Potential ameliorative effects of Sonchus oleraceus against hypercholesterolemic induced by high-fat diets in albino rats

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Potential ameliorative effects of Sonchus oleraceus against hypercholesterolemic induced by high-fat diets in albino rats

Abstract:

This study was conducted to find out the potential effect of *Sonchus oleraceus* on biological, biochemical, and histological changes of hypercholesterolemic rats induced by high fat diets. Therefore, Thirty-two Adult male albino rats Sprague Dawley strains, weighing 102±1.85 gm were used, and were divided into two groups; the first group (8 rats) fed on basal diet throughout the experimental periods (16 weeks) and served as a negative control group (G1). The second group was fed a high fat diet containing cholesterol, then this group (n=24 rats) was divided into three subgroups (8 rats per each) as follows: The first subgroup continued to be fed on hypercholesterolemic diet (G2), The second subgroup fed on hypercholesterolemic diet supplemented with *Sonchus Oleraceus* 5 % (G3). The third subgroup fed on hypercholesterolemic diet supplemented with 10% *Sonchus oleraceus* (G4). The results revealed that hypercholesterolemic diet rat groups showed a significant increase in body weight from positive control (G2). Also increase significantly levels of lipid profile, liver enzymes (AST, ALT and ALP) and cholesterol, except high-density lipoprotein cholesterol (HDL-c) compared to negative control grope (G1). When feeding rats with a high hypercholesterolemic diet containing *Sonchus oleraceus* occur significant ($P \leq 0.05$) decrease in body weight, liver enzymes (AST, ALT and ALP), kidney function and level of lipid profile (TC, TG, T. Lipid and LDL) and increase in the level of HDL. These results were confirmed with histopathological examination of liver, kidney, heart and brain. Therefore, we recommend using *Sonchus oleraceus* in moderate amount in our daily diets to benefit from its health benefits.

Keywords: *Asteraceae* family, hypercholesterolemia, liver functions, kidney functions, lipid profile**.**

Introduction

The World Health Organization (WHO) recently estimated that 46% of all fatalities in Egypt are caused by cardiovascular diseases. Atherosclerotic cardiovascular diseases (ASCVD) represent a major public health issue with significant social and

economic ramifications **(Mach *et al*., 2020).**Hypercholesterolemia is defined as the presence excessive levels of cholesterol in the blood, it is a condition of hyperlipidemia and consider one of the risk factors of cardiovascular diseases (CVD).

Research has demonstrated that 37% of the Egyptian population has elevated blood cholesterol levels **(Farag *et al*., 2017)**. Cholesterol is a type of fat known as a sterol. It is one of three major kinds of lipids used by all animal cells to build their membranes. It also serves as a precursor for all steroid hormones, vitamin D, and bile acid. The bloodstream contains cholesterol **(Vijayan *et al*.,2018).**

Egypt has a high prevalence of CVD events, especially apparent in Cairo and urban communities, where unhealthy lifestyles and fast-food eating habits, increase cholesterol and triglyceride levels, and decrease HDL levels in the blood (**Malloy and Kane 2004)**.

Unconventional food plants are those that spread naturally, aren't handled, and can be seen growing among other agricultural crops and along highways, in the center of pastures, and in orchards **(Leal *et al*.,2018)**. *Sonchus oleraceus* L. is a common annual herb, known as smooth sow-thistle, which is also referred to as lobbain in Upper Egypt because of the milky liquid it produces (**Qureshi *et al*.,2002).** Its belonging to the *Asteraceae* family. **Elokda *et al*., (2022)** the chemical composition moisture, ash, fat, protein, and fiber were 3.005, 16.709, 8.126, 27.373, 12.2 and 3.005 on dry weight basis % respectively. Also, *S. oleraceus*, an excellent source of minerals such as Na, K, Ca, Fe, Cu, Z and Mn by 5.62, 490.09, 83.26, 23.74, 0.13, 0.27 and 0.77 mg respectively (**Filho *et al*., 2022)** . *S. oleraceus* are rich in extractable antioxidants and may be able to protect humans' cells from oxidative stress, the percent of antioxidant activity and polyphenol in plants depend on factors such as environment, location, and growing season **(Howard *et al*., 2002).** These components were steroids, terpenes, coumarins, and flavones,

which have an antitumor effect, cardiovascular therapy, and hepato- protective activity **(Jiang *et al*., 2007).** Nutrition experts around the world have demonstrated through their scientific studies that *Sonchus* species "*S. oleraceus*, *S. asper*, and *S. arvensis*" have far more nutritional and medicinal potential than any other leafy vegetables **(Guil-Guerrero *et al*., 1998)**. Therefore, the study aimed to evaluate the potential protective effects of *Sonchus oleraceus* on hypercholesterolemic rats feeding on high-fat diets**.**

Materials and Methods

Materials

Plant

Sonchus oleraceus was obtained from the Governorate of Minia, Egypt. A sample of this plant was sent to Faculty of Agriculture, Minia University to be identified.

Animals

Thirty-two Adult male albino rats Sprague Dawley strains, weighing 102±1.85 gm were purchased and housed in the biological laboratory of the Chemistry Department, Faculty of Agriculture, Minia University.

Chemicals

Cholesterol diet and bile salts were purchased from Sigma Co., Cairo, Egypt. Kits for biochemical analyses were purchased from Bio Diagnostic Co., Dokki, Giza, Egypt. The rest of the chemicals, reagents and solvents were of analytical grade and purchased from El-Gomhoria Company for Trading Drug Chemicals and medicals, Cairo, Egypt. Basal diet constituents were obtained from Technogene Co., Dokki, Giza, Egypt.

Methods

Draying of *S. oleraceus*

S. oleraceus plants were washed thoroughly with tap water and dehydrated into an air-circulated oven at 40-50˚C for 24 hrs. The dried samples were finely powdered by using a coffee

grinder, sieved with a sieve, and stored in polyethylene bags at -20˚C until used.

Experimental Design

Thirty-two albino male rats were acclimatized for at least 2 weeks, with a condition (12 h light/12 h dark regular cycle and 25±2 ^{o}C temperature) and maintained on ad libitum for water and a standard rat chow diet which contains 17% protein. Animals were randomly divided into two main groups, the first group (Group 1, 8 rats) fed on a basal diet throughout the experimental periods (16 weeks) as a negative control (ve-) and the other main group (24 rats) was feed with high fat diet (HFD) contains (10% animal fats, 2% cholesterol and 0.3% bile salts) for 8 weeks to induced hypercholesterolemia, then classified into three subgroups as follow:

Group (2): fed on HFD and used as a positive control group (ve+).

