spines. 4 typically white tapering styles. One-celled, one-valved, armed, sporting 2 symmetrical short horns, and topped with the last little calyx.^[11]

Spinach Origin

It is believed that spinach originated in Persia. It was originally noticed by the Chinese, who called it Persia's herb, around 600 A.D. It was first grown by the Arabs in North Africa, and it was introduced by the Moors in Spain, who brought it to northern Europe around 1100 A.D. It was originally noted in Germany in 1280, and by 1500, it had spread to England and France as a common garden produce. It was brought to North America by early settlers, and by 1806 three varieties had been discovered. The first savory variety was released in 1828.

Nutrient Contents:^[9]

Spinach is a vegetable full with minerals. An earlier study on spinach's edible fraction (87%) found that the following nutrients were present: moisture (94.3%), fat (0.7), fiber (0.6), mineral matter (1.7), protein (2.2%), carbohydrate (2.9%), and oxalic acid (658 mg/100g). Calcium, 73; potassium, 206; iron, 10.9; phosphorus, 21; nickel, magnesium, 84; sodium, 58.5; zinc, 13.53; copper, 0.01; sulphur, 30; 0.42; manganese, 9.61; molybdenum, 0.08; and strontium, 0.077 make up the mineral composition (in mg/100g). Ascorbic acid, vitamin B complex, vitamin A, and beta-carotene are all present in spinach in good amounts. Additionally, it is a natural source of vitamin K 11. Various carotinoids, including lutein, violaxanthin -carotene, and 9'-(Z)-neoxanthin, are present in spinach.



Fig1: Spinach

CLASSIFICATION:^[12]

- Kingdom : Plantae
- Superdivision : Spermatophyta
- Division : Magnoliophyta
- Class : Magnoliopsida
- Order : Caryophyllales
- Family : Amaranthaceae
- Subfamily : Chenopodioideae
- Genus : Spinacia
- Species : Spinacia oleracea

Different Activities Of Spinach

Table 1: Spinach Activities

SI.NO.	ACTIVITY
1.	Antioxidant
2.	Anticancer
3.	Anti-schizophrenia
4.	Anthelmintic
5.	Hepatoprotective

Pharmacological Activities

Antioxidant Activity

The chemical subset of *Spinacia oleracea*'s natural antioxidant (NAO) components. Water was used to extract the spinach leaves, and a water-to-acetone (1:9) solution was used to extract the 20,000 g supernatant, which contained the antioxidant activity. The 20,000 g supernatant was further purified using a C-8 semi-preparative column on reverse phase HPLC. TFA elution at 0.1% produced intense hydrophilic peaks. Seven more hydrophobic peaks were created by acetonitrile elution in TFA. At 250 nm, all of the peaks were discovered. The research revealed for the first time that the aqueous extract of spinach leaves contains antioxidants in the form of flavonoids and derivatives of p-coumaric acid.^[13]

Anticancer Activity

In one study, the ability of spinach ethanol extract (SE) and the three hydrophobic column chromatography fractions to inhibit calf DNA polymerases (pol) was examined. With an IC50 value of 43.0 g/ml, the spinach glycolipid fraction inhibited the activity of pol α in a dose-dependent manner. The activity of pol α was also slightly decreased by the fat soluble fraction, but not by the water soluble fraction. Despite the fact that the spinach ethanol extract includes pol inhibitory glycolipid, it had no impact on pol α . This found that oral administration of the spinach glycolipid fraction can reduce mammalian pol α activity, human cancer cell growth in vitro, and in vivo solid tumor proliferation. This fraction may serve as a functional food with

anticancer properties and aid in the prevention of cancer.

Anti-schizophrenia Activity

The prevention properties of spinach seed extract were investigated in a mouse ketamine-induced schizophrenia (SZ) model. Mice were subjected to the induction of stereotypical psychotic behavioral signs with ketamine (50 mg/kg). Spinach seed extract was effective against stereotypical behaviors, positive, negative, and cognitive symptoms of SZ induced by ketamine in mice by decreasing dopamine levels, AChE activity, and inflammatory surge and increasing levels of gamma-aminobutyric acid (GABA) and reduced glutathione (GSH). There were no extra-pyramidal negative effects from the extract.

