



## Phytochemistry and Pharmacological Effects of Plants in Genus *Sonchus* (Asteraceae)

Heba Fouad, Eman S. Habib, Safwat A. Ahmed\*

Pharmacognosy Department, Faculty of Pharmacy, Suez Canal University, Ismailia, Egypt

### Abstract

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Correspondence Author:

Tel: + 01092638387

E-mail address:

safwat\_aa@yahoo.com

Medicinal plants have been used since ancient times for treatment of various diseases. Many of the drugs available on the market today originated either directly or indirectly from bioactive compounds isolated from plants. Family Asteraceae is one of the largest families of flowering plants, comprising 1600 genera and almost 30000 species worldwide (Bisht et al., 2010). The genus *Sonchus* is a genus of flowering plants in the dandelion tribe of the Asteraceae Family. It consists mostly of annual herbs, but a few are perennial or woody herbs. Annual herbs, known as sow thistles, were used as food stock for animals, particularly for rabbits. They are also edible to humans as a leafy vegetable. In Chinese folk medicine, sow thistles have been used for the treatment of fever, inflammation, for detoxication and improvement of blood circulation. Recent advances in the ethnomedicinal, phytochemical, and pharmacological studies of this genus are reviewed in this paper (Muhammed et al., 2012). Results showed that secondary metabolites isolated and identified from genus *Sonchus* were mainly terpenes, sterols, flavonoids, and coumarins. In vivo and in vitro pharmacological studies have shown that plants belonging to this genus exhibit various biological activities, including antioxidant, anti-inflammatory, antibacterial, antidepressant, anxiolytic, and anti-tumor activities (Jain et al., 2014). Further attention should be given to the study of species belonging to genus *Sonchus* especially regarding toxicological effects. Further research on *Sonchus* plants should be conducted using bioactivity-guided isolation strategies to isolate and identify the bioactive metabolites in this genus.

**Keywords:** *Sonchus*, secondary metabolites, Asteraceae.

## 1. Introduction

Since ancient times, people have turned to natural sources, mainly plants, for production of foods, clothing, fragrances, flavors and medicines (Gurib-Fakim, 2006). In recent years, a renewed interest in obtaining biologically active compounds from natural sources has been observed. Reasons for this worldwide attention towards formulations based on natural products include their low toxicity, their complete biodegradability, their availability

from renewable sources, and in most cases, their low cost compared to synthetic compounds. Phytochemical investigation of plants has led to the discovery of novel secondary metabolites, which were used as leads for therapeutic agents (Savithamma et al., 2011). Family Asteraceae, previously known as Compositae, is also known as the daisy family, sunflower family or thistle family. It is one of the largest families of flowering plants,

including almost 30000 species and 1600 - 1700 genera worldwide, and inhabits almost every environment. The name Asteraceae comes from the term Aster meaning star and refers to the characteristic flower heads composed of many small flowers, called florets, surrounded by bracts. Asteraceae plants are most common in the moderate regions and hot mountains. **(Bisht et al., 2010)**.

The genus *Sonchus* is a genus of the Asteraceae Family that belongs to the dandelion tribe. It consists mostly of annual herbs, but a few are perennial or woody herbs, such as subgenus *Dendrosonchus* which grows in the Canary Islands. Annual herbs in the genus are known as sow thistles, because they were fed to lactating sows and believed to increase milk production. They are characterized by soft, irregularly lobed leaves that clasp the stem and sometimes form a basal rosette. The stem can range from 30 cm to 2 m (1 to 6 feet) in height and contains a milky latex. Flower heads are yellow, half to one inch in diameter; the florets are all of ray type. Sow thistles are common roadside plants that are native to Eurasia and tropical Africa, but they are found almost worldwide in temperate regions. Sow thistles are

considered noxious weeds, as they grow quickly and spread rapidly in a wide range of conditions.