Group (3): group infected with hypercholesterolemia and fed on HFD supplemented with 5 % dried *S. oleraceus*.

Group (4): group infected with hypercholesterolemia and fed on HFD supplemented with 10% dried *S. oleraceus*.

Biological experiments performed a complied with the rulings of the Institute of Laboratory Animal Resources, Commission on life Sciences, National Research Council **(NRC, 1996)**

Body weight gain (as a percent of initial weight) was assayed every week in rats.

Blood and Tissues sampling

At the end of the experiment (16 weeks) rats were fasted overnight before sacrificing and blood samples were taken from the retro-orbital plexus **(Schermer, 1967)** from all animals of each group after being anesthetized by diethyl ether. Each sample was centrifuged at 3000 rpm for 15 min and the obtained supernatant (serum) was kept at -20°C until used in biochemical analysis. Animals were dissected as quickly as possible and the liver, kidney, pancreas, spleen, heart and testis were excised, washed in ice-cold saline, wiped with filter paper and weighed.

Biochemical analyses

Serum levels of total cholesterol, HDL-c and TG were determined according to the methods of (**Zollner and Kirsch, 1962**; **Tietz, 1976; Castelli *et al.*, 1977**; **Vassault 1986)** respectively. Low-density lipoprotein cholesterol and very low-density lipoprotein cholesterol are calculated according to (**Friedewald, *et al*., 1972**) as the following equation:
LDL-c =TC concentration–TG concentration/5 –HDL-c concentrate. Total protein, albumin, globulin and urea nitrogen were determined according to the methods of (**Gornall *et al.*, 1949; Doumas *et al.*, 1971**; **Fawcett and Soctt, 1960)** respectively. Liver function as AST, ALT and ALP were measured with the colorimetric method according to (**van and Sons, 1992; Henry, 1964**; **Belfield and Goldberg 1971)** respectively. lipid peroxide and nitric oxide were determined according to methods of (**Ohkawa *et al*., 1979** ; **Montgomery and Dymock 1961)** respectively.

Histopathological studies

Small pieces of liver, kidney, heart, spleen and brain of each animal of control and treated groups were fixed in 10% formol saline solution for twenty-four hours. Washing was done using tap water then serial dilutions of absolute ethyl alcohol were used for dehydration. After routine processing, paraffin bees wax tissue blocks were prepared for sectioning at 4 microns thickness by slidge microtome. The obtained tissue sections were collected on glass slides, deparaffinized and stained by hematoxylin and eosin stain for histopathological examination through the light microscope **(Banchroft *et al*., 1996).**

Ethical approval

All experiments for this study especially the biological experiments ones were ethically approved by Scientific Research Ethics Committee (SREC) Faculty of Specific Education, Minia University, Minia, Egypt

Statistical analysis

The data were analyzed using SPSS (Statistical Package for Social Sciences) version, 17.0, performed by one-way analysis of variance (ANOVA). The results were expressed as mean ± standard error and values of ($P \leq 0.05$) were considered statistically significant.

Results and Discussion

The effect of feeding hypercholesterolemic rats on HFD containing (5 and10%) of *S. oleraceus* on body weight was shown in Table (1). From such data it could be noticed that feeding of rats on HFD to induce hypercholesterolemia leads to an increase in the final body weight ratio than the control group. At the end of the experiment (16 weeks), rats of the hypercholesterolemic group recorded 235.01% of the control (normal) group for the BWG %. Feeding of (5 and10%) *S. oleraceus* induced a significant $P \leq 0.05$ decreasing on BWG% of the hypercholesterolemic rats which recorded 193.71 and 168.02 % respectively. This may be attributed to the therapeutic effect of antioxidant, anxiolytic, and antinociceptive of *S. oleraceus* against infections, inflammation, and also as a general tonic **(Kusum *et al*., 2022)**.

Table (1): Effect of *S. oleraceus* on body weight gain (BWG, g) of hypercholesterolemic rats

Groups		Initial body Weight (g)	Final body weight (g)	BWG (g)	BWG %
Control (-)		103.17 ± 1.97	237.5 ± 6.35	134.32 ± 4.47	125.17 ±11.21
Hypercholesterolemic groups	**Control (+)**	102.72 ± 2.12	342.52 ± 8.35[a]	239.27 ± 8.35[a]	235.01 ± 10.23[a]
	***S. oleraceus* 5%**	102.47 ± 1.74	301.03 ± 6.95[ab]	198.52 ±5.57[ab]	193.71 ± 3.66[ab]
	***S. oleraceus* 10%**	102.9 ± 2.29	275.3 ± 8.42[ab]	172 ± 7.38[ab]	168.02 ± 6.92[ab]

Mean ±S.D of eight rats [a] significantly different from control group at $P \leq 0.05$ [b] significantly different from hypercholesterolemic groups at $P \leq 0.05$.

Also, *S. Oleraceus* lipid extracts could partially prevent adipogenesis and reduce HFD-induced obesity and suggest that *S.*

oleraceus could use as a dietary supplement for protection against obesity **(Chen *et al*., 2021)**.

From the data in Table (2), it could be indicated that rats fed on a hypercholesterolemic diet without supplementation (control positive) had significant $P \leq 0.05$ increase in liver and heart to body weight ratio compared with rats fed on a basal diet (control negative). Moreover, it could be observed that, liver and heart to body weight ratio had a significant decrease for all hypercholesterolemic rats administrated with different levels of S. oleraceus (5 and 10 %), the results are in agreement with a histological examination in organs. Meanwhile, weight to body weight ratio in the kidney, spleen, testes and brain did not appear to be any change in all groups.

