Pharmacognosy Reviews, 2026; 20(39):91-97.
www.phcogrev.com

Review Article

Phytochemical and Medicinal Potential of Genus *Sonchus*: A Review Article

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ABSTRACT

Genus *Sonchus* is a member of the Asteraceae family, contains several species that are well-known for both their medicinal properties and their extensive distribution throughout Europe, Asia, and Africa. The morphology, phytochemistry, and medicinal uses of *Sonchus oleraceus* and other prominent species are thoroughly reviewed in this article. Their potential as anti-inflammatory, antioxidant, antimicrobial, diuretic, antihypertensive, and cardioprotective agents has been highlighted by recent research. The findings demonstrate the pharmacological diversity of *Sonchus* species, confirming their traditional application and highlighting their importance in the development of contemporary drug discovery and Phytotherapy. First, a search was performed across different databases, including, Scopus, Science Direct, Google Scholar, The Cochrane Library, \Web of Science and PubMed from the year 2000 mostly till 2025. Second, articles were chosen based on specific related criteria as mentioned below. As this is a review article, we include most types of articles relevant to our subject and published in peer-reviewed journals. The search yielded 115 articles, and most of them were selected as the basis for the construction of the review. This literature review discussed the biological constituents and pharmacology of genus *Sonchus*. Based on the promising results collected in this manuscript, we recommend further research to be carried out on the extracts of plants of this genus for the extraction and identification of further molecules which can be helpful in medicine.

Keywords: *S. oleraceus*, Flavonoids, Hydroxycinnamic acids, Anti-cancer, Antimicrobial.

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Received: 15-12-2025;
Revised: 02-01-2026;
Accepted: 25-02-2026.

INTRODUCTION

Medicinal plants have long been used in traditional medical systems all over the world. Among these, genus *Sonchus* that belongs to family Asteraceae and comprises 98 species, commonly known as sow thistles, has garnered attention due to its wide variety, high nutritional value, and range of pharmacological traits.[1] Numerous scientific studies have confirmed that it is edible and rich in minerals, flavonoids, phenolic acids, and vitamins A, D, and E.[2] *Sonchus arvensis* has a very high vitamin E content, according to several studies.

In 2013, the "Shen Nong's Herbal Classic" shows that *Sonchus* species, especially *Sonchus oleraceus* and *Sonchus arvensis*, were used in ancient Chinese medicine. Recent research has also revealed that these species have strong medicinal properties, helping to prevent heart failure and showing hepatoprotective, anticancer, antioxidant, anti-inflammatory, and antimicrobial effects due to the presence of hydroxycinnamic acids, flavonoids and sesquiterpenes (Figure 1).[3,4]

The phytochemical composition and medicinal potential of these two species, have been the subject of recent scientific studies. The traditional uses, pharmacological activities, and potential uses of this species in contemporary medicine are highlighted in this article, which compiles results from several studies.

In 2022, a study carried out by Galdino *et al*., identified the presence of minerals (K, Ca, Mg, Cu, Mn, Fe, Zn, Na, and Se) in *S. oleraceus, S. asper*, and *S. arvensis*. This study showed that, *S. arvensis* had the highest concentration of potassium, while *S. oleraceus* was rich in iron. These species are therefore greatly enhanced in terms of food and nutrition because they are widely distributed, are reasonably priced, function as pesticides in their production systems, and are heavily consumed by many families and rural populations living in Asia. The roots of the *S. oleraceus* species were used as a galactagogue, febrifuge, sedative, and to treat various liver disorders in many ancient medical systems, including Chinese medicine. Due to its growing dominance over

DOI: 10.5530/phrev.20260001

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the past ten years, this species has grown in importance as one of the major plants and has a wide range of biological functions that enable it to survive in various environmental conditions.[5,6]

Tables 1, 2 presented below list the most prevalent *Sonchus* species and isolated compounds.

Inclusion Criteria

- Original research articles, short communications, and comprehensive reviews published in peer-reviewed journals.
- Studies focused explicitly on *Peganum* species, reporting phytochemical profiling, biological activity assessments, or both.
- *In vitro* or *in vivo* pharmacological evaluations conducted under standardized conditions.
- Investigations into structure–activity relationships.

Exclusion Criteria

Non-peer-reviewed materials (e.g., conference abstracts, editorials, book chapters, theses).

