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ORIGINAL ARTICLE

Preliminary phytochemical investigation of *Sonchus oleraceus* L. (sow-thistle) root and leaf extracts

Bhavna Kabila, Sandeep Kaur, Sushma

Department of Botany, Kanya Maha Vidyalaya, Jalandhar, Punjab, India

Abstract

Background: *Sonchus oleraceus* L., commonly known as common sow-thistle, belongs to the family Asteraceae, one of the largest families of flowering plants. It is widely distributed and recognised for its nutritional and medicinal significance. **Objectives:** The present study aimed to investigate the phytochemical constituents of *S. oleraceus* and compare the phytochemical profiles of aqueous and ethanolic extracts prepared from its roots and leaves. **Materials and Methods:** Roots and leaves of *S. oleraceus* were used to prepare aqueous and ethanolic extracts. We performed qualitative phytochemical screening using standard preliminary tests to detect the presence or absence of various bioactive constituents. The investigation included screening for amino acids, carbohydrates, coumarins, reducing sugars, terpenoids, gums and mucilage, oxalates and quinones. **Results and Discussion:** Phytochemical screening revealed the presence of various phytoconstituents in the aqueous and ethanolic extracts of the roots and leaves of *S. oleraceus*. The investigated constituents included amino acids, carbohydrates, coumarins, reducing sugars, terpenoids, gums and mucilage, oxalates and quinones. Comparative analysis indicated that aqueous extracts exhibited comparatively more promising phytochemical responses than ethanolic extracts. These findings suggest that the extraction solvent influences the recovery and detection of phytochemical constituents from different plant parts. The findings provide preliminary scientific evidence supporting the phytochemical potential of this plant and provide a basis for further quantitative analysis, isolation and characterisation of bioactive compounds, and evaluation of their biological activities.

Key words: Leaf, phytochemicals, plants, root, *Sonchus oleraceus*, therapeutic

INTRODUCTION

Plants are inherent to life on Earth, being stationary organisms capable of photosynthesis and performing various activities. They boast intricate structures, contribute to local climates, and serve as living biological barriers.[9] Because they provide humans and other living things with food, fiber, and shelter, they are essential to life. In addition, plants are grown as ornamentals and as cleaners of the air, soil, and water. They are also helpful in a variety of social, cultural, and religious rituals. Plants have been utilized for thousands of years to treat many health concerns in both animals and humans, and, in contrast to chemical-based medicines, they tend to have little or no adverse effects and are relatively safe (Usman *et al*., 2014;[35] Chandra, 2016).[3,5,6]

The World Health Organization states that more than 80% of people worldwide rely on traditional medicine, which is mostly plant-based, to address their basic medical needs. In India, the harvesting and manufacturing of therapeutic plants and plant products also supports the country's economy.[29] Around 3000 plant species are known to have therapeutic qualities. Herbs are used in the treatment of many ailments across systems, including homeopathy, unani, siddha, and Ayurveda. An estimated 40% of the global population receives their medical care only from plants. Medicinally important plants provide safe, affordable healthcare options in India.[19]

Sonchus oleraceus belongs to the Asteraceae family, the biggest group of flowering plants. *S. oleraceus* is widely

Address for correspondence:
Bhavna Kabila, Department of Botany, Kanya Maha Vidyalaya, Jalandhar-144004, Punjab, India.
E-mail: bhavnakabila273@gmail.com

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distributed, with high levels of vitamins A, D, and E, and is also edible.[23] Most commonly, it is used in salads, decoctions, and edible aerial parts.[11] In more than 55 nations, this species is regarded as a therapeutic herb. *S. oleraceus* was first identified as a weed; it was later shown to have significant medicinal benefits. This weed is primarily found in cultivated crops and is important to the production of medications and animal feed.[15] *S. oleraceus* aerial portions are mostly used in salads and decoctions; they are also taken orally to treat infections, hepatitis, and stomach pain. The extract has a wide range of bioactivities, including antibacterial, pain-relieving, general tonic, anti-aging, and anti-inflammatory qualities.[11] As a leaf vegetable, *S. oleraceus* is edible to humans and widely consumed in Australia and New Zealand.[37] *S. oleraceus* leaves contain a variety of bioactive substances such as alkaloids, steroids, phenols, tannins, and flavonoids.[20] They are important in rural diets because they give society an affordable option for vegetables. *S. oleraceus* is also one of the traditional medicinal plants used in the treatment of different diseases because of the presence of different active metabolites and is also used in the treatment of hepatitis, infections, and stomachache. The amount and diversity of phytoconstituents that a certain plant species has determine its therapeutic efficacy.