Table (2): Effect of Sonchus oleraceus on organs relative weight of hypercholesterolemic rats

Groups	Control (-)	Hypercholesterolemic groups		
		Control (+)	*S. oleraceus* 5%	*S. oleraceus* 10%
Liver (g)	6.71± 0.11	10.77± 0.21	8.70± 0.13	7.63 ± 0.07
Liver (%)	2.81± 0.04	3.15 ± 0.06 [a]	2.89 ± 0.03 [b]	2.77± 0.06 [b]
Heart (g)	0.82 ± 0.02	1.25 ± 0.02	0.97± 0.02	0.92 ± 0.02
Heart (%)	0.34 ± 0.02	0.36 ± 0.02[a]	0.33 ± 0.01[b]	0.33± 0.01 [b]
Spleen(g)	0.87 ± 0.01	1.14± 0.02	1.00 ± 0.01	0.97± 0.02
Spleen (%)	0.34 ± 0.005	0.33 ± 0.01	0.33 ± 0.006	0.34 ± 0.008
Kidney (g)	1.74 ± 0.02	2.38 ± 0.05	1.94 ± 0.21	1.85 ± 0.03
Kidney (%)	0.72 ± 0.01	0.71 ± 0.01	0.68 ± 0.02	0.68 ± 0.02
Tests (g)	2.58 ± 0.07	3.4 ± 0.1	3.02 ± 0.05	2.92± 0.03
Tests (%)	1.05 ± 0.02	1.03± 0.01	1.03± 0.01	1.04± 0.02
Brain (g)	1.36 ± 0.04	1.85 ± 0.02	172 ± 0.01	1.69 ± 0.01
Brain (%)	0.56 ± 0.03	0.55 ± 0.02	0.56 ± 0.01	0.56 ± 0.01

Mean ±S.D of eight rats [a] significantly different from control group at $P \leq 0.05$ [b] significantly different from hypercholesterolemic groups at $P \leq 0.05$.

The results are in agreement with results of **(Hossin, 2009)** who support the protective effects exhibited by pomegranate peels and it's extract on the liver, kidney and spleen in obese hypercholesterolemic rats.

Table (3): Effect of *Sonchus oleraceus* on serum cholesterol and triglycerides of hypercholesterolemic rats

Groups		TC (mg/dl)	TG (mg/dl)
Control (-)		146 ± 4.32	115 ± 5.05
Hypercholesterolemic groups	**Control (+)**	248 ± 6.78[a]	176 ± 5.10[a]
	***S. oleraceus* 5%**	193 ± 3.37[ab]	146 ± 4.35[ab]
	***S. oleraceus* 10%**	150 ± 2.94[b]	124 ± 4.4 [ab]

Mean ±S.D of eight rats [a] significantly different from control group at $P \leq 0.05$ [b] significantly different from hypercholesterolemic groups at $P \leq 0.05$.

Table (3) shows the serum TC and TG levels in normal and hypercholesterolemic rats fed on HFDs with (5 and 10%) *S. oleraceus*. It was found that the control (+) group fed on HFD exhibited a significant increase in serum TC and TG concentrations as compared to the control (-) group fed on a basal diet. Feeding hypercholesterolemic rats on high dietary fibers diet, could decrease the levels content of total lipids, cholesterol and triglycerides to nearly normal levels (**El-Sayed, 2013)**, that explain our result, that fed hypercholesterolemic rats with 5 and 10 % of *S. oleraceus* decreased serum concentrations of TC and TG in serum as compared to the control (+) group. hypercholesterolemic rats fed on 10% *S. oleraceus* were more effective in lowering TC from 248mg/dl in the positive group to nearly level of the normal group, and TG from 176mg/dl in the positive group to124mg/dl.

The treatments of HFD-induced obese rats with *S. oleraceus* (0.3 mg/g of BW per rat) for a month, exhibited a significant decrease in weight gain, fat accumulation and blood triglyceride **(Chen *et al*., 2021)**.

Table (4): Effect of *S. oleraceus* on serum lipoproteins of hypercholesterolemic rats

Groups		HDL-c (mg/dl)	LDL-c (mg/dl)	VLDL-c (mg/dl)	TC/ HDL ratio	TC/ LDL ratio	LDL/ HDL ratio
Control (-)		66.45 ± 0.82	56.37 ±3.75	23.18 ± 1.01	2.2 ±0.56	2.61 ±0.11	0.85 ±0.05
Hypercholesterolemic groups	**Control (+)**	45.48 ±1.01^{a}	167.25 ±6.88^{a}	35.27 ±1.02^{a}	5.48 ±0.17^{a}	1.48 ±0.02^{a}	3.7 ±0.17^{a}
	***S. oleraceus* 5%**	61.76 ±0.92^{ab}	102.06 ±3.13^{ab}	29.27 ±8.7^{ab}	3.13 ±0.05^{ab}	1.9 ±0.03^{ab}	1.66 0.05^{ab}
	***S. oleraceus* 10%**	65.7 ±0.62^{b}	59.13 ±2.8^{b}	24.86 ± 0.89^{ab}	2.28 ±0.02^{b}	2.55 ±0.06^{b}	0.89 ±0.03^{b}

Mean ±S.D of eight rats ^{a} significantly different from control group at $P \leq 0.05$ ^{b} significantly different from hypercholesterolemic groups at $P \leq 0.05$.

Cholesterol is not soluble in water; it is carried in the blood plasma by protein particles (lipoproteins). Lipoproteins are divided into four types based on their density: VLDL, IDL, LDL, and HDL. Although all lipoproteins include cholesterol, excessive levels of lipoproteins other than HDL, especially LDL-c, are linked to a higher risk of atherosclerosis and CVD. High levels of LDL in the blood can be caused by a poor diet, obesity, or the presence of another condition such as diabetes **(Vijayan *et al.*,2018)**. The effect of two levels (5 and 10%) of S. *oleraceus* on HDL-c, LDL-c, and VLDL-c of hypercholesterolemic rats are presented in Table (4). Results indicate that the control (+) group had an elevated significantly ($P \leq 0.05$) in LDL-c as compared to the control negative (167.25 mg/dl vs 56.37 mg/dl); in contrast, HDL-c decreased significantly ($P \leq 0.05$) (45.48 mg/dl vs 66.45 mg/dl), respectively. Supplementation diets with 5 and 10% of *S. oleraceus* led to a significant increase ($P \leq 0.05$) in HDL-c, while this addition caused significant decrease ($P \leq 0.05$) in LDL-c & VLDL-c, as compared to the control positive group. This may be attributed to a high fiber content of *S. oleraceus.*

