International Journal of Chemical and Biochemical Sciences
(ISSN 2226-9614)

Journal Home page: www.iscientific.org/Journal.html



# Spiny sowthistle facts and health benefits: A review

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## Abstract

Spiny sowthistle (*Sonchus asper* L.*)* is an annual herb belonging to the Asteraceae family. It has been cultivated throughout the world and used for thousands of years for food flavoring, essential oil application and in traditional medicine. Mostly dhodak contain alkaloids, saponins, flavonoids, phenols, saponins, and tannis. The extent of each of these chemical constitute varies depending upon the type of species or cultivars as well as cultivation conditions such as soil type, weather, irrigation, pruning, and other horticulture practices. Spiny sowthistle is an essential component of several industrial applications that range from food to cosmetics and pharmaceutical products. More uses and applications of dhodak byproducts are continuously added. Further research on maximizing yield per hectare; optimum preservation and oil extraction methods are needed.; especially indeveloping countries where the methods of harvesting are traditional.

**Key words:** Asteraceae, Silymarin, Antifungal, Carbohydrate, Dhodak

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## 1. Introduction

Spiny sowthistle (*Sonchus asper L.*) is an annual herb belonging to the Asteraceae family. The plant *Sonchus asper* has been used for the cure of skin ailments and many other disease conditions [1]. The genus Sonchus alliance contains 19 species and varieties native to the tropical regions of Europe, North Africa, and western Asia. The uncertainty in the exact number of species within the genus is largely attributed to the great variability among the constituent species. Variability is prevalent in morphology, growth, habit, flower, color, leaves, stems and chemical composition. *Sonchus asper* flowers are insect pollinated by solitary bees and fly species. Flowers are also self-compatible and seeds are produced through self-pollination easily, the resulting diversity and variation has led some authors to classify portions of genus [2]. *Sonchus asper* is known by different names depending where you are in the world. In English, it is typically called Spiny sowthistle. In Spanish, it is called Cerraja. In French, it is called Laiteron rude. In India, specifically in Hindi it is called Dudhi. In Pakistan in Urdu it is known as Dhodhakhari (Goudy *et al.*, 2001). Probably the most familiar specie is Spiny sowthistle (*S. asper*), however this had a wide range of varieties and cultivars, varying in flavors and uses.

## 2. History/origin

Spiny sowthistle is native to North Africa, Europe and West Asia. The plant has been introduced to East Asia, North America, South Africa, South America, New Zealand and Australia. There are a number of suggested origins for the word prickly sow thistle. It comes from the Greek word [1].

## 3. Demography/Location

*S. asper* (SA) can be grown in a variety of climatic and environmental conditions but the countries having warm climate are considered to have optimum conditions for the best growth of *S. asper*. However, it can be grown in an area having semi shade or no shade. For the cultivation of spiny sowthistle, the prime ecological requirements are warmth, light and loamy soil. There re number of countries where spiny sowthistle is grown widely such as Germany, France, Italy, Poland, Belgium, Greece, Austria, Pakistan, Iran, India, Afghanistan, Australia, South Africa, New Zealand and some parts of America.

## 4. Botany, Morphology, Ecology

Spiny sowthistle is an annual to perennial, branched, undershrub to herb of about 30 cm to 120 cm height, minutely stellate and tomentose branches. Roots are tapering, fleshy, whitish brown. Leaves are ovate and flowers are green in color. Height of dhodak plant is 0.50m

[3]. Spiny sowthistle can grow in most soil conditions, including clay and loamy or sandy soils. It grows best on well-drained, nutrient-rich soils with pH levels between 6.5 and 9. It grows well during temperate summers or tropic winters.

**5. Chemistry**

It was observed that *S. asper* have appreciable amount of fiber, proteins, carbohydrates, fat, polyphenols, mineral elements, polyphenols and generally toxicants in low level. *S. asper* is a good vitamins source including niacin, ascorbic acid, thiamine and riboflavin. Vitamin C is an effective antioxidant. Even small amount of vitamin C is very effective in protecting indispensable molecules of body like carbohydrates, proteins, nucleic acid and lipids from the damage cause by the free radicals as well as reactive species.

***5.1. Chemical composition***

Bioactive constituents present in *S. asper* are alkaloids, saponins, flavonoids, phenols and tannins [4]. *Sonchus asper* plant is quite rich in Vitamin C, Omega-3 Fatty Acids, Fiber, Calcium, Manganese, Zinc, Iron and Copper. Furthermore, it also contains leutiolin, luteolin-7-O-β-D-glucoside, apigenin-7-O-β-D-glucopyranuronide, apigenin-7-O-β-D-glucuronide methyl ester, germanicyl acetate and apigenin-7-O-β-D-glucuronide ethyl ester. However, composition varies with different season [5].

