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### A REVIEW ON NUTRITIONAL PHYTOCHEMICAL AND THERAPEUTICAL POTENTIAL OF SPINACIA OLERACEA

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#### ABSTRACT

Consuming a diet high in fruits and vegetables can help prevent major chronic diseases including cancer, obesity and heart disease. Particularly leafy green vegetables are known to have significant health-promoting effects, which are attributed to the functional characteristics of their nutrients and non-essential chemical components. Spinach (*Spinaciaoleracea* L) is sometimes regarded as a functional food because of its diverse nutritional composition, which includes vitamins and minerals as well as phytochemicals and bioactives that support health beyond just basic nutrition. Vitamin B complex (niacin and folic acid), ascorbic acid, carotenoids ( $\beta$ -carotene, lutein and zeaxanthin), phenols (flavonoids, p-coumaric acid), apocynin and Omega-3 fatty acids are all present in spinach in good amounts. Due to the presence of biological tannins and phenolic active phytochemicals such as alkaloids, flavonoids, steroids, glycosides and terpenoids, the entire plant is medicinally significant and is utilised in traditional medicine for a variety of therapeutic benefits. Diabetes, leprosy, asthma, lung inflammation, joint problems, thirst, sore throat, scabies, vomiting, ringworm, painful eye, cold and urinary infections are among the conditions it is used to treat.

#### KEYWORDS

Leafy green vegetables, Spinach, Phytochemicals, Nutrients and Diabetes.

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#### INTRODUCTION

It is well known that eating plenty of fruit and vegetables benefits human health and has been linked to a lower risk of several chronic illnesses, including cardiovascular disease, diabetes and various types of cancer<sup>1</sup>. Green leafy vegetables like spinach are abundant in nutrients and fall within the category of vegetables known as “nature’s anti-aging wonders” and having therapeutic effect. By causing

the release of satiety hormones, spinach-derived phytochemicals and bioactives can reduce calorie intake by scavenging reactive oxygen species and preventing macromolecular oxidative damage. They can also regulate the expression and activity of genes involved in metabolism, proliferation, inflammation and antioxidant defence. When spinach is fresh, steamed, or briefly cooked, it is very high in nutrients and antioxidants. It is a good source of iron<sup>2</sup>, magnesium, manganese, folate, vitamin A (lutein), vitamin C, vitamin E and vitamin K. The leaves of spinach have historically been used in folk medicine for a variety of ailments, including cooling, emollient, wholesome, antipyretic, diuretic, maturant, laxative, digestible, anthelmintic, urinary calculi, inflammation of the lungs and bowels, sore throat, pain in joints, thirst, lumbago, cold and sneezing, sore eye, ring worm, scabies and leucoderma.

## CHEMICAL CONSTITUENTS

### Flavonoids

*Spinaciaoleracea* is very rich in the flavonoids. Various flavonoids reported to be present are quercetin; myricetin; kampeferol<sup>3</sup>; apigenin; luteolin; patuletin; spinacetin; jaceidin; 4'-glucuronide; 5, 3', 4'-trihydroxy-3-methoxy- 6: 7-methylenedioxyflavone-4'- glucuronide; 5, 4'-dihydroxy-3,3'- dimethoxy-6:7-methylene dioxyflavone- 4'-glu-curonide<sup>4</sup>; 5, 4'-dihydroxi-3, 3'-dimithoxi-6, 7-methylene-dioxi- flavone (C<sub>18</sub>H<sub>14</sub>O<sub>8</sub>.); 3, 5, 7, 3', 4'pentahydroxi-6-methoxiflavone<sup>5</sup>.

### Phenolic compounds

The polyphenols isolated from the plant are *para*-coumaric acid, ferulic acid, *ortho*- coumaric acid<sup>6</sup>.

### Carotenoids

Spinach shows presence of different carotinoids like lutein, β-carotene, violaxanthin and 9'-(Z)-neoxanhin.