There was a relationship between increased dietary fiber intakes and increase in HDL cholesterol and decreased in LDL (**Zhou *et al.*, 2015)**. The TC/HDL-c ratio complements cholesterol

markers such as non-HDL-c and LDL-c and should consider for further risk assessment in the prevention programs, especially among high-risk patients such as diabetics. Individuals with low LDL-c or non-HDL-c levels may be at risk of ASCVD if their TC/HDL-c ratio is discordantly higher **(Quispe *et al*.,2020).** In the same table, the ratios of TC/HDL-c, TC/LDL-c and LDL/HDL were calculated for all groups. The results indicated that, the positive group had a ratio of TC/HDL-c (5.48), which was about twice the ratio of negative group. In contrast TC/LDL-c recorded the lowest ratio (1.48). The ratio of LDL/HDL in normal rats accounted for a value of (0.85), this ratio increased to (3.7) in the positive group. Supplementation diets with (5 & 10%) of *S. oleraceus* led to improvement in the TC/HDL-c and TC/LDL-c ratios.

Table (5): Changes in serum urea, protein, albumin, and globulin levels in hypercholesterolemic rats

Groups		Protein (g/dl)	Albumin (g/dl)	Globulin (g/dl)	Alb/Glu	Urea (mg/dl)
Control (-)		6.67 ± 0.22	4.03 ± 0.12	2.36 ± 0.28	1.85 ± 0.25	40.79 ± 0.86
Hypercholesterolemic groups	**Control (+)**	7.76 ± 0.04[a]	4.65 ± 0.09	3.13 ± 0.13[a]	1.48 ± 0.06[a]	49.56 ± 1.96[a]
	***S. oleraceus* 5%**	7.24 ± 0.14[ab]	4.09 ± 0. 12[ab]	3.15 ±0.03[a]	1.30 ± 0.03 [a]	44.61 ± 0.51[ab]
	***S. oleraceus* 10%**	6.81 ± 0.17[b]	4.48 ± 0.18[b]	2.33 ± 0.20[b]	1.94 ± 0.22[b]	41.61 ± 0.68 [b]

Mean ±S.D of eight rats [a] significantly different from control group at $P \leq 0.05$ [b] significantly different from hypercholesterolemic groups at $P \leq 0.05$.

Effect of *S. oleraceus* on total protein , albumin and globulin (g/dl) of hypercholesterolemic rats. Data in Table (5) indicated an elevation of total protein, albumin and globulin in hypercholesterolemic rats of about 16 % , 15% and 32 % respectively ,compared to normal control. Rats fed on high cholesterol diet (control +ve) had a significant increase in the concentration of total protein, albumin and Globulin which

recorded 7.76 ± 0.04, 4.65 ± 0.09 and 3.13 ± 0.13 respectively compared to the control (–ve) group which recorded 6.67 ± 0.22 , 4.03 ± 0.12 and 2.36 ± 0.28 . Meanwhile, supplementation of S. oleraceus to hypercholesterolemia rats restored these parameters to normal levels. Our results are in agreement with the results obtained by **(Elhassaneen, *et al.*, 2020)** reported that the coconut fruits and coconut milk decreased albumin and total protein of hypercholesterolemic rats.

On other hand, hypercholesterolemic diets caused a significant ($P \leq 0.05$) increase in serum urea about 21.5 % compared to normal control. Meanwhile, treatment with S. oleraceus 5% ameliorated the urea level to near normal while *S. oleraceus* 10 % restored this level to normal.

Hypercholesterolemic diets induced oxidative stress in rat liver was evaluated by assessing lipid peroxide and nitric oxide levels. As shown in Table (6) hypercholesterolemic diets significantly ($P \leq 0.05$) increased lipid peroxide and nitric oxide levels by about 51 and 16% respectively compared to normal control. These results in accordance with many authors (**Mahmoud *et al.*, 2013; Abdel –Rahim *et al.*, 2013; Wang *et al.*,2011 and Setorki *et al.*,2011**). *S. oleraceus* at two doses return this elevation to normal levels.

Table (6) Effect of *S. oleraceus* on oxidative stress in hypercholesterolemic rat

Groups		Lipid peroxide	Nitric oxide
Control (-)		22.17 ± 0.68	6.61 ± 0.30
Hypercholesterolemic groups	**Control (+)**	25.82 ± 0.31[a]	9.98 ± 0.34[a]
	***S. oleraceus* 5%**	22.5 ± 0.23[b]	6.81 ± 0.25[b]
	***S. oleraceus* 10%**	22.02 ± 0. 56[b]	6.81 ± 0.22[b]

Mean ±S.D of eight rats [a] significantly different from control group at $P \leq 0.05$ [b] significantly different from hypercholesterolemic groups at $P \leq 0.05$.

Table (7) Effect of *S. oleraceus* on liver function activity in Hypercholesterolemic Rats

Groups		AST	ALT	ALP
Control (-)		33.05 ± 2.45	10.44 ± 0.85	97.5 ± 2.08
Hypercholesterolemic groups	**Control (+)**	67.56 ± 1.82[a]	35.61 ± 3.18[a]	141.75± 2.75[a]
	***S. oleraceus* 5%**	46.77 ± 1.29[ab]	22.13 ± 1.01[ab]	118.75± 2.22[ab]
	***S. oleraceus* 10%**	35.81±1.08[b]	10.97 ± 0.86 [b]	101.25± 2.75[b]

Mean ±S.D of eight rats [a] significantly different from control group at $P \leq 0.05$ [b] significantly different from hypercholesterolemic groups at $P \leq 0.05$.

Hypercholesterolemia diets resulted in considerable hepatic injury as assessed by significant ($P \leq 0.05$) elevations in serum transaminases and alkaline phosphatase. The elevation of ALT, AST and ALP in hypercholesterolemic rats was about 104%, 241% and 45 % respectively compared to normal control. Meanwhile, supplementation of *S. oleraceus* to hypercholesterolemic rats restored these parameters to normal levels . Our results are in agreement with the results obtained by **(Elokda *et al.*, 2022)** who reported the effect of treating acute liver disease rats with two levels (2% and 4%) of S. *oleraceus* led to a significant decrease in liver enzymes, as compared to the positive control group. The high level from *S. oleraceus* achieved the best results in decreasing the mean value of serum (AST, ALT, and ALP enzymes). On the other side **(Akhlaghi, 2016)** reported that flavonoids present in *S. oleraceus* prevent hepatosteatosis by increasing fatty acid oxidation in the liver.