- Articles with inadequate methodological detail or irreproducible protocols.
- Non-English articles without verified translations.

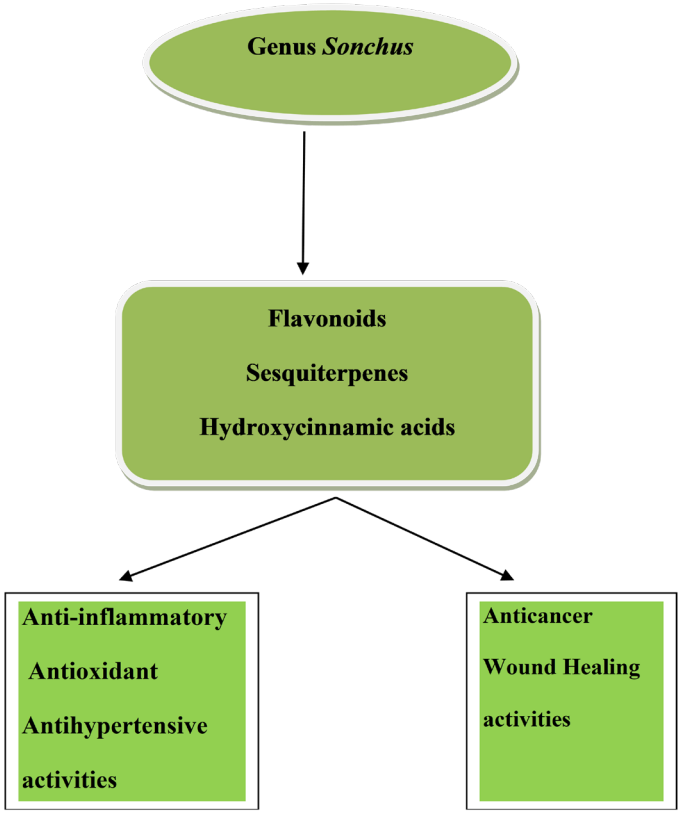


Figure 1: Flow Diagram of the Chemical Composition and Biological Activities of Genus Sonchus.

- Case reports or opinion pieces without original data.

SEARCH STRATEGY

The data supporting the results of this research are accessible in standard research databases like PubMed, Scopus, ScienceDirect, Google Scholar, The Cochrane Library, Web of Science, and/or public domains that are accessible via keywords or DOI numbers.

PHARMACOLOGICAL ACTIVITIES

Anti-Inflammatory and Antioxidant Activities

The extracts from *S. arvensis* and *S. oleraceus* had the highest phenolic and flavonoid contents having the potential to eliminate toxins and free radicals from the body and shield the kidneys from these substances. which explained their antioxidant effects, according to a study carried out by Dao *et al., S. arvensis* extract demonstrated a remarkable ability to scavenge radicals (DPPH) and inhibit lipid peroxidation. It also showed the greatest reducing power at 500 µg mL−1 by A 700 = 0.80.[1,22]

According to a 2024 study by Naunyn *et al.*, *Sonchus oleraceus* has potent anti-inflammatory and antioxidant qualities both *in vitro* and *in vivo*. A rich profile of bioactive substances, particularly flavonoids, terpene lactones and phenolics, is the primary cause of these beneficial effects.[23,24]

In addition, a recent research carried out on thirty rats has demonstrated that *S. arvensis* extract rich in luteolin, quercetin and apigenin can lessen inflammation brought on by the deposition of monosodium urate crystals in the synovial tissue. One of the flavonoids found in *S. arvensis*, quercetin, inhibits the proliferative phase of inflammation.[25]