### Vitamins

*Spinaciaoleracea* contains high concentration of vitamin A, E, C, K and also folic acid, oxalic acid.

### Minerals

Along with these chemicals various minerals present in the spinach. These are magnesium, manganese, calcium, phosphorus, iron, zinc, copper and potash<sup>5</sup>.

### Pharmacological effects

#### Antidiabetic effects

The spinach antidiabetic activity may be due to the presence of flavonoids such as kaempferol, qyricetin, quercetin, apigenin and luteolin. It is reported that flavanoids constitute the active biological principles of most medicinal plants with hypoglycemic and antidiabetic properties. Spinach ethanolic and aqueous extract produced a significant reduction in fasting blood glucose levels in the normal alloxan-induced diabetic rats. Also, significant differences were observed in serum lipid profiles including cholesterol and triglyceride and changes in body weight by both ethanolic and aqueous treated diabetic animals. Histopathological studies of the pancreas of these animals showed comparable regeneration by extract which were earlier necrosed by alloxan<sup>7</sup>.

#### Antioxidant activity

Compared the effect of drying in fresh and dried leaves with reference to the phytoconstituents. There was no change in the phytochemical constituents present in fresh and dried leaves of spinach. The anti-inflammatory, laxative and antioxidant property may be due to the presence of glycosides such as coumarins, anthroquinones, steroids and flavonoids, respectively. Loss of water content on drying has no effect on the extractive values of leaves and phytoconstituents. So the dried leaves can be used for its medicinal values and can be stored till its use<sup>8</sup>.

#### Anti-osteoarthritis effects

Spinach leaves were used as traditional Persian medicine for joint pains which osteoarthritis and rheumatoid arthritis are the most popular ones. The antiosteoarthritic and chondro-protective effects of spinach extract evaluated on chemically induced osteoarthritis. Results indicated that spinach extract acts as a strong anti-oxidant and an anti-inflammatory agent<sup>9</sup>.

#### Anti-schizophrenia activity

The protective effects of spinach seed extract were carried out in an experimental model of ketamine

induced schizophrenia (SZ) in mice. Ketamine (50mg/kg) was used to induce stereotyped psychotic behavioural symptoms in mice. Spinach seed extract reduced dopamine levels, AChE activity and inflammatory surge and increased the levels of gamma-aminobutyric acid (GABA) and reduced glutathione (GSH), thereupon was effective against stereotypic behaviours, positive, negative and cognitive symptoms of SZ induced by ketamine in mice. The extract did not show extra-pyramidal side effects<sup>4</sup>.

#### **Spatial memory**

The effects of ethanolic extracts of spinach on spatial memory in wistar rat induced by diazepam were studied. There is an effect of 200mg/kg BW spinach ethanolic extracts in preventing impairment on spatial memory by accelerating escape latency time<sup>10</sup>.

#### **Anti-bacterial activity**

Spinach extract can be used as a natural antibiotic and preservative in food industries and Pharmaceuticals<sup>11</sup>. It is very rich in the flavonoids including quercetin, myricetin, kampapigenin, luteolin, patuletin and spinacetin. The polyphenols para-coumaric acid, ferulic acid and orthocoumaric acid also reported from this plant which may be responsible for antibacterial activity. The methanolic extracts of spinach were tested against twelve Gram-positive and eighteen Gram-negative bacteria at 1000µg/disc concentration by disc diffusion method and it exhibited activity against three Gram-positive and one Gram-negative bacteria demonstrated that the antibacterial activity of spinach polyphenol against Gram-negative bacteria was stronger than that of Gram-positive bacteria<sup>12</sup>.