Histological examination

The results of the histological study support the results of biochemical parameters. The microscopic examination of liver tissues in the control group showed a normal histological structure of the hepatic lobule (Fig.1G1). On the other hand, hypercholesteremia rats showed a fatty change of centrolobular and cholangitis hepatocytes associated with inflammatory cells

infiltration (Fig.1G2). Whereas the group treated with hypercholesteremic plus *S. oleraceus* 5% showed a fatty change of centrilobular hepatocytes (Fig.1G3) meanwhile, hypercholesteremic plus S. oleraceus 10% restored these changes to normal (Fig.1 G4).

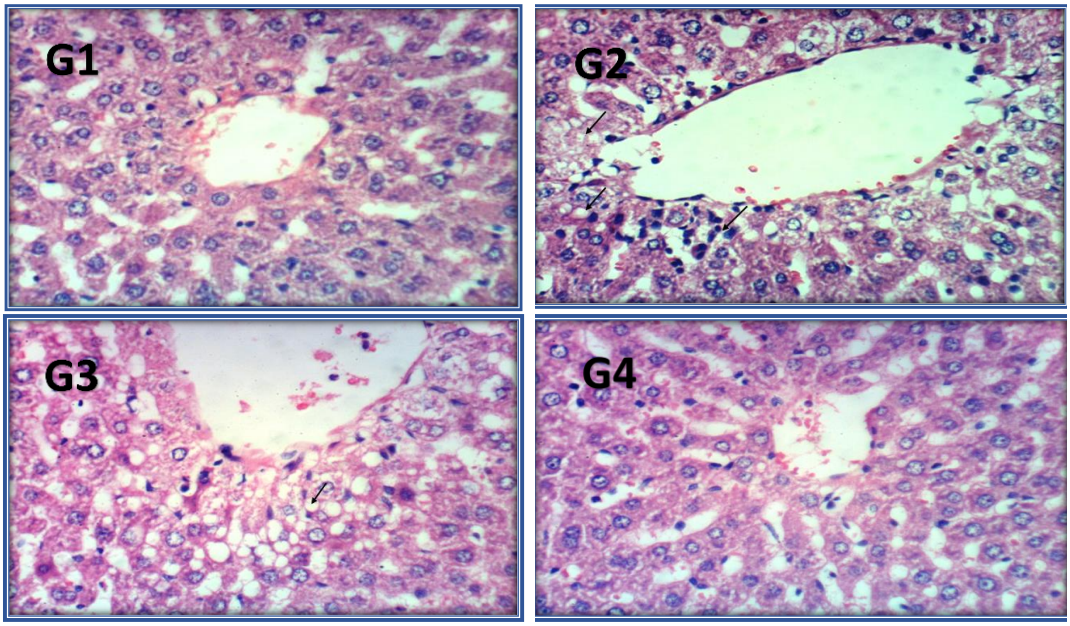

Fig. (1): Photomicrograph of the **cross-section in the liver cortex of control (G1), hypercholesterolemia (G2), hypercholesterolemia + S. oleraceus 5% (G3), and hypercholesterolemia S. oleraceus + 10 % (G4) (H & E x 400).**

Heart of control rats revealed normal histopathologic structure. On contrary, the examined sections of hypercholesterolemic rats showed focal myocarditis and intermuscular oedema associated with inflammatory cellinfiltration (Fig.2G2). Whereas the group treated with hypercholesterolemic plus *S. oleraceus* 5% improved heart structure, one slit showed focal myocarditis and others exhibited no histopathological changes (Fig.2G3) while high dose *(S. oleraceus* 10%) restored heart tissue to the normal structure (Fig.2G4).

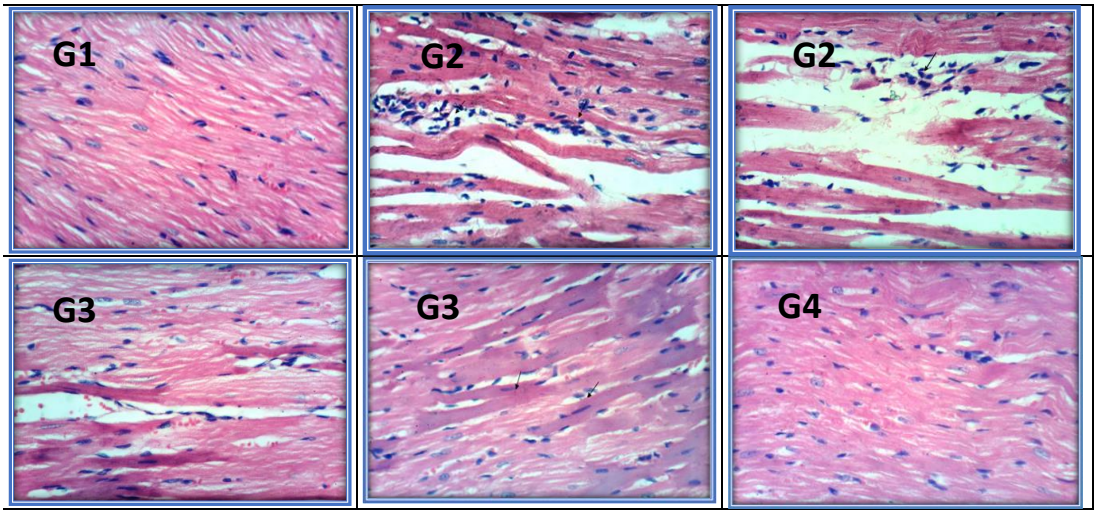

Fig. (2): Photomicrograph of the cross-section in the heart cortex of control (G1), hypercholesterolemia (G2), hypercholesterolemia + S. oleraceus 5% (G3), and hypercholesterolemia S. oleraceus + 10 % (G4) (H & E x 400).

Sections taken from hypercholesterolemic rat's kidney showed glomerulitis, protein cast in the lumen of renal tubules and congestion of intratubular blood vessels (Fig.3G2).