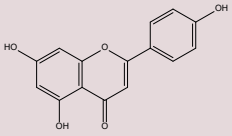
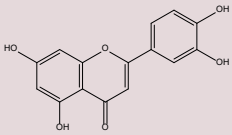
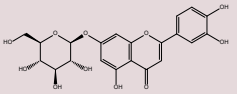
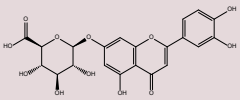
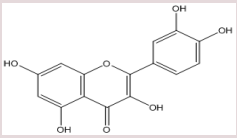
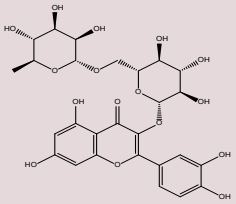
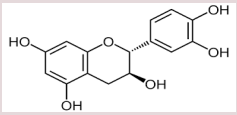
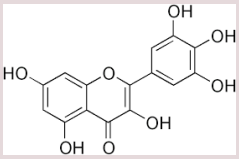
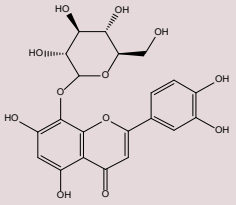
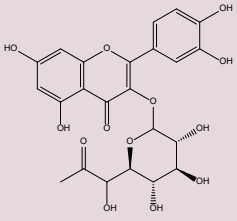
Antihypertensive effect

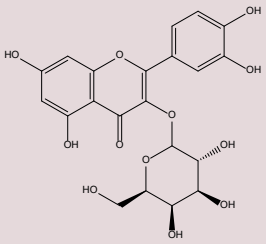
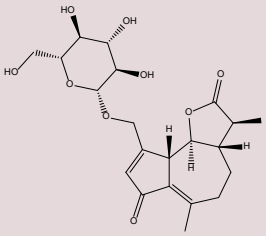
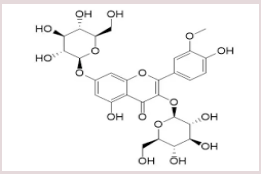
A study carried out by Mushtaq *et al.*, examined the impact of *Sonchus asper* L. aerial parts on rats that were fed a glucose and egg feed diet to induce hypertension. The results showed that the extract dramatically and dose-dependently lowered blood pressure and heart rate. The maximum antihypertensive effect was produced by 1000 mg/kg of the extract, which explains why this plant is used in traditional medicine for lowering hypertension.[26]

In a study conducted in 2021, male wistar rats were given 0.25 mg/kg b.w. of epinephrine intraperitoneally after induction. The CODA® noninvasive blood pressure device was used to measure the animals' final blood pressure. The systolic and diastolic blood pressures of all animal test groups at T60 differed significantly from the initial blood pressure (T0), $p < 0.05$ thus confirming its antihypertensive activity.[27]

Furthermore, another study showed that *Sonchus arvenis* aqueous extracts exerted cardioprotective effects against TNF-alpha due rich presence of flavonoids in this extract.[1] Moreover, A 14-day study on Isoproterenol (ISO)-induced Myocardial Infarction

Table 1: Main Flavonoids isolated from the genus Sonchus.

Name	*Ferula* species (Part used)	Structure	References
Apigenin	*Sonchus brachyotus* (aerial & root extracts)		[11]
Luteolin	*Sonchus brachyotus* (aerial & root extracts)		[11]
Luteolin-7-O-β-D-glucoside	*Sonchus brachyotus* (aerial & root extracts)		[11]
	Sonchus brachyotus (aerial & root extracts)		[11]
Quercetin	*Sonchus brachyotus* (aerial & root extracts)		[11]
Rutin	Sonchus oleraceus (aerial & root extracts)		[12,13]
Catechin	Sonchus oleraceus (aerial & root extracts)		[12]
Myricetin	Sonchus oleraceus (aerial & root extracts)		[12,13]
Orientin	Sonchus arvensis (aerial & root extracts)		[13,14]
Quercetin acetylglycoside	Sonchus oleraceus (aerial & root extracts)		[15]

Name	*Ferula* species (Part used)	Structure	References
kaempferol	Sonchus arvensis (aerial & root extracts)		[13,14]
Crepidiaside	Sonchus oleraceus (aerial & root extracts		[15]
Isorhamnetin diglucoside	Sonchus oleraceus (aerial & root extracts		[15]

(MI) in Wistar rats and the survival of starved cardiomyocytes have both shown this effect.[28]

Antimicrobial effect

Most Sonchus species exerted antimicrobial activity, such as antibacterial, antifungal, and antiviral activities, etc. This genus's rich phytochemical profile, which includes bioactive substances like flavonoids, and terpenoids, is largely responsible for the plants' antimicrobial potential. The antioxidant and antimicrobial properties of phenolic, tannins and flavonoid compounds as secondary metabolites are particularly well-known.[29]

