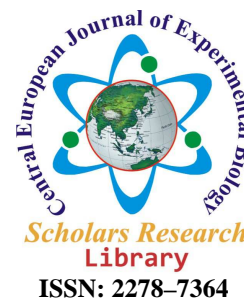




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Phytochemical Investigations of *Spinacia oleracea*: An important leafy vegetable used in Indian Diet

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ABSTRACT

The nutritional and medicinal benefits of vegetables provide a better support for human wellbeing. There are several edible vegetables which are used in day to day kitchen in different forms. The usages of green leafy vegetables are limited to a specific geographical location. In the present work, we have investigated phytochemicals of *Spinacia oleracea*, one of the most important vegetable used in India. The presence of phytochemicals including phytosterols, saponins, alkaloids, phenolic compounds and tannins, proteins, glycosides, flavonoids, carbohydrates, quinones, coumerin, terpenoids, anthocyanins and emodins were determined in the *Spinacia oleracea*. The extract of *Spinacia oleracea* exhibits the presence of phytosterols, proteins, glycosides, flavonoids, carbohydrates, quinones, and terpenoids. It was concluded that the extracts of *Spinacia oleracea* consists of important constituents for pharmacological activities.

Key words : *Spinacia oleracea*, Phytochemistry, Pharmacological activities, Nutrition

INTRODUCTION

Spinach (*Spinacia oleracea*) is an edible flowering plant in the family Amaranthaceae. This plant grows to a height of up to 30 cm. Spinach may survive over winter in temperate regions. The leaves are alternate, simple, ovate to triangular - based, varying in size from about 2–30 cm long and 1–15 cm broad. The larger leaves are at the base of the plant and small leaves higher on the flowering stem. The flowers are inconspicuous, yellow - green, 3–4 mm in diameter, maturing into a small, hard, dry, lumpy fruit cluster about 5–10 mm across containing several seeds. Spinach has a high nutritional value. It is a rich source of vitamin A, vitamin C, vitamin K, magnesium, manganese, folate and iron.

The biochemical components present in green leafy vegetables are of great pharmacological or medicinal importance. The phytonutrients present in green leafy vegetable gives many common health benefits such as protection from eye disorders, oxidative stress, iron deficiency etc., Consumption of green leafy food is good for human health as it improves nutritional status and reducing risks of specific diseases like diabetes, cancer and hepatotoxicity. The present study determines availability of phytochemicals in vegetable and their pharmacological benefits. *Spinacia oleracea* is used since ancient periods as food source. It contain many nutrients and minerals

which are helpful in maintaining human health. Especially in developing countries the nutrition and health of increasing world population is a major upcoming challenge. Plant food acts as sources of energy, supplying nutrients and micronutrients essential for health. This also includes added health benefits like antioxidant activity [1].

Several studies on the chemical composition of leafy vegetables have shown that, they contain enormous amount of micronutrients, several agronomic advantages and economic value. They also contain some chemical compounds that are having important medicinal uses, human well-being and healthy lifestyle. Some of the vegetables are also reported to cure more than one health problem. The medicinal values of vegetables and fruits are believed to be dictated by their phytochemical and other chemical constituents [2].

Fruits and vegetables are important sources of phytochemicals and it is studied that some antinutritional content of these vegetables have exhibited potential for reducing the risk of certain diseases in human beings [3]. These diseases include high blood pressure, heart attack, stroke, and other cardiovascular diseases [4]. These antinutrients or phytochemicals carry out their healing activities by combining with vitamins or with other nutrients [5]. Information is however scanty on the nutritional and phytochemical contents of the leafy vegetables [6].

Phytochemicals are naturally occurring components in fruits, vegetables, legumes and grains. Plants are getting specific colour, flavour, smell and are part of plant's natural defense system i. e. disease resistance. Phytochemicals are bioactive, non-nutrient plant compounds in fruits, vegetables, grains and other plant foods that have been linked with reducing the risk of major degenerative diseases [7, 8].

Thus there is a need to evaluate the potential of local vegetables in relation to the provision of basic nutrients and phytochemicals, which will help in providing vital data for food processors, nutritionist, dieticians, as well as the consumers for the selection of proper green leafy vegetables.

MATERIALS AND METHODS

Collection of plant material -

The plant material, *Spinacia oleracea* was collected from the agricultural field of Junnar Tehsil, Pune, India. The plant material was collected in plastic zip lock bags and brought to the laboratory, washed thrice with tap water to remove any debris and then washed with double distilled water. The cleaned material was shed dried and used for the extraction.