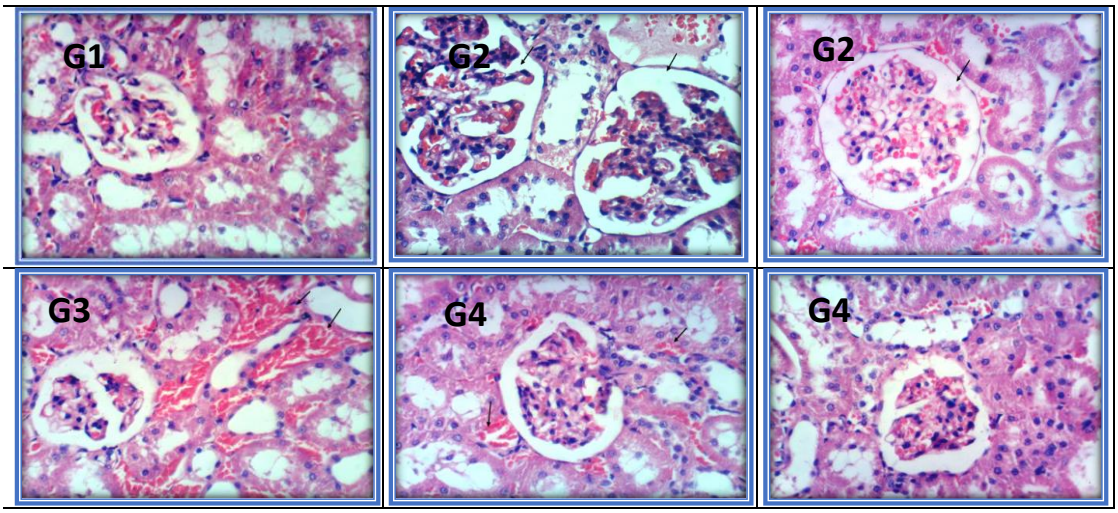

Fig. (3): Photomicrograph of the cross-section in the kidney cortex of control (G1), hypercholesterolemia (G2), hypercholesterolemia + S. oleraceus 5% (G3), and hypercholesterolemia S. oleraceus + 10 % (G4) (H & E x 400).

Nevertheless, these findings were ameliorated by treatment with S. oleraceus which showed moderate congestion of intratubular blood vessels at a low dose (Fig.3G3) while a high dose showed slight congestion of glomerular tufts and other sections exhibited no histopathological changes (Fig.3G4).

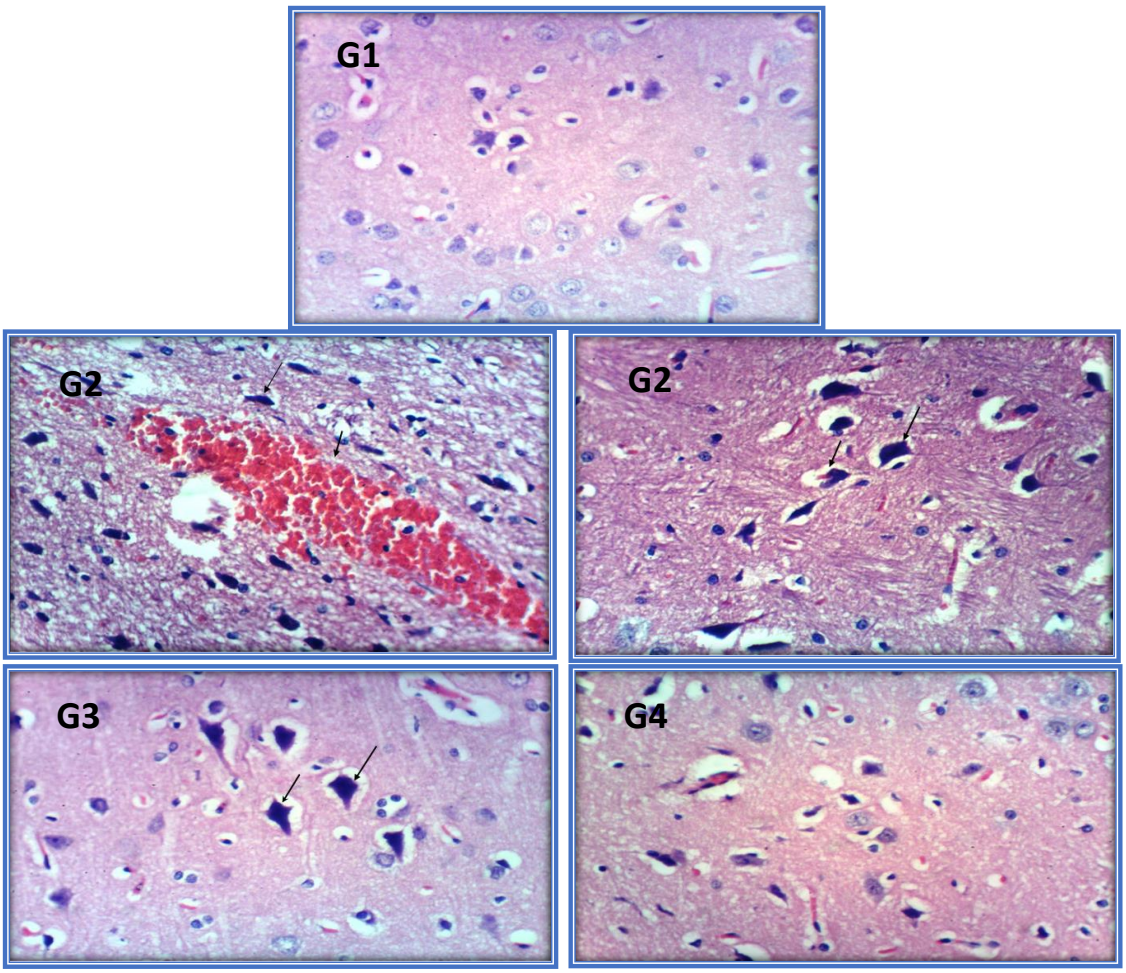

Fig. (4): Photomicrograph of the cross-section in the brain cortex of control (G1), hypercholesterolemia (G2), hypercholesterolemia + S. oleraceus 5% (G3), and hypercholesterolemia S. oleraceus + 10 % (G4) (H & E x 400).