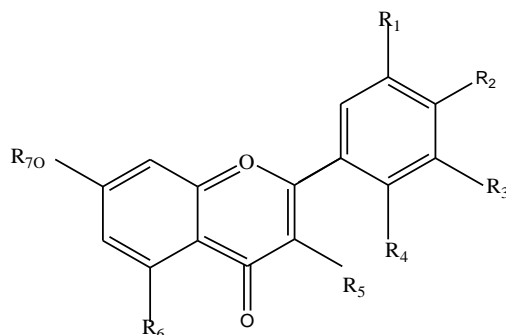
Sow thistles have been used as food for livestock, hence sometimes known by the common name "hare thistle" or "hare lettuce". They are also edible to humans as leafy vegetables, commonly consumed in Mediterranean countries. It is very important in the diets of urban people and provides a relatively inexpensive vegetable to the society **(Vilala, 2009)**. In China, sow thistles have been used in folk medicine for the treatment of fever, inflammation, for detoxication and improvement of blood circulation **(Muhammad et al., 2012)**. Phytochemical investigation of plants belonging to genus *Sonchus* has showed that they contain several classes of secondary metabolites, including terpenes, sterols, flavonoids, and coumarins. Pharmacological studies conducted on the plant extracts and isolated compounds have shown that the plant has various medicinal uses including antioxidant, anti-inflammatory, antitumor, antibacterial, antidepressant, emollient, blood purifying and liver tonic activities **(Jain et al., 2014)**.



**Fig. (1): *Sonchus oleraceus* herb.**

## 2. Chemical constituents reported from some species of genus *Sonchus*:

### 2.1 Flavonoids:

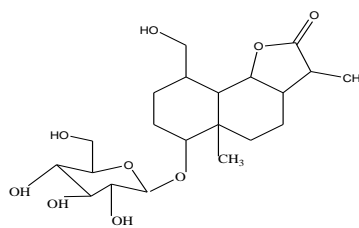


Species	Name	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	R <sub>4</sub>	R <sub>5</sub>	R <sub>6</sub>	R <sub>7</sub>	Reference
<i>S.oleraceus</i>	Luteolin	OH	OH	H	H	H	OH	OH	(Bondarenko et al.,1973)
<i>S.oleraceus</i>	Luteolin-7- <i>O</i> -glucoside	OH	OH	H	H	H	OH	<i>O</i> -Gluc.	(Bondarenko et al.,1973)
<i>S.arvensis</i>	Isocinaroside	OH	OH	H	H	H	H	<i>O</i> -Gluc.	(Bondarenko et al.,1974)
<i>S. arvensis</i>	Linarin	H	OCH <sub>3</sub>	H	H	H	H	<i>O</i> -Rutinoside	(Bondarenko et al.,1975)
<i>S.arvensis</i>	Isorhamnetin	OH	OCH <sub>3</sub>	H	H	OH	OH	OH	(Bondarenko et al.,1976)
<i>S.arvensis</i>	Quercetin	OH	OH	H	H	OH	OH	OH	(Bondarenko et al.,1976)
<i>S.arvensis</i>	Soncoside	OH	OH	H	OH	H	OH	<i>O</i> -Gluc	(Bondarenko et al.,1978)
<i>S.arvensis</i>	Apigenin	H	OH	H	H	H	OH	OH	(Qu Guirong et al.,1993)
<i>S.oleraceus</i> <i>S.asper</i> <i>S.maritimus</i>	Apigenin-7-glucoside	H	OH	H	H	H	OH	<i>O</i> -Glu	(Giner et al.,1993)

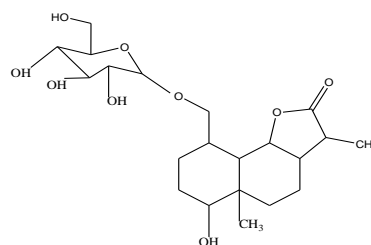
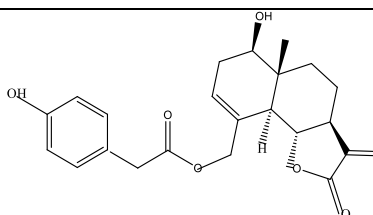
2.2. Terpenoids:

Plant species	Compound name	Compound structure	Reference
	15-hydroxy-4- $\beta$ ,15-dihydroreynosin		
<i>S. macrocarpus</i>	sonchucarpolide		(Mahmoud et al.,1984)
	15-hydroxy-4 $\beta$ ,15,11 $\beta$ ,13-tetrahydroreynosin		
	Sonchuside E		
<i>S. asper</i>	Sonchuside H		(Shimizu et al.,1989)
	Sonchuside G		

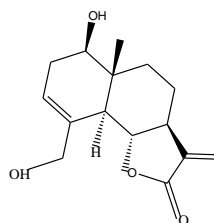
Sonchuside F



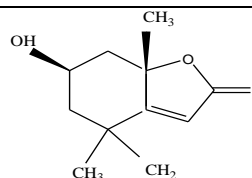
Sonchuside I

(1 $\beta$ ,6 $\alpha$ )-1,6-dihydroxy-14-O-  
[(4hydroxyphenyl)acetyl]eudesma-  
3,11(13)-dien-12-oic acid  $\gamma$ -  
lactone*S. uliginosus*

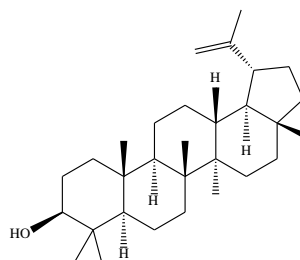
(Zhang et al., 2006)

(1 $\beta$ ,6 $\alpha$ )-1,6,14-  
trihydroxyeudesma-3,11(13)-dien-  
12-oic acid  $\gamma$ -lactone

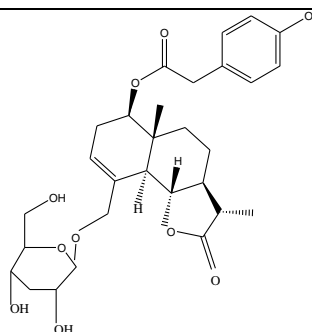
loliolide

*S. oleraceus*

lupeol

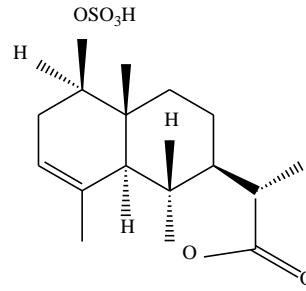


(Saad.E., 2009)

1 $\beta$ -(p-hydroxyphenylacetyl)-15-  
O $\beta$ -D-glucopyranosyl-5 $\alpha$ ,6Bh-  
eudesma-3-en-12,6 $\alpha$ -olide*S. arvensis*

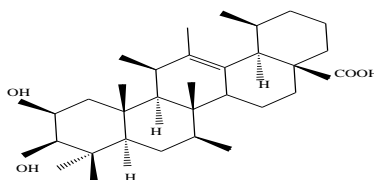
(Xia et al., 2010)

1 $\beta$ -sulfate-5 $\alpha$ ,6 $\beta$ H-eudesma-3-en-12,6 $\alpha$ -olide



2.3. Organic acids:

Plant species	Compound name	Compound structure	References
<i>S.maritimus</i> <i>S.asper</i> <i>S.glaucescens</i> <i>S.oleraceus</i>	Caffeic acid		(Giner et al ., 1993)
<i>S. maritimus</i> <i>S.asper</i> <i>S.glaucescens</i> <i>S.oleraceus</i> <i>S.tenerrimus</i>	Chlorogenic acid		(Giner et al ., 1993)
<i>S. oleraceus</i>	Caftaric acid		(Ou et al .,2012)
<i>S.oleraceus</i>	Chicoric acid		(Ou et al ., 2012)

