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Original article

Evaluation of anti-ulcer and ulcerative colitis of *Sonchus oleraceus* L

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ABSTRACT

Sonchus oleraceus L. was evaluated for its gastro antiulcerogenic and anti-ulcerative colitis activities Different extracts and fractions from *Sonchus oleraceus* aerial parts and roots were evaluated at different dose; total alcohol extracts of aerial parts SA and roots SR were evaluated doses 250 & 500 mg/kg, While Successive extracts (SAL, SRL, CSA, CSR, BSA & BSR) were evaluated at dose of 150 mg/kg. Absolute ethanol-induced ulcer model was used for evaluation of the anti-ulcerogenic activity. The root extract showed promising antiulcerogenic activity as the total alcohol extract of the root SR (500 mg/kg) produced 88.5% protection from control ulcer which is significantly more effective than the standard drug omeprazole (20 mg/kg), in addition, the butanol fraction of the root extract BSR also produced 76.66% protection from control ulcer. On the other hand, the aerial parts total extract SA showed low antiulcerogenic activity in both tested doses (250 & 500 mg/kg) as it produced 25% & 28.33% protection from control ulcer respectively. Only the butanol fraction of the aerial parts extract BSA showed promising activity 54.16%. In the acetic acid-induced ulcerative colitis model, among the investigated extracts of *Sonchus oleraceus*; only the total extract of the aerial parts (SA) at dose 500 mg/kg showed strong anti-ulcerative colitis activity and this activity is followed by the activity of the butanol and chloroform fractions of the aerial parts, they produced 77.28%, 57.4% & 47.68% protection from control colitis respectively. The standard drug dexamethasone produced 63.36% protection from control colitis. The total alcohol extracts SR & SA showed no alteration on liver and kidney functions and these extracts are safe up to 5000 mg/kg. Phytochemical screening of the investigated extracts revealed the presence of carbohydrates, flavonoids, tannins, unsaturated sterols, proteins and lactones which could be responsible for the activities.

1. Introduction

The Asteraceae (commonly known as sunflower) is a large and widespread family which contain many genera. *Sonchus oleraceus* is a plant belongs to family *asteraceae* which is in use in folklore medicine in treatment of gastrointestinal tract disorder in addition to its used as food in some parts of Asia and Africa (Hussain et al., 2010). Sonchus contains variety of phytochemical compounds such as sesqueterpene lactones of the eudismanolide and guaianolide structures (Elkhayat, 2009) also contain flavonoids, flavonols, proanthocyanidins, total phenols, saponins, phytate and alkaloids (Jimoh et al., 2011). High concentration of fatty acids, vitamin C, carotenoids, oxalic acid, and high mineral contents which gave this plant high value in as nutritional supplements (Guil-Guerrero et al., 1998). Reviewing the literature the plant *S. oleraceus* antioxidant, antidiabetic (Teugwa et al., 2013), Anti-inflammatory, antipyretic (Fabiana et al., 2011), antinociceptive, anxiolytic (Fabiana et al., 2011), cytotoxic, antibacterial (Elkhayat, 2009; Xia et al., 2011).

Although this plant is in use in folklore medicine in treatment of some GIT disorder but no previous studies were carried on its used

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for treatment of peptic ulcer or ulcerative colitis. So the study aimed to investigate its effect on both of those diseases.

2. Material and methods

2.1. Phytochemical studies

2.1.1. Plant material

Sonchus oleraceus L. Aerial parts and roots were collected in May 2016 from Al-Dhelam (south of Riyadh. KSA) Alkharj in Saudi Arabia and identified by Dr. Jacob Thomas, Taxonomist, College of Science, King Saud University. The plant materials of aerial parts and root were separately air dried, grounded to powder, packed and stored in a tightly closed container for further phytochemical and biological studies.

2.1.2. Phytochemical screening

Powdered samples of the aerial parts and roots of *Sonchus oleraceus* were subjected to preliminary phytochemical screening according to the published methods (Awaad et al., 2016).

2.1.3. Extraction

The air dried powdered plant material for both aerial parts and roots were symbolized as SA & SR respectively. Then, 500 g of each powder were separately extracted by percolation in two liters of ethanol (95%) at room temperature for 2 days then the solvents of each part was filtered off using Whitman filter paper, the marks lifted of each part were re-extracted for 4 times by the same way (Awaad et al., 2015). The total alcohol extracts were concentrated separately using rotatory evaporator at low temperature (not exceeded 35 °C).