The microscopic examination of brain tissue in the control group showed normal histological (Fig.4 G1). On the other hand hypercholesteremia rats showed focal hemorrhage and necrosis of neurons (Fig.4G2). Whereas the group treated with hypercholesterolemic plus *S. oleraceus* 5% showing necrosis of

neurons (Fig.4G3) meanwhile, hypercholesterolemic plus *S. oleraceus* 10% restored these changes to normal (Fig.4G4).

Conclusion

This study has shown that *Sonchus Oleraceus* contains several bioactive compounds capable of mitigating the harmful effects of high cholesterol and inhibiting hypercholesterolemia in rats. Therefore, we recommend using *Sonchus Oleraceus* in moderate amount in our daily diets to benefit from its health benefits

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References

Abdel-Rahim, E.; El-Beltagi ,H. and Romela, R. (2013). White Bean seeds and pomegranate peel and fruit seed as hypercholesterolemic and hypolipidemic agents in albino rats . Gras. Aceites, 64 : 50-58.

Akhlaghi, M. (2016). Non-alcoholic Fatty Liver Disease: Beneficial Effects of Flavonoids . Wiley Online Library. 30 (10): 1559–1571.

Banchroft, J. D.; Stevens, A. and Turner D. R. (1996). Theory and practice of histological techniques. Fourth Ed. Churchil Livingstone, New York, London, San Francisco, Tokyo.

Belfield, A. and Goldberg, D. M. (1971). Revised assay for serum phenyl phosphatase activity using 4-amino-antipyrine. Enzyme. 12(5):561-73.

Castelli, W. P.; Doyle, J. T.; Gordon, T.; Hames, C. G.; Hjortland, M. C.; Hulley, S. B. and Zukel, W. J. (1977). HDL cholesterol

and other lipids in coronary heart disease. The cooperative lipoprotein phenotyping study. Circulation, 55(5): 767-772.

Chen, C. Y.; Su, C. W.; Li, X.; Liu, Y.; Pan, Q.; Cao, T. and Kang, J. X. (2021). Lipid extract from a vegetable (Sonchus Oleraceus) attenuates adipogenesis and high fat diet-induced obesity associated with AMPK activation. Frontiers in nutrition, 8: 1-10.

Doumas, B. T.; Watson, W. A. and Biggs, H. G. (1971). Albumin standards and the measurement of serum albumin with bromcresol green. Clinica chimica acta, 31(1): 87-96.

Elhassaneen, Y.; Nasef, A. and Abo-Khazima, A. (2020). Effect of coconut fruits and their milk on biological and biochemical changes of hypercholesterolemic rats. Journal of Home Economics, 30(1): 85-106.

Elokda, E. A.; El-Megeid, A. A. ; El-Marasy, S. S. and Shaaban, E. S. (2022). Effect of Sonchus Oleraceus and Malva Parviflora Leaves on Acute Liver Diseases in Rats Fed on Normal Diet. Journal of Research in the Fields of Specific Education, 8(40): 521-252

El-Sayed, M. E. (2013). Effect of feeding on some dietary fibers for reducing blood cholesterol. Journal of Food and Dairy Sciences, 4(1), 13-25

Farag, ES.; Reda, A.; Farag, N.; Salama, S.; Elbahry, A.; Sanad, O. ;Abdou, W. and El-Kersh, A. (2017). The Egyptian cardiovascular risk factors project, phase (II) results: a multicenter observational study of the pattern of risk factor profile in Egyptian patients with acute coronary syndrome. Atherosclerosis, 263, e159.

Fawcett, J. K. and Soctt, J. E. (1960). A rapid and precise method for the determination of urea. Journal of clinical pathology, 13(2): 156 – 159.

Filho, G. X.; Barreira, T. F. and Pinheiro-Sant'Ana, H. M. (2022). Chemical Composition and Nutritional Value of Three Sonchus Species. International Journal of Food Science, V. 2022: 1-9.

Friedewald, W. T.; Levy, R. I. and Fredrickson, D. S. (1972). Estimation of the concentration of low-density lipoprotein

cholesterol in plasma, without use of the preparative ultracentrifuge. Clinical chemistry, 18(6), 499-502.

Gornall, A. C.; Bardawill,m C. J. and David, M. M. (1949): J. Biol. Chem. 177 : 751.

Guil- Guerrero, J. L.; Giménez- Giménez, A.; Rodríguez- García, I. and Torija- Isasa, M. E. (1998). Nutritional composition of Sonchus species (S asperL, S oleraceusL and S tenerrimusL). Journal of the Science of Food and Agriculture, 76(4): 628-632.

Henry, R. J. (1964). Clinical chemistry, principles and techniques. Harper and Row Publishers. New York.

Hossin, F. L. (2009). Effect of pomegranate (Punica granatum) peels and it's extract on obese hypercholesterolemic rats. Pak J Nutr, 8(8), 1251-7.

Howard, L. R.; Pandjaitan, N.; Morelock, T. and Gil, M. I. (2002). Antioxidant capacity and phenolic content of spinach as affected by genetics and growing season. Journal of agricultural and food chemistry, 50(21), 5891-5896.

Jiang, L.; Wang, G. and Yao, Q. (2007). Review on the chemical constituents and pharmcological activities of Sonchus L. Qilu Pharmaceutical Affairs, 26, 670-672.

Kusum S. A.; Rashmi H. C. and Pratiksha A. (2022). Evaluation of Hepatoprotective Activity of Sonchus oleraceus L. Extract against CCl4-induced Hepatic Damage in Wistar Rats International Journal of Pharmaceutical Sciences and Drug Research. 14(4): 364-372.

Leal, M. L.; Alves, R. P. and Hanazaki, N. (2018). Knowledge, use, and disuse of unconventional food plants. Journal of ethnobiology and ethnomedicine, 14(1):1-9.

Mach, F., Baigent, C., Catapano, A. L., Koskinas, K. C., Casula, M., Badimon, L., and Wiklund, O. (2020). 2019 ESC/EAS Guidelines for the management of dyslipidaemias: lipid modification to reduce cardiovascular risk: the Task Force for the management of dyslipidaemias of the European Society of Cardiology (ESC) and European Atherosclerosis Society (EAS). European heart journal, 41(1), 111-188.

Mahmoud, H. M.; Zaki, H.F. ; El Sherbiny , G.A.; Abd El-latif ,H.A. and Abd El-latif, H.A. (2013): Effects of Simvastatin and Vitamin E on Diet Induced Hypercholesterolemic in Rats .Br. J. of pharmacology and toxicology.