*S. eruca*Erucaic  
acid(Muhammad  
et al.,2012)

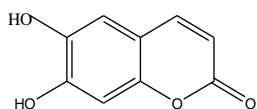
## 2.4. Fatty acids:

Plant species	Compound name	Compound structure	References
	Myristic acid		
<i>S. arvensis</i>	Palmitic acid		(Shukla et al.,2014)
	Linoleic acid		

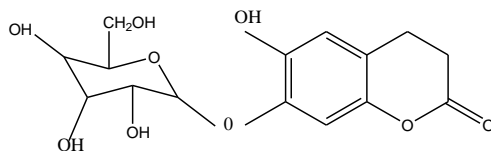
## 2.5 Miscellaneous compounds:

### 2.5.1 Coumarins:

Cichoriin has been detected in *Sonchus asper*, *Sonchus glaucescens* and *Sonchus tenerrimus*. Aesculetin has been detected in *Sonchus asper* and *Sonchus glaucescens*, (Giner et al., 1993).



Cichoriin



Aesculetin

### 2.5.2 Esters

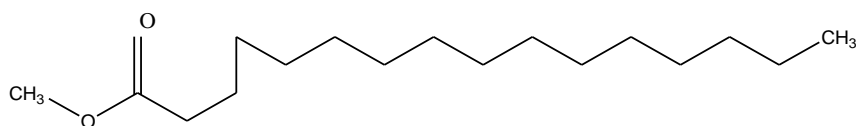
Quinic acid ester was identified from *Sonchus arvensis* (Xu et al., 2008)



3, 4, 5-tri-(p-hydroxyphenylacetyl)

quinic acid methyl ester

Hexadecanoic methyl ester was identified from *Sonchus wightianus* (Joshi et al., 2011).

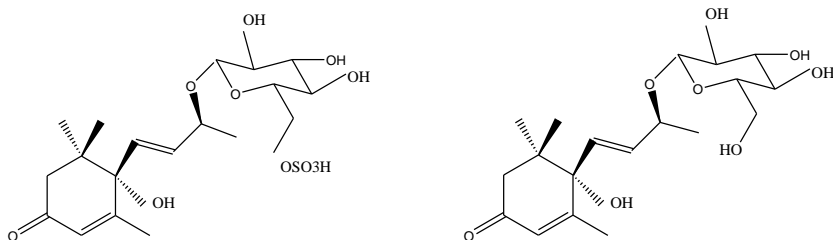


### 2.5.3. Ionone glycosides

These were isolated from *Sonchus erzincanicus*

Corchoionoside C 6'-O-sulfate (Ozgen et al, 2010).

Corchoionoside (Ozgen et al, 2010).



## 3. Biological activities of some species of genus *Sonchus*:

### 3.1 Antioxidant activity:

In a study by Khan et al., *Sonchus asper* extracts exhibited a remarkable capacity to scavenge all the tested reactive species with IC<sub>50</sub> values at the µg/ml level. The methanolic extract showed the best activities in scavenging of superoxide radicals and hydrogen peroxide as well as hydroxyl radicals. In addition, *S.arvensis* extract was found to possess free radical- scavenging properties which might be

due to the presence of polyphenolic constituent (Khan et al., 2012). Using the CAA assay, it was shown that foliar extracts of *Sonchus oleraceus* were effectively absorbed into HepG2 cells, and exerted antioxidant activity at levels comparable to those of extracts from blueberry. (McDowell et al., 2011). Another study that investigated the antioxidant activity of *Sonchus oleraceus* L.in vitro was performed by Yin and his coworkers, and the results suggested that *S. oleraceus* extract could be used as a potential source of natural antioxidants (Yin et al., 2007). *Sonchus arvensis* extract exhibited the highest radical scavenging power and



lipid peroxidation inhibitory power among a number of tested extracts (Xia et al., 2011).