The antibacterial activity of *Sonchus asper* crude extracts against multidrug resistant bacteria pathogens, such as Gram-positive bacteria *Staphylococcus aureus* and *Bacillus subtilis* subsp. *B. spizizinii*, and Gram-negative bacteria *Escherichia coli* and *Pseudomonas aureginosa*, was investigated in a 2021 study by Rizwana *et al*. Maximum antibacterial activity against *S. aureus* was demonstrated by the methanolic extract of *S. asper*; zones of inhibition for *B. subtilis* subsp. *B. spizizinii, E. coli*, and *P. aureginosa* were also notable.[30]

In 2011, a study carried out IN China on six *Sonchus* species (*Sonchus oleraceus* L., *Sonchus arvensis* L., *Sonchus asper* (L.) Hill., *Sonchus uliginosus* M.B., *Sonchus brachyotus* DC. and *Sonchus lingianus* Shih) showed that, *S. Arvensis* extract demonstrated the greatest capacity to scavenge radicals and inhibit lipid peroxidation. Additionally, it demonstrated the highest reducing power at 500 µg mL^{-1}. The antibacterial test results showed that the *S. oleraceus* extract was more active against Gram-positive bacteria (*Staphylococcus aureus*) and Gram-negative bacteria (*Escherichia coli, Salmonella enterica*, and *Vibrio parahaemolyticus*) than the other five *Sonchus* wild vegetable extracts. These findings suggest that *Sonchus* food plants may have applications in both natural medicine and nutritious food.[31]

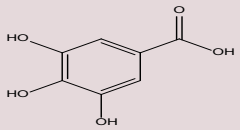
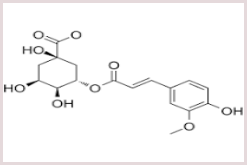
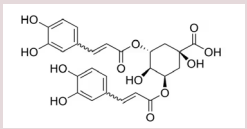
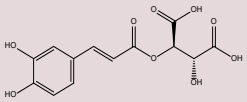
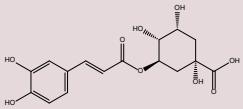
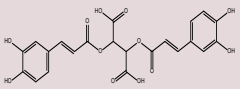
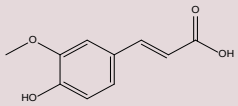
Anticancer effect

In Chinese folklore, *Sonchus oleraceus* (L.) has been used to treat tumors and numerous other ailments. According to a study by Ting *et al*., aqueous extracts of *SO* inhibit HepG-2 and K562 cells by reducing cell viability and triggering apoptosis by up-regulating the expression of genes linked to apoptosis.[32]

Another study showed the cytotoxic effect of Essential Oils (EO) on the aerial parts of *S. oleraceus* against the cell growth of HepG2 cell lines, demonstrating that the cell viability of the cell lines was highest at a higher concentration of EO (100.0 µg/mL). In comparison to the reference medication, doxorubicin, which has an IC_{50} of 0.23 ± 0.01, the results showed that this oil has moderate cytotoxic potency, with an IC_{50} of 136.02 µg/mL.[33] Additionally, another study showed that *SO* ethanol extracts had the strongest inhibitory effect on the growth of stomach cancer cells *in vitro*.[34]

Additionally, a 2010 study by Zghair *et al*., examined the impact of *Sonchus oleraceus* crude extracts on cancer cell growth in vitro using rat embryogenic fibroblast as a normal cell line, laryngeal carcinoma, and murine mammary adenocarcinoma cell lines. After 48 hr, ethanolic extract at higher concentrations had the

Table 2: Main Hydroxycinnamic acids isolated from the genus Sonchus.

Name	Ferula species (Part used)	Structure	References
Gallic acid	Sonchus oleraceus (aerial & root extracts)		[16]
3-O-feruloylquinic acid	*Sonchus palustris* L. (aerial & root extracts)		[17]
3,5-di-O-caffeoylquinic acid	*Sonchus palustris* L. (aerial & root extracts)		[17]
Caftaric acid	*Sonchus oleraceus* L (aerial parts)		[18]
Chlorogenic acid	*Sonchus oleraceus* L (leaf extracts)		[19]
Chicoric acid	Sonchus asper (leaf extracts)		[20]
Ferulic acid	Sonchus arvensis (aerial parts)		[21]

greatest impact. In contrast, the cytotoxic effects of both hot and cold aqueous extracts on AMN-3 and Hep-2 cell lines showed that the higher concentrations significantly (p<0.05) inhibited the growth rate of cells at 24 hr.[35]

All of these studies contribute to *Sonchus*'s future development as an anti-cancer medication.