Malloy, M.J. and Kane, J.P. (2004). Agents used in hyperlipidemia. In: Katzung BG. Basic and Clinical Pharmacology. Ninth edition, International Edition, The McGraw-Hill Companies: 561-575.

Montgomery, H. A. and Dymock, J. F. (1961). The determination of nitrite in water Analyst. 86: 414-416.

NRC, National Research Council (1996). Guide for the Care and Use of Laboratory Animals Washington: National Academy Press. Obtained from hypertensive-diabetes rats. Fundam Clin Pharmacol 10:329–336.

Ohkawa, H; ohishi, W and Yaqi, K. A. (1979). Assay for lipid peroxides in animal tissues by thiobarbituric acid reaction. Anal Biochem. 95(2):351-8.

Quispe, R.; Elshazly, M. B.; Zhao, D.; Toth, P. P.; Puri, R.; Virani, S. S.; Blumenthal, R.S.; Martin, S.S.; Jones, S.R. and Michos, E. D. (2020). Total cholesterol/HDL-cholesterol ratio discordance with LDL-cholesterol and non-HDL-cholesterol and incidence of atherosclerotic cardiovascular disease in primary prevention: The ARIC study. European journal of preventive cardiology, 27(15), 1597-1605.

Qureshi, S. J.; Awan, A. G.; Khan, M. A. and Bano, S. (2002). Taxonomic study of the genus Sonchus L. from Pakistan. Online Journal of Biological Sciences, 2(5): 309-314.

Schermer, S. (1967). The Blood Morphology of Laboratory Animals.1:200.

Setorki, M. ; Asgary, S. ; Haghjooyjavanmard, S. and Nazari, B. (2011). Reduces cholesterol induced atherosclerotic lesions in aorta artery in hypercholesterolemic rabbits . J. Med. Plants Res., 5, 1518-1525.

Tietz, N. W. (1976). Method of the estimation of lipoprotein concentration without ultracentrifugation. Tietz Fundamentals of Clinical Chemistry. 2nd ed. Philadelphia: WB Saunders company**.**

Van, D. S. and Sons, J.W. (1992). A time-resolved fluoroimmuno assay of the IgM-rheumatoid factor. Eur J clin Chem Biochem; 30: 301-305.

Vassault, A.; Grafmeyer, D.; Naudin, C.; Dumont, G.; Bailly, M.; Henny, J. and Georges, P. (1986). Protocole de validation de techniques. Ann Biol Clin, 44(686), 45.

Vijayan, J.; Sruthy, S.; Neethu, J.; Manohar, N.; Babitha, M. and Soumya, R. (2018). Hypercholesterolemia. European Journal of Biomedical AND Pharmaceutical sciences 5(9): 115-123.

Wang, W. ; Zhang, H. ; Gao, G. ; Bai, Q. ; Li, R. and Wang, X.(2011). Adiponectin inhibits hyperlipidemia –induced platelet aggregation Via attenuating oxidative nitrative stress . Physiol. Res.,60: 347-354.

Zhou, Q.; Wu, J.; Tang, J.; Wang, J. J.; Lu, C. H. and Wang, P. X. (2015). Beneficial effect of higher dietary fiber intake on plasma HDL-C and TC/HDL-C ratio among Chinese rural-to-urban migrant workers. International journal of environmental research and public health, 12(5): 4726-4738.

Zollner, N. and kirsch, K. (1962). User die quantities bestimmung von lipoiden mittes driveline naturliche lipoiden. 2. ges. Exp. Med. 135, 545 – 561.

التأثيرات التحسينية المحتملة للجعضيض ضد ارتفاع مستوى الكوليسترول الدم الناجم عن الأنظمة الغذائية عالية الدهون في الفئران البيضاء

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المستخلص

أجريت هذه الدراسة لمعرفة تأثير الجعضيض على التغيرات البيولوجية والكيميائية والنسيجية للفئران المصابة بارتفاع مستوى كوليسترول الدم. لذلك تم استخدام 32 من ذكور الفئران البيضاء وزنها 102± 1.85 جم. تم تقسيم ذكور الفئران البالغة الي مجموعتين رئيستين الأولي مكونه من 8 فئران و التي تغذت علي نظام غذائي طبيعي طوال فتره التجربة (16 أسبوعا) وهي مجموعه1 (G1) المجموعة الضابطة السالبة C– أما المجموعة الثانية الرئيسية والتي تغذت علي نظام غذائي يحتوي علي دهون حيوانيه و كولسترول وكان عددها 24 فارا قسمت إلى ثلاثة مجموعات فرعيه وهي مجموعه2 (G2) وتمثل المجموعة الضابطة الموجبة والتي تغذت علي النظام الغذائي عالي الدهون والكولسترول طوال فترة التجربة ومجموعه 3 (G3) والتي تغذت علي نظام غذائي عالي الدهون والكولسترول بالإضافة إلي 5% جعضيض ، مجموعه 4 (G4) والتي تغذت علي نظام غذائي عالي الدهون والكولسترول بالإضافة الي 10 %جعضيض. وقد أظهرت النتائج وجود زيادة معنوية في كلا من وزن الجسم ومستوي الدهون وإنزيمات الكبد و الكولسترول باستثناء الكوليسترول المفيد عالي الكثافة (HDL–c) لدي المجموعة الضابطه الموجبة G2 مقارنةً بالمجموعة الضابطة السالبة G1. بينما كان هناك انخفاضا ملحوظ في المجموعتين اللتان تغذيتا علي الجعضيض في كلا من وزن الجسم وأنزيمات الكبد ووظائف الكلي ومستوي الدهون والكولسترول و مستوي الكولسترول الضار (LDL) والجلستريدات الثلاثية في حين كان هناك ارتفاع ملحوظ في مستوي الكولسترول المفيد (HDL) مقارنةً بالمجموعة الضابطة الموجبة G2 . وأكد ذلك الفحص النسيجي للكبد والكلي والقلب و المخ . لذلك ، نوصي باستخدام الجعضيض بكميات معتدلة في وجباتنا الغذائية اليومية للاستفادة من فوائده الصحية.

الكلمات المفتاحية: عائلة النجمية ، فرط كوليسترول الدم ، وظائف الكبد ، وظائف الكلى ، مستوي الدهون.