Classification

Kingdom: Plantae
Division: Magnoliophyta
Class: Magnoliopsida
Subclass: Asteridae
Order: Asterales
Family: Asteraceae
Genus: *Sonchus*
Species: *oleraceus*.[23]

Common Name – Common Sow Thistle

S.oleraceus originates in Europe but was later found in Asia and North Africa. It grows throughout the Middle East, Australia, South America, and North America. In India, *S. oleraceus* is found in many regions of the country, including Punjab, Haryana, Himachal Pradesh, etc.[15]

Botanical Description

It is an annual herb that reaches a maximum height of four feet. *S. oleraceus* is a plant with the proper five leaves. Leaves have two-pointed little auricles, fine serrations, and delicate teeth at the base of their limbs. The delicate, thin leaves can grow up to 36 cm in length and 12 cm in width and are firmly lobed. The leaves are hairless, lanceolate to oblong in shape, dark green, and have faint white to purple veins.[22] The leaves possess a slender spine and a minute serrated edge. The leaves have a thin spine and a tiny notched edge. The upper surface of leaves bears tiny hairs, and tips of mature leaves feature slender, delicate spines that finish in uneven teeth [Figure 1].[23]

The flowers have a yellow tint and possess a diameter of up to 7 mm. Typically, flowering occurs throughout the spring and summer. Flowers come in different arrangements and can be classified as either monosexual or bisexual. The valved tube adheres to the ovary completely.[23,28]

S. oleraceus possesses various medicinal importance and shows strong antimicrobial activity. Different chemical compounds were identified and analyzed for their antibacterial properties from the root of *S. oleraceus*. It has been established that different plants and their parts have anti-plasmodial action, antifungal, and larvicidal properties. Phytochemicals are the chemical components of plants that give them their medicinal properties.[15,37] These are physiologically active substances, such as phenols, tannins, terpenoids, alkaloids, and flavonoids, that serve as defensive mechanisms for plants against microbial predation and also act as a shield for human health against many diseases from a range of illnesses.[24,27]

MATERIALS AND METHODS

Study Area

The plant was recorded from the local area of Baba Deep Singh Nagar, Jalandhar (31.3578° N, 75.5955° E). It was identified and authenticated as *S. oleraceus*.

Morphology and Collection of Research Materials

The plant species were collected from their natural habitat surroundings for evaluating their structural characteristics. Standard monographs (floras and manuals) and other sources were used to identify the species.[7,8,23,32,36,38]

Phytochemical Analysis

The leaves and roots of *S. oleraceus* were collected from their natural habitat.

Processing of Material

The gathered materials were allowed to air-dry at room temperature after being cleaned with ordinary and then distilled water. An electric grinder was used to grind the material till it was completely dry. To be used later, the powdered substance was kept in an airtight container.

Preparation of Aqueous and Ethanol Extract

2.5 g of the powder was soaked in 25 mL of distilled water/ethanol taken in a conical flask. The flask was kept on a rotary

Table 1: Test for phytochemical analysis

Phytoconstituents	Test(s)	Observations
Amino acid (Ninhydrin Test)	1 mL extract+1 mL Ninhydrin reagent+boil	Blue coloration
Carbohydrates	(Molisch's Test) 1 mL extract+5 drops molisch reagent+2 mL conc. H_2SO_4	Violet ring at the junction
Coumarin	1 mL extract+1.5 mL NaOH (10%)	Yellow coloration
Flavonoids	1 mL extract+10 drops conc. H_2SO_4	Yellow coloration
Gums Mucilage	1 mL extract+2.5 mL absolute alcohol (with constant stirring)	Creamy precipitates
Oxalate	2 mL extract+25 drops glacial acetic acid	Greenish-black coloration or precipitates
Quinones	1 mL extract+10 drops conc. HCl	Yellow precipitate or coloration
Reducing sugars (Fehling's Test)	1 mL of both Fehling's solution A and B+heat+cool. Add 1 mL extract to it+heat	Brown-red precipitates
Saponins (Froth Test)	2 mL extract+shake vigorously	Froth formation
Terpenoids (Salkowski Test)	1 mL extract+2 mL $CHCl_3$+2 mL conc. H_2SO_4	Reddish brown ring at the junction



Figure 1: Morphological photos of *Sonchus oleraceus*

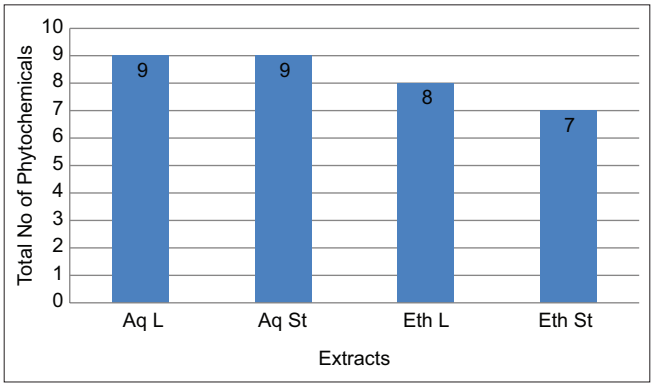


Figure 2: Number of phytochemicals in each extract

shaker for 24 h. The obtained mixture was filtered through a muslin cloth followed by Whatman filter paper No. 1. The filtrate was collected in vials and stored in the refrigerator till further use.[10,14,28,39]

Phytochemical Screening

The extracts of plant species and their parts were screened for different phytochemicals, including alkaloids, flavonoids, saponins, coumarins, terpenoids, gums and mucilage, reducing sugar, amino acids, carbohydrates, quinones, oxalate, etc., through standard procedures.[4,12,14,17,18,21,31,33,34] Standard procedures tabulated in Table 1.