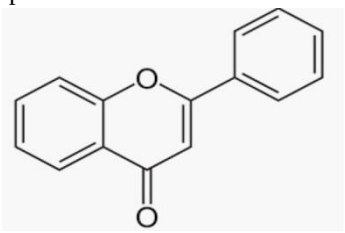


Fig.1. Structure of Flavanoids

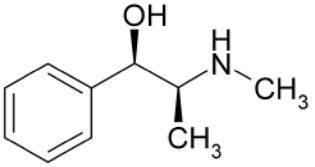


Fig.2. Structure of Alkaloids

**6. Postharvest Technology**

The roots of this plant are cut transversely into small pieces having size of 7-10 cm. After that, roots are grinded as per demand in the market. Both berries and leaves are hand plucked and crushed separately in order to take out the seeds.

**7. Processing**

*Sonchus asper* is traditionally used to treat numerous ailments related with kidney, lungs and liver [2]. After harvesting, the whole plant is air-dried for about 10 days and grinded, in order to get powder form which is either directly uses or in the form of extract in various applications. Furthermore, bioactive components present in it can also be isolated by using appropriate method for their use in pharmaceutical products.

**8. Value addition**

Its wood use as ornamental purposes however, some woods are valued for its building and other fireworks. On an average from one hectare crop under commercial cultivation approximately 6 to 8 quintals of dried roots and 50 to 75 kg seeds can be obtained.

**9. Uses**

It is traditionally used in Ayurveda for feeling stressed-out, emotional instability, and memory enhancement. It has the dual action of energizing while calming. Extract of this plant is applied to the wounds as well as boils. The roots and leaves a of *S. asper* are used in indigestion and also as a febrifuge. However, its roots also act as vermifuge. Stems of this plant are given as sedative and tonic [4].

***9.1. General Uses***

SA is a good source of various vitamins such as riboflavin, ascorbic acid, niacin and thiamine. However, ascorbic acid (Vitamin C) is present in higher amount as compare to others. It is an highly effective antioxidant and even in very small amounts it can protect vital molecules in body like lipids (fats), nucleic acids (RNA and DNA) carbohydrates and proteins from damage by the reactive species as well as free radicals. Traditionally it was used in Ayurveda for emotional instability, memory enhancement and feeling stressed-out. Genus *Sonchus* shown a marked reduction in its relative growth rate at elevated levels of ozone [4]. The extract obtained from SA is used to treat wounds and boils. The roots and leaves of SA are used for the treatment of indigestion and as a febrifuge while its latex is used to treat eye diseases. However, its stems are used as a sedative and tonic [4]. Furthermore, SA is also used in controlling depression, anxiety, phobias, schizophrenia and alcoholic paranoia etc. The active chemical constituents present in the SA plant which are responsible for pharmacological action are alkaloids and steroidal lactones [6-7]. The plant SA has been used to treat skin ailments as well as many other diseases.

***9.2. Pharmacological uses***

Various pharmacological activities on genus *Sonchus* have been reported [4]. Leaves as well as seeds of SA plant have medicinal properties and hence, are used in preparation of numerous drugs. Tissues are used for Debility, emaciation, low body weight, deficient haemoglobin, post convalescent weakness, anaemia, and athletic exertion and also with caution in pregnancy. SA plant is used treat various human disorder like wounds, diabetis, burns, asthma, liver disorders, cough, bronchitis, inflammation, gastrointestinal infection, cardiac dysfunction, cancer, jaundice, kidney disorder and reproductive disorder [1]. The SA plant has great potential to be used as a medicine against free-radical-associated oxidative damage [2].

***9.2.1. Antifungal assay***

Sabouraud dextrose agar (MERCK) was used by some researchers to grow fungus and various samples for antifungal assay were prepared. Prepared cultures were examined during incubation twice weekly and their % inhibition was calculated by using following formula; Percentage inhibition of fungal growth = [(100 - linear growth in test in mm) / (linear growth in control in mm)] × 100. It was found that SA plant exhibits good antifungal activities. [8].

***9.2.2. Hepatoprotective activity***

It was observed by some researchers that the methanolic extract of SA and silymarin administration considerably lowered the $CCl_4$ induced serum levels of various hepatic marker enzymes (transferase, aminotransferase, aspartate amino, lactate dehydrogenate, alanine), low-density lipoprotein, cholesterol and triglycerides with the elevation of levels of high-density lipoprotein. Furthermore, it was noted that hepatic contents of the glutathione and activities of superoxide dismutase, catalyses, glutathione reductase, glutathione S-transferase and glutathione peroxides were reduced. The thiobarbituric acid-reactive substances levels that were increased by $CCl_4$ (carbon tetrachloride) were brought back to control levels with the help of silymarin and methanolic extract of SA. Liver histopathology had shown that methanolic extract of SA also reduces the incidence of hepatic lesions induced by $CCl_4$ in rats [9].