The total alcohol extracts (SA & SR) were separately dissolved in hot water and filtered off using piece of cotton, the non-filtered parts were symbolized as; SAL & SRL indication for lipoidal matters of aerial parts and root respectively. The aqueous filtered portions were symbolized as; ASA and ARP (for aerial parts and roots respectively).

The aqueous fractions residues (ASA and ARP) were separately extracted successively using chloroform and butanol saturated with water. Each extract was passed over anhydrous sodium sulphate and concentrated using rotatory evaporator at temperature not exceeding 35° to obtained residuals with different weight. The obtained dry chloroform extracts were symbolized as CSA & CSR for aerial parts & roots respectively while the butanol extracts were symbolized as BSA & BSR for aerial parts & roots respectively (Awaad et al., 2016).

2.2. Pharmacological studies

2.2.1. Animals

Swiss albino mice of both sex (26–30 g) and male Wister rats (180–200 g) were housed in standard polypropylene cages with wire mesh top and maintained under standard conditions (temperature 23 ± 1.0 °C, humidity 55 ± 10%, 12 h light/12 h dark cycle). They fed with a standard pellet diet with water ad libitum and were allowed to adapt to the laboratory environment for one week before experimentation.

2.2.2. Preparation of the plant extract

Each dried plant extracts obtained previously from aerial parts and roots of *Sonchus oleraceus* (SA, SR, SAL, SRL, CSA, CSR, BSA & BSR) was freshly suspended in distilled water just before administration (for each experiment) by the aid of few drops of Tween 80.

2.2.3. Acute toxicity (LD_{50}) test

The oral median lethal dose (LD_{50}) of each alcohol extracts of *Sonchus oleraceus* different parts (**SA & SR**) was separately determined at doses up to 5000 mg/kg (Awaad et al., 2016).

2.2.4. Measurement of liver and kidney function markers

Alcohol extracts of *Sonchus oleraceus* different parts (SA & SR) were administered orally daily for 14 consecutive days at a dose of 500 mg/kg to male Wister rats. Liver functions were evaluated by measuring the serum activity of ALT and AST in addition to serum levels of total bilirubin, total proteins and albumin. While serum concentrations of urea and creatinine were determined calorimetrically as measures of kidney functions (El-Meligy et al., 2017).

2.2.5. Effect on peptic ulcer

Absolute ethanol-induced ulcer model was used for evaluation of the anti-ulcerogenic activity according to the method described by Awaad et al. (2016). Groups each of 6 Male Wister rats were used. Treated groups received on of; total alcohol extracts of SA & SR at doses 250 & 500 mg/kg. Successive extracts (SAL, SRL, CSA, CSR, BSA & BSR), at dose of 150 mg/kg. In addition to standard group received Omeprazole (20 mg/kg) and control group received water (5 mL/kg). All treatments were administered orally to all groups. Thirty minutes later, all groups administrated oral absolute ethanol (1 mL/200 g body weight). Then after one hour, all rats were sacrificed by inhalation of an overdose of diethyl ether, the stomachs were rapidly removed, opened along their greater curvature, and gently rinsed under running tap water. Number of ulcer and score were counted and ulcer index and percent protection of control ulcer were calculated according to published method by Awaad et al. (2016).

2.2.6. Effect on ulcerative colitis

Groups each of 6 Male Wister rats were used. Rats of groups 1 and 2 received the vehicle (5 mL/kg) and served as normal control and control colitis groups respectively, third group administered standard drug dexamethasone (0.1 mg/kg) and served as Reference group. Rats of groups 4–10 received 250 & 500 mg/kg of total alcohol extracts from each plant parts (SA, SR) and Successive extracts (SAL, SRL, CSA, CSR, BSA & BSR), at dose of 150 mg/kg. All medications were administered orally, once daily for 5 consecutive days and the first dose was administered 2 h after colitis induction by 2 mL (4%, v/v) acetic acid in saline (El-Meligy et al., 2017). Assessment of colonic lesions, Ulcer area, ulcer index (UI) and curative ratio was determined according to the published methods (El-Meligy et al., 2017).

2.3. Statistical analysis

All values were expressed as mean ± S.D. Comparisons between means were carried out using a one-way ANOVA test followed by the Tukey HSD test using SPSS, version 14 (SPSS, Chicago, IL). Differences at p50.05 were considered statistically significant.