Wound Healing Effect

Sonchus species are useful in both conventional and contemporary treatments for skin regeneration and vitiligo treatment because they exhibit strong potential for wound healing and skin repair.[36] According to several studies, the flavonoids found in the majority of plants have healing properties that stimulate fibroblast growth and collagen synthesis.[37]

In 2018, Nonato *et al.* conducted a study on Wistar rats by making wounds on their backs and using *Sonchus oleraceus* ointment every day for wound measurement and clinical evaluation. A biopsy was carried out for histopathological examination and type I and III collagen fibre measurement after 15 days. Rats treated with an ointment containing showed improved tissue retraction, and after ten days of treatment, complete retraction was seen.[38]

DISCUSSION

Plants are rich in phytochemicals that have a range of biological effects.[39] Many secondary metabolites, such as flavonoids, which are believed to be the primary antioxidants in natural products and have a range of important physiological effects on both humans and animals, are associated with their functional properties. Unique biological properties, like anti-inflammatory, antihypertensive and anti-cancer effects, have been assigned to this chemical group.[24-29] Furthermore, the primary subjects of this literature review are pharmacology and biological

components revealing that the anti-inflammatory, antibacterial, anti-cancer and anti-oxidant activity of different species mainly *S. arvensis*, and *S. oleraceus* due to their high contents in flavonoids like luteolin, quercetin and apigenin, playing an important role as free radical scavengers and thus treating heart, cancer and several skin problems.[39]

Furthermore, compared to *Sonchus asper*, which showed a significant antibacterial effect against both types of bacteria, *S. oleraceus* extract was more effective against Gram-positive bacteria like Staphylococcus aureus and Gram-negative bacteria like Escherichia coli and Salmonella enteric. Additionally, *Sonchus oleraceus* demonstrated a significant anti-cancer effect, as was previously mentioned. All of these results point to potential uses for *Sonchus* food plants in both natural medicine and wholesome food.[31]

Based on the promising results collected in this manuscript, we recommend further researches and clinical studies to be carried out on the extracts of plants of this genus for the extraction and identification of further molecules especially the flavonoids in order to investigate further biological activities. Finally, in order to support clinical applications and safety, preclinical and clinical research will be suggested.

CONCLUSION

The objective of this paper is to show the medicinal importance of several species of the genus *Sonchus* as a curative agent as it possesses several biological activities due to the presence of various bioactive compounds, mainly flavonoids as revealed in numerous studies. In addition, this study suggests that *Sonchus* species may be used as a supportive therapy to treat cancer, skin diseases and other illnesses. Moreover, we recommend further researches and clinical studies to be carried out on the extracts of plants of this genus for the extraction and identification of further molecules especially the flavonoidal ones in order to investigate further biological activities which will be helpful for use in industrial pharmacy in the future.

ACKNOWLEDGEMENT

None.

ABBREVIATIONS

DPPH: 2,2-diphenyl-1-picrylhydrazyl; **TNF-alpha:** Tumor Necrosis Factor-alpha; **ISO:** Isoproterenol; **MI:** Myocardial Infarction; **EO:** Essential Oils; **IC_{50}:** Half-maximal Inhibitory Concentration.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

AUTHOR'S CONTRIBUTIONS

The authors confirm their contribution to the paper as follows: RB, AWA, AFH, AN, MG, AS, FN, RH, and MAE were remarkably involved in the work reported. They provided concept and design, data collection, and analysis. They were also involved in drafting and evaluating the manuscript. All supervised and granted the final acceptance of the manuscript before it was published.

USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY

The authors state that they have not utilized Artificial Intelligence (AI) tools for writing and editing of the manuscript, and no pictures were modified using AI.

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Cite this article: Boukhary RE, Assi AW, Hachichou AF, Nagar AE, Ghalayini M, Saab A, *et al*. Phytochemical and Medicinal Potential of Genus Sonchus: A Review Article. Pharmacog Rev. 2026;20(39):91-7.