***9.2.3. Immunity and anti-inflamatory effect***

SA plant is frequently used in painful or swollen arthritic conditions as a anti-inflammatory agent and painkiller. It has capability to strengthen the weakened immune system and also to protect it from becoming depleted because of various immunosuppressive drugs. It seems to have both immunotonic as well as immunosuppressive abilities and is therefore true adaptogen. This plant show good anti-inflammatory activities due the presence of various flavonoids. Polyphenolic compounds have various properties, like inhibition of hydrolytic enzyme, inhibition of oxidative enzymes, free radical scavenging, and ant-inflammatory action [4]. Sesquiterpene and lactones were isolated by some researchers from both aerial parts and roots. Several of these were proved to be effective against *Plasmodium falciparum*, fungi and inflammations.

***9.2.4. Antibacterial Activity***

In developing countries, deaths are occurred because of infectious microbes. These microbes not only causing diseases but also cause problem in food preservation at large scale [11-12]. However, various chemicals can be used to preserve food but these are proved to be hazardous to health. That is why, there is a need to adopt method for food preservation which have natural as well as green image. Hence, essential oils extracted from the aromatic plants are used as antibacterial additives. There are some chemicals present in the essential oils which are responsible for the antimicrobial activity [13-14]. Analysis of essential oils is generally carried out by the use of GC-MS analysis [13-15;16]. Various antimicrobial compounds produced by the plants are proved to be affective against both plant as well as human pathogenic microorganisms. These antimicrobial agents have been used extensively in order to inhibit the growth of food borne bacteria and also to increase the shelf life of processed food [8].

SA is used for the treatment of various diseases all over the world. In a study, phytotoxic effects as well as antimicrobial activity of various fractions of SA plant were investigated by some researchers. Six different bacteria (*Bacillus subtitles, Escherichia coli, Micrococcus lutes, Staphylococcus aureus, Pseudomonas aeruginosa and Klebsiella pneumoniae*) were used in order to find out antibacterial action of SA plant. For phytotoxic screening, radish root inhibition assay was used. Methanolic fraction of SA plant had shown the best activities in all of assays. This was due to the presence of bioactive saponins, flavonoids, and phenolic compounds. Furthermore, aqueous as well as methanolic extract of SA plant was investigated against bacterial pathogens (Gram positive and gram negative bacteria). It was found that SA plant extracts showed more inhibitory results against Gram positive bacteria as compare to that of Gram negative bacteria [1].

***9.2.5. Antioxidant Activity***

Various plants are used in medicine due the due to its antioxidant properties [10]. Antioxidant properties of plant are due to the presence of phenolic or flavonoid components [10]. SA plant may show antioxidant activities because of the presence of various flavonoids contents. However phenolic compounds are good antioxidant agents, which act as terminators of free radical. At present, there are various synthetic antioxidant agents are available but there is a great interest of finding out natural antioxidant agents in order to avoid health hazards [4]. From the analysis it was found that SA plant has various antioxidant compounds like catechin, carotenoids and many other phenolic compounds [2].

***9.2.6. Phytotoxicity bioassay***

Phytotoxicity bioassay for SA plant was performed by researchers. Various fractions of SA plant were incorporated at different concentrations (100, 1000 g/mL) in respective solvents in replicates. Seeds of radish were washed with the help of distilled water and then with the 1% mercuric chloride. After that, filter paper was put in each autoclaved petri plates and poured 5ml of each fraction in each petri plate. And then it was allowed the respective solvent to be evaporated. 10 seeds were placed in these petri plates and incubated in growth room for 5 days. It was noted that after 3 days, shoot and root growth was inhibited. [8].

***10. Summary***

Spiny sowthistle (*Sonchus asper* L.*)* is an annual herb belonging to the Asteraceae family. It has been cultivated throughout the world and used for thousands of years for food flavoring, essential oil application and in traditional medicine. Mostly dhodak contain alkaloids, saponins, flavonoids, phenols, saponins, tannis. The extent of each of these chemical constitute varies depending upon the type of species or cultivars as well as cultivation conditions such as soil type, weather, irrigation, pruning, and other horticulture practices. Spiny sowthistle is an essential component of several industrial applications that range from food to cosmetics to pharmaceutical products. More uses and applications of dhodak by-products are continousily added. Further research on maximizing yield per hectare and optimum preservation and oil extraction methods are needed, particularly in the developing world where dhodak leaf and flowers harvesting and post-harvest processing methods are traditional.