RESULTS AND DISCUSSION

Phytochemical analysis has been done on aqueous and ethanol extracts of roots and leaves of *S. oleraceus*, which are tabulated in Table 2. Various phytoconstituents such as amino acids, carbohydrates, coumarin, reducing sugar, terpenoids, gums and mucilage, oxalate, and quinones were studied in different extracts.

The maximum number of phytoconstituents was recorded from the aqueous extracts of roots and leaves, while the least number has been reported from the ethanol extract of roots [Figure 2]. Coumarin, carbohydrates, quinones, reducing sugar, and terpenoids are present in all the tested extracts. Amino acids are present in trace amounts in the aqueous and ethanol extracts. Flavonoids are absent in leaf and root ethanol extracts. Similarly, saponins are absent in root extracts.

Table 2: Phytochemical analysis of *Sonchus oleraceus* leaves and roots

S. No.	Test (s)	Observations	Results			
			Leaves aqueous	Root aqueous	Leaves ethanol	Root ethanol
1	Amino Acid	Blue coloration	±	+++	±	–
2	Coumarin	Yellow color	++	+++	++	++
3	Carbohydrates	Violet color	+	++	+	++
4	Flavonoids	Violet color	±	+++	–	–
5	Gums and mucilage	Creamy color	+++	+++	–	++
6	Oxalate	Greenish black coloration or ppt	–	++	±	+
7	Quinones	Yellow ppt or coloration	++	+++	+++	++
8	Reducing sugar	Brown ppt	+++	+++	±	+++
9	Saponins	Froth formation	±	–	±	–
10	Terpenoids	Reddish-brown ring	+++	+++	±	+++

+++: High, ++: Moderate, +: Low amount, ±: Traces, –: Negative

According to Yinand Singh, the different constituents were studied, and flavonoids, tannins, alkaloids, terpenes, steroids, and phenols were reported in the leaves of *S. oleraceus*.[30,40] A detailed study of the alcoholic extract of *S. oleraceus* recorded tannins, anthraquinones, alkaloids, saponins, sterols, flavonoids, and carbohydrates.[1] These studies are in agreement with the present investigation of different bioactive metabolites in leaf extract.

Jimoh *et al*. reported the antioxidant, antibacterial, phytochemical, and nutritional properties of acetone extracts from *S. oleraceus*.[13] The detailed importance of aqueous extracts of *S. oleraceus* possessing anti-inflammatory properties, and these studies are in agreement with the present work irrespective of the different plant parts used for analysis. The root extracts were reported to have more stimulatory effects, whereas leaf extracts demonstrated more inhibitory effects.[3] As stated by Roberts *et al*. and Botella *et al*., antioxidants help protect a variety of diseases, including cancer, myocardial infarction, arthrosclerosis, neurogenerative diseases, etc. protect against various diseases, including cancer, myocardial infarction, atherosclerosis, and neurodegenerative disorders.[5,26] Plants are a good source of natural antioxidants since they contain phenols, flavonoids, and tannins. The presence of these compounds in species may work as the main antioxidants to neutralize free radicals and shield cells from harm.[2] Saponins manage diabetes mellitus and hypercholesterolemia. The inclusion of *S. oleraceus* in both conventional and modern-day medicine will provide an alternative approach in studies of *S. oleraceus* by the compound's anticancer, antidiabetic, antioxidant, antibacterial, and anti-inflammatory properties.[16]

A range of active phytoconstituents found in plants can be used to determine their pharmacological applications, providing fundamental knowledge for the preservation of known plant species. It is important to identify and analyze the chemical compounds that offer a substitute source for the pharmaceutical aspects of herbal medicinal plants.

CONCLUSION

Plants are essential for life on Earth, providing food, fiber, shelter, ornamental purposes, and cleaning air, soil, and water. They have been used for thousands of years to treat various health conditions and maintain the balance of nature. *S. oleraceus* is a therapeutic herb found in over 55 countries. The genus *Sonchus,* which belongs to the family Asteraceae, has around 50 species, with many bioactive metabolites used in herbal remedies. Phytochemical analysis has been done on aqueous and ethanol extracts of the root and leaves of *S. oleraceus*. The aqueous extract gives promising results compared to the ethanol extract. The medicinal characteristics and pharmacological actions of different components of *S. oleraceus* have been discussed, including the phytochemical constituents of the extracts. In comparison to ethanol extracts, the greatest amount of phytoconstituents has been extracted by aqueous extraction. In addition, the data highlight the importance of a particular test that is a key component in verifying the existence of a phytoconstituent. Thus, the present investigation will be useful in identifying and characterizing the various pharmacologically active principles that underpin the various biological activities and therapeutic benefits of the plant species.

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