### 3.2 Anti-inflammatory effect:

In a study by Li et al. the extract of *Sonchus oleraceus* had significant anti-inflammatory effects in vivo at the concentration of 250 and 125mg/kg. (Li et al., 2017). In 2010, a study showed that *Sonchus oleraceus* extract exhibited anti-inflammatory effects by reducing paw edema brought by carrageenan. The extract administered at 300 mg/kg had a powerful anti-inflammatory effect compared to indomethacin at a dose of (10 mg/kg) (Vilela et al., 2010).

### 3.3 Anti-nociceptive activity:

The extract of *Sonchus oleraceus* produced significant inhibition of chemical nociception induced by intraperitoneal acetic acid and subplantar formalin. (Vilela et al., 2009).

### 3.4 Anti-Ageing effect:

At a dose of 5 and 20 mg/mL, *S. oleraceus* extracts showed significant reduction of stress-induced premature senescence compared to ascorbic acid treatments, and was recommended for use as an anti-ageing agent (Ou et al., 2015).

### 3.5 Anxiolytic like effect:

The extracts of *Sonchus oleraceus* administered at 30–300 mg/kg, had a similar anxiolytic effect to clonazepam (0.5 mg/kg) (Vilela et al., 2009).

### 3.6 Hepatoprotective activity:

Liver histopathology showed that *Sonchus asper* extract reduced the incidence of hepatic lesions induced by CCl<sub>4</sub> in rats (Khan et al., 2012).

### 3.7 Antidepressant activity:

The active principles present in the extract of *Sonchus oleraceus* had an antidepressant like effect which was found to be comparable to that of amitriptyline. Therefore, the authors concluded that a standardized *S. oleraceus* extract or its pure active constituents could be of possible interest for the treatment of depressive disorders (Vilela et al., 2010).

### 3.8 Antibacterial activity:

Xia et al. investigated the antibacterial activity of six *Sonchus* extracts. *Sonchus oleraceus* extract showed higher antibacterial activity than the other five *Sonchus* extracts (*S. arvensis*, *S. asper*, *S. uliginosus*, *S. brachyotus* and *S. lingianus*), both in Gram-negative bacteria (*Escherichia coli*, *Salmonella enterica* and *Vibrio parahaemolyticus*) and in a Gram-positive bacterium (*Staphylococcus aureus*) (Xia et al., 2011).

### 3.9 Antitumor activity:

Yin et al. reported that hot aqueous extract of *Sonchus oleraceus* had inhibitory effects on the liver cancer cell line HepG-2 and K562 cells by decreasing cell sustainability and prompting apoptosis which could block the tumor cell cycle (Yin et al., 2007). Ibrahim et al. investigated the cytotoxicity of *Sonchus oleraceus* and *S. asper* extracts. *S. oleraceus* showed a moderate inhibition of Hep-G2 and HCT-116 cells, while *S. asper* showed low inhibition against all cells (Hep-G, HCT-116 and MCF-7) (Ibrahim et al., 2015). In 2010, a study was designed to evaluate the cytotoxic effect of the ethanolic, cold aqueous and hot aqueous extracts of *S. oleraceus* on three cancer cell lines (AMN-3), (Hep-2) and (REF) as normal cell line. The cytotoxic effect of both cold and hot aqueous extracts on AMN-3 and Hep-2 cell lines was higher than that of the ethanolic extract (Zghair et al., 2010).

## 4. Conclusion:

The genus *Sonchus* is rich in secondary metabolites that belong to various classes such as flavonoids, terpenes, fatty acids and coumarins. Plants of genus *Sonchus* have various biological activities including antioxidant, anti-inflammatory, antidepressant, anxiolytic and antitumor activities. In this review, we covered the secondary metabolites isolated from plants belonging to the genus *Sonchus*, in addition to the various pharmacological studies on the biological activities of *Sonchus* species.

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