**References**


[1] H. Upadhyay, A. Kumar, M. Gupta, A. Sharma, A. Rahal. (2013). Validation of medicinal values of traditionally used Sonchus asper (prickly sow thistle) leaves for the treatment of skin ailments. Advancement in Medicinal Plant Research. 1(3): 29-35.

[2] R.A. Khan, M.R. Khan, S. Sahreen, M. Ahmed. (2012). Evaluation of phenolic contents and antioxidant activity of various solvent extracts of Sonchus asper (L.) Hill. Chemistry Central Journal. 6(1): 12.

[3] R.A. Khan, M.R. Khan, S. Sahreen, M. Ahmed. (2012). Evaluation of phenolic contents and antioxidant activity of various solvent extracts of Sonchus asper (L.) Hill. Chemistry Central Journal. 6(1): 1.

[4] J. Hussain, Z. Muhammad, R. Ullah, F.U. Khan, I. Ullah, N. Khan, J. Ali, S. Jan. (2010). Evaluation of the chemical composition of Sonchus eruca and Sonchus asper. J. Am. Sci. 6(9): 231-235.

[5] A.Y. Al-Maskri, M.A. Hanif, M.Y. Al-Maskari, A.S. Abraham, J.N. Al-sabahi, O. Al-Mantheri. (2011). Essential oil from Ocimum basilicum (Omani Basil): a desert crop. Natural product communications. 6(10): 1934578X1100601020.

[6] I. Ahmad, M.A. Hanif, R. Nadeem, M.S. Jamil, M.S. Zafar. (2008). Nutritive evaluation of medicinal plants being used as condiments in South Asian Region. JOURNAL OF THE CHEMICAL SOCIETY OF PAKISTAN. 30(3): 400-405.

[7] Z. Arshad, M.A. Hanif, R.W.K. Qadri, M.M. Khan. (2014). Role of essential oils in plant diseases protection: a review. International Journal of Chemical and Biochemical Sciences. 6: 11-17.

[8] R.A. Khan, M.R. Khan, S. Sahreen, J. Bokhari. (2010). Antimicrobial and phytotoxic screening of various fractions of Sonchus asper. African Journal of Biotechnology. 9(25): 3883-3887.

[9] R.A. Khan, M.R. Khan, S. Sahreen, N.A. Shah. (2012). Hepatoprotective activity of Sonchus asper against carbon tetrachloride-induced injuries in male rats: a randomized controlled trial. BMC complementary and alternative medicine. 12(1): 90.

[10] M.M. Khan, M. Iqbal, M.A. Hanif, M.S. Mahmood, S.A. Naqvi, M. Shahid, M.J. Jaskani. (2012). Antioxidant and antipathogenic activities of citrus peel oils. Journal of Essential Oil Bearing Plants. 15(6): 972-979.

[11] H.A. Abdulmumeen, A.N. Risikat, A.R. Sururah. (2012). Food: Its preservatives, additives and applications. International Journal of Chemical and Biochemical Sciences. 1(2012): 36-47.

[12] S. Ganguly, S.K. Mukhopadhayay, S. Biswas. (2012). Preservation of food items by irradiation process. International Journal of Chemical and Biochemical Sciences. 1(2012): 11-13.

[13] M.A. Hanif, M.Y. Al-Maskari, A. Al-Maskari, A. Al-Shukaili, A.Y. Al-Maskari, J.N. Al-Sabahi. (2011). Essential oil composition, antimicrobial and antioxidant activities of unexplored Omani basil. Journal of Medicinal Plants Research. 5(5): 751-757.

[14] M.A. Hanif, H.N. Bhatti, M.S. Jamil, R.S. Anjum, A. Jamil, M.M. Khan. (2010). Antibacterial and antifungal activities of essential oils extracted from medicinal plants using CO2 supercritical fluid extraction technology. Asian journal of chemistry. 22(10): 7787.

[15] M.A. Hanif, A.Y. Al-Maskri, Z.M.H. Al-Mahruqi, J.N. Al-Sabahi, A. Al-Azkawi, M.Y. Al-Maskari. (2011). Analytical evaluation of three wild growing Omani medicinal plants. Natural product communications. 6(10): 1934578X1100601010.

[16] I. Shahzadi, R. Nadeem, M.A. Hanif, S. Mumtaz, M.I. Jilani, S. Nisar. Chemistry and biosynthesis pathways of plant oleoresins: Important drug sources.