Anthelmintic Activity

Using *Pheretima posthuma* as test worms, crude extracts of *Spinacia oleracea* Linn and two other extracts, fresh juice extract and methanolic extract, were compared for their anthelmintic efficacy. To find out when the worms became paralyzed and when they died, several quantities of fresh juice extract and methanolic extract of *Spinacia oleracea* Linn (MSO), 10 mg/ml, 20 mg/ml, 30 mg/ml, 40 mg/ml, and 50 mg/ml, were examined. The extracts both exhibited in-vitro anthelmintic activity.^[14]

CNS Depressant Effect

In Holtzman strain adult male albino rats, treatment with *Spinacia oleracea* extract lowered locomotor activity, grip strength, increased pentobarbitone-induced sleeping time, and also significantly changed pentylenetetrazole-induced seizure state. In the cerebral cortex, cerebellum, caudate nucleus, midbrain, and pons and medulla, *S. oleracea* boosted serotonin levels while decreasing nor epinephrine and dopamine levels.^[15]

Hepatoprotective Activity

The amelioration of hepato suppression caused by carbon tetrachloride [CCl4] by *Spinacia oleracea* L. leaves alcoholic extract (SE). In addition to concurrent hepatic antioxidants like SOD, CAT, GSH, GPx GR, GST, ascorbic acid (vitamin-c), -carotene, and cytochrome P-450 enzyme, this was assessed in terms of serum-marker enzymes like GGT, AST, ALT, LDH, SDH, GDH, ALP, serum-total bilirubin, and total protein levels. LPO, however, was observed in the liver as well as the serum. The single dose of CCl4 considerably (P 0.001) changed several metabolic markers. Using SE as a pre-treatment before giving CCl (1.0 ml/kg, i.p., with a 1:1 dilution of olive oil). 4, at dosages of 100 and 200 mg/kg/day, p.o. for 7 days, effectively restored all serum and liver parameters to levels that were close to normal level.^[16]

Uses

1. The seed are useful in fevers, leucorrhoea, urinary discharges, lumbago, and diseases of the brain and of the heart^[13]
2. Spinach in the diet every day can lower the risk of cancer, heart disease, and stroke^[17,16].
3. Malabar spinach is referred to in Ayurveda as "Upodika," "Potaki," "Malvaa," and "Amritvallari," as well as in Siddha/Tamil as "Vaslakkirai."^[18,19]
4. Epidemiological studies have demonstrated that eating spinach can reduce the risk of developing esophagus, colon, and breast cancers^[8].
5. Seeds are cooling and laxative. Jaundice, liver inflammation, and lung problems have all been treated with them.
6. Spinach has been used in the treatment of febrile conditions^[20].

CONCLUSION

Spinach is referred to as a "Life Protective Food." Each and every system can benefit from spinach's healing properties. Spinach safeguards our from conception to death as

development of the fetus in the womb to aging and degeneration. Spinach displays its care and love at every similar to that of a mother. The usage of spinach in daily life is crucial to protecting our health from a variety of diseases because it includes active chemicals that have a strong antioxidant impact and are readily available to the body. Even so, we can't tally up their incalculable value advantages on the finger tips, although some indelible advantages in today's wrong Diabetes and other lifestyle disorders Heart conditions, obesity, and hypertension Anemia, osteoporosis, and blindness Constipation, among other things. Spinach revitalizes each human bodily organ that's Lungs, Heart, Throat, Mouth, and Eyes stomach, intestines, liver, skin, and hair teeth, bones, etc. Spinach is referred as as QUEEN OF GREENS, who presents gifts to us of organic health.

