

Investigation of Hypoglycemic Effects of *Sonchus oleraceus* (Moleta) in Normal Albino Rats

Imad Eldin Mohamed Tag Eldin³, Ezdihar Elhadi Elamin Ahmed², Mai Abdalla Ali^{1*} Awad Mohamed Abdel-Rahim² and Ivan Kahwa^{4,5}

¹Department of Biochemistry and Molecular Biology, Faculty of Science, University of Gezira, P.O Box, Wad Medani, Sudan

²Center of Bioscience and Biotechnology, Faculty of Engineering and Technology, University of Gezira, P. O Box, Wad Medani, Sudan

³Department of Pharmacognosy, Faculty of Pharmacy, University of Gezira, P.O Box, Wad Medani, Sudan.

⁴Pharm-Biotechnology and Traditional Medicine Centre of Excellence (PHARMBIOTRAC), Mbarara University of Science and Technology, Mbarara, Uganda

⁵Department of Pharmacy, Faculty of Medicine, Mbarara University of Science and Technology, Mbarara, Uganda

*Corresponding Author: Mai Abdalla Ali, Department of Biochemistry and Molecular Biology, Faculty of Science, University of Gezira, P.O Box, Wad Medani, Sudan.

Received: November 18, 2020; **Published:** January 29, 2021

Abstract

The purpose of the study was to investigate the hypoglycemic effects of ethanolic and hexane extracts of *Sonchus oleraceus* in normal albino rats using fasting blood glucose and glucose tolerance tests. About 200 g leaves of *S. oleraceus* were macerated in 2 liters of hexane for two days, filtered and evaporated to dryness. Sixty albino rats were divided into six groups. Negative control group received water (5ml) and the positive control group administered by glibenclamide (5 mg/kg) which is known to increase insulin release from pancreatic β - cell. Four test groups received two doses (150 and 300mg/kg) of hexane extract and hydroethanolic extract of *S. oleraceus* leaves. Hydroethanolic extract (150, 300 mg/kg) produced insignificant reduction in blood glucose level (P -value = 0.2492, 0.1345), while hexane extract showed significant reduction (P -value = 0.001) in fasting blood glucose, moreover, hexane extract showed a significant reduction in blood glucose level when using the glucose tolerance test (P -value = 0.3173, 0.0305). It was evident that *S. oleraceus* leaves revealed significant hypoglycemic effects thus, it could be used as a dietary supplement for type two diabetic patients.

Keywords: *Sonchus Oleraceus*; Hypoglycemic; Diabetes Mellitus; Hydroethanolic; Hexane

Introduction

Diabetes Mellitus is a metabolic syndrome caused by lack of enough insulin, that is to say there is hyperglycemia and deficient glucose utilization by the cells [1]. The high rise of diabetes mellitus is being attributed to the increase in population, rapid urbanization, aging, poor living life styles and deity [2]. People with Diabetes mellitus may develop a number of complications which include macrovascular complications, this leads a number of diseases, for example, cerebrovascular disease, peripheral vascular disease, coronary heart disease; microvascular complications causing diabetic neuropathy, diabetic retinopathy and diabetic nephropathy other disease caused by macrovascular complication are gastroparesis, diarrhea, sexual dysfunction, dermatologic diseases, infections, cataract, glaucoma and periodontal disease [3].

Many studies have shown that diabetes mellitus (type 1 and 2) is associated with increased formation of free radicals and decreased antioxidant potential, leading to oxidative damage of cell components [4]. However, the consumption of natural antioxidant like vegetables has linked to reduction in the incidence of oxidative stress related diseases due to beneficial health functionality of phenolic antioxidants present in them [5]. One of these vegetables is *S. oleraceus* which is rich of alkaloids, tannins and phenolic compounds [6].

Sonchus oleraceus belongs to family Asteraceae and traditionally its aerial parts are administered orally to treat stomach pain, hepatitis, infections, inflammation, headaches, general pain and rheumatism [7] and used by traditional healers to treat diabetes in Cameroon [8]. But in Sudan, the leaves of *S. oleraceus* are potentially used for the treatment of diabetes, but information regarding the anti-hypoglycemic effect is not available, thus this study focused to determine the fasting blood glucose (FBG) level and glucose tolerance test (GTT) of *S. oleraceus* ethanolic and hexane leaf extracts in normal albino rats. This study therefore aimed at evaluating the hypoglycemic activity of *S. oleraceus* on normal albino rats.