3. Results

3.1. Phytochemical studies

Phytochemical screening of *Sonchus oleraceus* L both parts (SA, SR) showed the presence of the following groups: carbohydrates and/or glycosides, flavonoids, sterols and/or triterpenes, protein and/or amino acids, and tannins and absence of saponin, Anthraquinones, alkaloids, and cardinolides, the investigated parts.

The yields of total alcohol extracts of aerial parts and roots (SA, SR) were, 99.6 g & 45.5 g respectively. The lipoidal matter was of aerial parts and roots (SAL, SRL) provided 15 g & 5.5 g for SAL, SRL respectively; while chloroform extracts CSA, CSR produced 3.9 g & 4.5 g respectively. Butanol BSA & BSR yielded 14.5 & 15.3 g respectively. The presence of variation in phytochemical contents and their yields explain the variation in biological effects of both aerial and root parts.

3.2. Pharmacological activity

The investigated extracts are characterized by a low degree of toxicity. The obtained results showed that different doses of each investigated alcohol extract up to 5000 mg/kg did not produce any symptom of acute toxicity and none of the mice died during 24 h of observation. It was suggested that oral LD_{50} of the tested extracts was higher than 5000 mg/kg and the tested extracts is considered safe (Awaad et al., 2016).

The sub-chronic toxicity also supported the safety of the plant extracts of both aerial parts and roots (SA, SR). The oral dosing (500 mg/kg) administrated to rats for 14 consecutive days, did not alter the liver and kidney functions represented by the levels of ALT, AST, total bilirubin, total proteins, albumin, urea and creatinine as compared to control (Table 1). It means that the investigated extracts are neither hepatotoxic nor nephrotoxic (Rysz et al., 2017).

3.3. Antiulcer activity

Ethanol-induced gastric ulcers have been widely used for the evaluation of gastro protective activity. Ulcers caused by ethanol are due to superficial damage to mucosal cells. The ethanol-induced ulcers are predominant in the glandular part of stomach. In this study; The root extract of *Sonchus oleraceus* showed promising antiulcerogenic activity as the total alcohol extract of the root SR (500 mg/kg) produced 88.5% protection from control ulcer which is significantly more effective than the standard drug omeprazole (20 mg/kg), in addition, the butanol fraction of the root extract also produced 76.66% protection from control ulcer (Table 2). On the other hand, the aerial parts total extract SA showed low antiulcerogenic activity in both tested doses (250 & 500 mg/kg) as it produced 25% & 28.33% protection from control

Table 1
Effect of the total alcohol extracts *Sonchus oleraceus* L. (500 mg/kg) on liver and kidney functions.

Plant part	Parameter						
	ALT (U/L)	AST (U/L)	Total bilirubin (mg/dL)	Total protein (g/dL)	Albumin (g/dL)	Urea (mg/dL)	Creatine (mg/dL)
Control	59.33 ± 1.2	49.40 ± 1.5	1.57 ± 0.1	8.56 ± 0.4	3.9 ± 0.2	36.11 ± 0.1	0.51 ± 0.1
Aerial parts (SA)	61.51 ± 1.1	47.10 ± 1.2	1.60 ± 0.2	7.90 ± 0. 1	3.3 ± 0.1	36.78 ± 0.2	0.52 ± 0.1
Root (SR)	58.10 ± 1.4	48.10 ± 1.1	1.58 ± 0.4	8.25 ± 0.3	3.8 ± 0.4	35.93 ± 0.2	0.49 ± 0.3

Table 2
Effect of different extracts of *Sonchus oleraceus* L parts on absolute ethanol-induced ulcer rats.