REFERENCES

- Godfray HCJ, Beddington JR, Crute IR, Haddad L, Lawrence D, Muir JF, Pretty J (2010) Food security: the challenge of feeding 9 billion people. *Science* 327:812-818.
- Morelock TE, Correll JC (2008) Spinach. In: Prohens J, Nuez F (eds) *Vegetables I: Asteraceae, Brassicaceae, Chenopodiaceae, and Cucurbitaceae*. Springer, New York, pp 189-218.
- Arnau Ribera Yuling Bai . Anne-Marie A. Wolters . Rob van Treuren . Chris Kik, A review on the genetic resources, domestication and breeding history of spinach (*Spinacia oleracea* L.), *Euphytica* (2020) 216:48
- Hassler M (2018) World Plants: Synonymic Checklists of the Vascular Plants of the World (version April 2018). In: Roskov Y, Abucay L, Orrell T, Nicolson D, Flann C, Bailly N, Kirk P, Bourgoin T, DeWalt RE, Decock W, De Wever A (eds) *Species 2000 & ITIS Catalogue of Life, 2018 Annual Checklist. Species 2000, Naturalis, Leiden. www.catalogueoflife.org/annual-checklist/2018*. Accessed 2 May 2019
- Kirtikar KR, Basu BD. *Indian Medicinal plants*. Deharadun: International Book Distributors. 2005;8:2078-2079.
- FAO. 2018. FAOSTAT. Food and Agriculture Organization of the United Nations-FAO Statistical Database. Available online at: <http://faostat.fao.org>
- Afra Roughani, Seied Mehdi Miri, Spinach: An important green leafy vegetable and medicinal herb, The 2nd International Conference on Medicinal Plants, Organic Farming, Natural and Pharmaceutical Ingredients, Feb 2019.
- Chokkara Sri Lasya, Spinach and its health benefits: A review, *The Pharma Innovation Journal* 2022;SP-11(8):1232-1239.
- Gomathi, V. Jayakar, B. Kothai, R. and Ramakrishnan, G. 2010. Antidiabetic activity of leaves of *Spinacia oleracea* Linn. in alloxan-induced diabetic rats. *Journal of Chemical and Pharmaceutical Research*. 2(4), 266-274.
- Cai, X, Jiao, C, Sun, H, Wang, X, Xu, C, Fei, Z, and Wang, Q. 2017. The complete mitochondrial genome sequence of spinach, *Spinacia oleracea* L. *Mitochondrial DNA Part B*. 2(1), 339-340.
- Gaikwad, P.S. Shete, R.V. and Otari, K.V. 2010. *Spinacia oleracea* Linn: A pharmacognostic and pharmacological overview. *International Journal of Research in Ayurveda and Pharmacy*. 1(1), 78-84.
- Sunita Verma, A study on medicinal herb *spinacia oleracea* linn: amaranthaceae, *Journal of Drug Delivery & Therapeutics*. 2018;8(4):59-61.
- Deven Metha, Sateesh Belemkar, pharmacological activity of *spinacia oleracea* linn. a complete overview, *Asian Journal of Pharmaceutical Research and Development*, vol. 2 (1) Jan.-Feb. 2014: 83-93.
- Patil UK, Dave S, Bhajji A, Baghel US, Yadav SK, Sharma VK. In-vitro Anthelmintic Activity of Leaves of *Spinacia oleracea* Linn. *Int. Jour. Toxicol. Pharmacol Res.* 2009;1(1):21-23.
- Guha D, Das S. CNS depressive role of aqueous extract of *Spinacia oleracea* L. Leaves in adult male albino rats. *Indian Jour. Exp. Biol.* 2008; 46:185-190
- Yadav, M. Parle, M. Sharma, N. Jindal, D.K. Bhidhasra, A. Dhingra, M.S. Kumar, A. and Dhingra, S. 2018. Protective effects of *Spinacia oleracea* seeds extract in an experimental model of schizophrenia: Possible behavior, biochemical, neurochemical and cellular alterations. *Biomedicine and Pharmacotherapy*. 105, 1015-1025.
- Rice-Evans CA, Packer L. *Flavonoids in Health and Disease*, New York: Marcel Dekker, Inc. 2003.
- Ajay Chaurasiya, Rajesh Kumar Pal, Pradeep Kumar Verma, Avineet Katiyar, Razauddin and Narendra Kumar, An updated review on Malabar spinach (*Basella alba* and *Basella rubra*) and their importance, *Journal of Pharmacognosy and Phytochemistry* 2021;10(2):1201-1207.
- Khare CP. *Encyclopedia of Indian Medicinal Plants*. Heidelberg, Springer Verlag Berlin 2004.
- Maeda N, Kokai Y, Ohtani S, Sahara H, Kumamoto-Yonezawa Y, Kuriyama I, et al. Anti-Tumor Effect of Orally Administered spinach Glycolipid Fraction on Implanted Cancer Cells, Colon-26, in Mice. *Lipids* 2008; 43 (8): 741-748.