#### **Anti-inflammatory activity**

The polyphenols have anti-inflammatory, antioxidant and anti-DNA damaging effects. Based on the epidemiological evidence and laboratory studies conducted using *in vitro* and *in vivo* systems, it is suggested that routine consumption of these polyphenols may provide efficient protection. The investigation of phytochemically evaluated ethanolic and aqueous extracts of spinach leaves for its antiinflammatory activity in rats demonstrated that ethanolic as well as aqueous extract at a dose level of

1100mg/kg have shown significant activity which is comparable to the standard drug (Indomethacin, 20mg/kg). The findings with spinach are significant, because it used as a dietary vegetable and is available all over the world. Therefore, it is worthwhile to conduct detailed studies in order to explore the full potential of this plant in reducing inflammation in humans from the point of view of cost and availability for people at all socioeconomic levels<sup>13</sup>.

#### **Anti-cancer effects**

Spinach is considered as a beneficial source for various carotenoids and lipophilic active compounds including neoxanthin, lutein, zeaxanthin, and chlorophylls. Dietary intake of spinach extract has beneficial effects on various types of cancer, such as ovarian, lung, prostatic, breast, and colon. Natural antioxidant mixture is composed of the main active compounds contained in spinach, mainly flavonoids, and cumaric acid derivatives. Natural antioxidant mixture can easily be used for chemoprevention or dietary intervention in humans because it is stable at high temperature and lacks toxicity<sup>14</sup>.

#### **Hepatoprotective Activity**

Gupta and Singh 2006 reported the amelioration by *Spinaciaoleracea* L. leaves alcoholic extract (SE) against the hepatosuppression induced by carbon tetrachloride (CCl<sub>4</sub>). This was evaluated in terms of serum- marker enzymes like GGT, AST, ALT, LDH, SDH, GDH, ALP serum-total bilirubin and total protein levels along with concomitant hepatic-antioxidants like SOD, CAT, GSH, Gx GR, GST, ascorbic acid (vitamin-c), β-crotonene and cytochrome P-450 enzyme. Whereas, LPO was monitored in both serum and liver. These biochemical parameters were significantly (P<0.001) altered by the single dose of CCl<sub>4</sub>. Pretreatment with SE prior to the administration of CCl<sub>4</sub> (1.0ml/kg, i.p., with olive oil, 1:1). 4, at the doses of 100 and 200g/kg/day, p.o. for 7 days, significantly restored to all the serum and liver parameters near to the normal levels. The hepatoprotective potential of *S. oleracea* L. against hepato suppression possibly involves mechanism related to its ability to block the P-450 mediated CCl<sub>4</sub> bioactivation through selective inhibitors of ROS (reactive oxygen species). Thus *S. oleracea* L.,

showing protection in liver, may prove as a rich source of antioxidants<sup>15</sup>.

#### **Anthelmintic Activity**

Dave *et al*, 2009 evaluated the anthelmintic activity of crude extract of *Spinaciaoleracea* Linn. And different extract namely fresh juice extract and methanolic extract using *Pheretimaposthuma* as test worms. Different concentrations 10mg/ml, 20mg/ml, 30mg/ml, 40mg/ml and 50mg/ml of fresh juice extract and methanolic extract of *Spinaciaoleracea* Linn (MSO) were studied to determine the time of paralysis and time of death of worms. Both the extract performed *invitro* anthelmintic activity. Albendazole was used as standard reference and saline water as control. The result was revealed that the fresh juice extract may show more potent anthelmintic activity than MSO<sup>16</sup>.

#### **CONCLUSION**

Spinach consumption is essential for preventing the onset of several ailments. Numerous pharmacological effects of *Spinaciaoleracea*, including antioxidant, anti-inflammatory, antiproliferative, CNS depressant, and hepatoprotective properties, have been reported. Numerous secondary metabolites, including flavonoids, carotenoids and phenolic compounds, have been shown to be present in this plant. Therefore, more research on *Spinaciaoleracea*'s phytochemical, pharmacological and clinical properties is necessary to develop an effective natural remedy that yields lead compounds with therapeutic value.

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#### **CONFLICT OF INTEREST**

We declare that we have no conflict of Interest.

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