Extract		Dose mg/kg	Score	No. of ulcers	Ulcer index	Percent protection
Control			4.50	15.00 ± 0.24	12.00 ± 0.94	0.00
Omeprazole		20	2.50	7.60* ± 0.65	6.50* ± 0.24	45.83
Aerial parts	Total extract	250	3.50	8.80* ± 0.51	9.00 ± 0.41	25.00
	Total extract	500	3.00	8.30* ± 0.35	8.60* ± 0.51	28.33
	Lipoidal matter	150	4.00	9.60 ± 0.95	10.20 ± 0.77	15.00
	Chloroform extract	150	3.00	6.80* ± 1.92	8.50 ± 0.51	28.30
	Butanol extract	150	2.00	4.40* ± 0.55	5.50* ± 0.41	54.16
Roots	Total extract	250	1.80	4.80* ± 0.11	5.20* ± 0.90	56.66
	Total extract	500	1.00	3.50* ± 0.38	1.38* ± 0.58	88.50
	Lipoidal matter	150	3.00	8.60* ± 0.95	9.20 ± 0.77	23.33
	Chloroform extracts	150	2.00	4.80* ± 0.11	5.20* ± 0.90	56.66
	Butanol extract	150	1.50	4.00* ± 0.17	2.80* ± 0.82	76.66

Data are expressed as mean ± SD, n = 6.
* Significantly different from control ulcer at $p < 0.05$.

Table 3
Effect of different extracts of *Sonchus oleraceus* L parts on n the macroscopic parameters of ulcerative colitis induced by acetic acid in rats.

Groups		Dose	Lesion score (0–5)	Ulcer area (mm^2)	Ulcer index	Wet W/L (g/cm)	% protection
Normal control		5 mL/kg	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.38 ± 0.05	–
Control colitis		5 mL/kg	4.50 ± 0.49	29.21 ± 1.22	35.21 ± 1.82	0.95 ± 0. 21	–
Dexamethasone		0.1 mg/kg	1.50* ± 0.25	11.70* ± 1.17	12.90* ±1.03	0.52* ±0.12	63.36
Arial parts	Total extract	250 mg/kg	3.00* ± 0.14	21.4* ± 0.27	28.20* ± 0.39	0.69* ± 0.14	19.90
	Total extract	500 mg/kg	1.50* ± 0.15	9.30* ± 0.27	8.00* ± 0.34	0.40* ± 0.15	77.28
	Lipoidal matter	150 mg/kg	3.50 ± 0.13	23.00 ± 0.30	29.50 ± 0.43	0.86 ± 0.05	16.21
	Chloroform extract	150 mg/kg	3.00* ± 0.16	22.2* ± 0.17	18.42* ± 0.29	0.60* ± 0.02	47.68
	Butanol extract	150 mg/kg	2.00* ± 0.17	11.00* ± 0.07	15.00* ± 0.12	0.46* ± 0.11	57.40
Roots	Total extract	250 mg/kg	4.00 ± 0.22	23.97 ± 0.20	30.10 ± 0.40	0.85 ± 0.06	14.51
	Total extract	500 mg/kg	3.00* ± 0.34	19.45* ± 0.20	23.22* ± 0.15	0.62* ± 0.40	34.05
	Lipoidal matter	150 mg/kg	4.00 ± 0.12	25.00 ± 0.17	29.80 ± 0.22	0.80 ± 0.01	15.36
	Chloroform extracts	150 mg/kg	3.00* ± 0.21	18.15* ± 0.57	27.12* ± 0.19	0.65* ± 0.04	22.98
	Butanol extract	150 mg/kg	3.00* ± 0.14	20.50* ± 0.53	27.50* ± 0.27	0.62* ± 0.05	21.90

Data are expressed as mean ± SD, n = 6.
* Significantly different from control colitis at $p < 0.05$.

ulcer respectively. Only the butanol fraction of the aerial parts extract showed promising activity 54.16%. These results could be explained by the contents of the extracts, as the phenolic contents of the butanol fractions of both SR & SA might be responsible for the antiulcerogenic activity.

3.3.1. Anti-ulcerative colitis

In the present study, Control colitis rats showed lesion score, ulcer area, ulcer index and Wet W/L (g/cm) values of 4.50 ± 0.49, 29.21 ± 1.22, 35.21 ± 1.82 and 0.99 ± 0.21, respectively (Table 3).

The inflammatory changes of the intestinal tract were associated with a significant increase of wet weight/length of the colon specimens as an indicator of inflammation. These inflammatory indices were significantly improved by oral dosing of dexamethasone, for 5 days after colitis induction. Among the investigated extracts of *Sonchus oleraceus*; only the total extract of the aerial parts (SA) at dose 500 mg/kg showed strong anti-ulcerative colitis activity and this activity is followed by the activity of the butanol and chloroform fractions of the aerial parts, they produced 77.28%, 57.4% & 47.68% protection from control colitis respectively. The standard drug dexamethasone produced 63.36% protection from control colitis.

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