Preparation of plant extracts -

The collected plant samples were dried and crushed to powder form. Five gm of powdered plant sample was soaked in extraction solution, which consists of chloroform : acetone in the proportion 1: 1. The entire mixture was incubated at 4°C for 48 hrs. After the incubation period is over, the mixture was filtered and centrifuged at 10,000 rpm at 4°C. The extracts were concentrated to dryness in rotary evaporator (IKA – RV 10 Control) and were stored at 4°C until further use.

Phytochemicals analysis -

Phytochemical analysis of the test sample was carried out according to standard methods [9, 10, 11, 12, 13, 14].

RESULTS AND DISCUSSION

The extract obtained was dried, weighed and percentage yield was calculated as depicted in table 1.

Table 1. Percentage yield of extract from *Spinacia oleracea*

Part used for extraction	Percentage yield of extracts
Leaf	0.53 ± 0.20

Values are means of three readings ± SE

The results of the phytochemical test carried out on the extract was recorded as shown in table 2. Preliminary phytochemical screening revealed the presence of alkaloids, saponins, steroids, tannins, flavonoids, proteins and carbohydrates in both crown as well as in fruit. Phytochemical constituents in the various part of the plant vary significantly.

Results revealed that the crown has quite a number of chemical constituents, which may be responsible for many pharmacological activities. Further work is essential to investigate the extracts of crown for various pharmacological activities.

As prevention is a more effective strategy than treatment for chronic diseases, a constant supply of phytochemical-containing plants with desirable health benefits beyond basic nutrition is essential in reducing the risk of diseases in humans. The importance of these phytochemicals is their presumed ability to inhibit carcinogenesis. They play a variety of role such as antioxidants, inhibitor of tumor growth, antimutagens, enzyme modulators, chemical inactivators, and free radical scavengers [15].

Several medicinal plants are used in traditional medicines for curing many diseases. The plant extract and their phytoconstituents are reported for anti inflammatory, antidiarrhoeal, antimicrobial, antioxidant and insecticidal activities [16].

In the present investigation, the extract of *Spinacia oleracea* shows the presence of phytosterols. Steroids and sterols are of immense importance in pharmacy because of their relationship with compounds like sex hormones and can be used for drug production [17].

In the present study, proteins, glycosides, flavonoids, carbohydrates, quinines and terpenoids were found to be present in *Spinacia oleracea* extract. Several workers reported that, glycosides play an important role in lowering the blood pressure. They are also used in treatment of congestive heart failure and cardiac arrhythmia [18].

Table 2. Phytochemical analysis of *Spinacia oleracea* extract

Sr. No.	Parameters	<i>Spinacia oleracea</i>
1.	Phytosterols	+
2.	Saponnins	-
3.	Alkaloids	-
4.	Phenolic compound and Tannins	-
5.	Proteins	+
6.	Glycosides	+
7.	Flavanoids	+
8.	Carbohydrates (F)	+
9.	Carbohydrates (B)	+
10.	Quinones	+
11.	Coumerin	-
12.	Terpenoids	+
13.	Anthocyanins	-
14.	Emodins	-

Flavonoids show anti allergic, anti inflammatory, anti microbial and anti cancer activity. Flavonoids are generally distributed throughout the plant kingdom and are 15 carbon compounds. Proteins and carbohydrates are necessary for the animal body for repair and maintenance. In the present work some plants exhibited the presence of proteins and carbohydrates, thus reflecting their nutritional importance as protein and carbohydrate supplement which cannot be ignored [19].

Natural or synthetic quinones show a biological or pharmacological activity, and some of them show antitumor activity as well. They embody some claims in herbal medicines. These applications include purgative (sennosdes), antimicrobial (rhein- and sapororthoquinone), anti-tumor (emodin and jugone), inhibition of PGE2 biosynthesis (arnebinone and arnebifuranone) and anti-cardiovascular disease (tanshinone). It has been reported that terpenoids are used in the treatment of cough, asthma and hay fever. Emodin could be used to reduce impact of type 2 diabetes. It was also reported that, emodin limits the effect of glucocorticoids and also shows anti cancer property [20].

CONCLUSION

The commonly consumed green leafy vegetable in India selected for the present study contain substantial amount of phytochemicals, which are helpful in the prevention of some deadly diseases. The phytochemicals were not affected

by cooking except for flavonoids and alkaloids. This implies that the fear of losing these plant chemicals as a result of cooking need not arise. Vitamins and minerals can be lost (leached out) during cooking but not the phytochemicals. This work also showed that the *Spinacia oleracea* is one of the most cherished vegetables in India which is very rich in most of these phytochemicals.

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