Materials And Methods

Plant collection and identification

The *S. oleraceus* whole plant was obtained from the local market of Wad Medani city in Sudan and was identified by a botanist at Faculty of Pharmacy, Department of Pharmacognosy, University of Gezira.

Preparation of the extracts

The fresh leaves of *S. oleraceus* were cleaned, dried in shade and powdered by electric grinder. 200g of powder were macerated in two liters of hexane for two days with thorough homogenization twice a day. The macerate was filtered using Whatman No 1 filter paper, and the filtrate was evaporated to dryness, collected and weighted. The obtained yield (9g) which is 4.5% of crude plant was dissolved in 90 ml of corn oil, the obtained liquid was used for biological testing. The rest of the residue was further subjected to extraction using two Liters ethanol (80%) for two days with thorough homogenization twice a day. Then was filtered using Whatman No 1 filter paper, the filtrate was evaporated to dryness and kept in a refrigerator until use. Four grams of the yield (40g), 20% of crude plant- was dissolved in 80 ml of distilled water and used for biological testing [9].

Experimental animals

Sixty albino rats, of both sexes (male and female), weighting (130 -190g) were used in the investigation. They were brought from the animal house of Faculty of Pharmacy, Gezira University.

Experimental design

The animals were randomly selected and divided into six groups: Group I (negative control, n = 10) received water, group II (positive control, n = 10) administered glibenclamide (5 mg/kg), group III and group IV (Test groups, n = 10 for each group) received (150 and 300) mg/kg of hydroethanolic extract, group V and group VI (Test groups, n = 10 for each group) received (150 and 300) mg/kg of hexane extract of *Sonchus oleraceus* leaves receptively [10].

Determination of fasting blood glucose level

The rats were submitted to fasting for sixteen hours prior to each experiment. Blood samples were obtained from lateral tail vein of the fasting rats at zero hour to determine the blood glucose level using an electronic glucometer and immediately, group I (negative control) received water only, group II (positive control) administered glibenclamide (5mg /kg) orally by gastric intubation, group III (test group)

treated with hydroethanolic extract of *S. oleraceus* (150 mg/kg) orally by gastric intubation, group IV (test group) received hydroethanolic extract of *S. oleraceus* (300 mg/kg) orally by gastric intubation, Then blood glucose levels for each group were determined at 1, 2 and 4 hours from a blood taken from the lateral tail vein of the rats. Lastly group V and group VI (test groups) were treated with hexane extract of *S. oleraceus* with same concentration, group V were treated with hexane extract of *S. oleraceus* (150 mg/kg) orally by gastric intubation, group VI (test group) received hexane extract *S. oleraceus* (300 mg/kg) orally by gastric intubation, after that the blood glucose levels were determined at 1, 2 and 4 hours from a blood taken from the lateral tail vein of the rats for two groups using electronic glucometer [10].

Glucose tolerance test (GTT)

The blood glucose level after sixteen hours of fasting was first measured for all the animals before administration of the different treatments. All group administered glucose (2g/Kg) injected subcutaneously, then group I (negative control) received water only, group II (positive control) administered glibenclamide (5mg /kg) orally by gastric intubation, group V (test group) treated with hexane extract of *S. oleraceus* (150 mg/kg) orally by gastric intubation, group VI (test group) received hexane extract of *S. oleraceus* (300 mg/kg) orally by gastric intubation. Lastly blood glucose levels for each group was determined at 1, 2 and 4 hours from a blood taken from the lateral tail vein of the rats using electronic glucometer.

Data analysis

The data were analyzed using the statistical analysis system (SAS), JMP software programs. Analysis of variance (ANOVA) and Duncan's multiple range tests at 0.05 probability level was used to study the significance of the differences between control groups and extract groups. The obtained results were expressed as \pm standard error of mean.

Results And Discussion

In the assessment of the hypoglycemic effect of hydroethanolic and hexane extract of *S. oleraceus*, the sixty albino rats under assay were divided into six groups ten rats in each, negative control group (water), positive control group (glibenclamide 5 mg/Kg), test groups treated with both extracts separately (150, 300 mg/kg). All groups submitted to fasting for sixteen hours then the blood glucose levels (fasting and GTT) were determined at 0, 1, 2 and 4 hour and the means of results were obtained.

Fasting blood glucose

After four hours the total reduction in fasting blood glucose levels in negative control group (group I) was 11.9 mg/dl with *P-value* 0.8454. This is insignificant reduction equivalent to the groups (III, IV) treated with hydroethanolic extract (150, 300 mg/kg), which was -1.8, 14.7 mg/dl with *P-value* 0.2492, 0.1345, compared to group II (positive control group) with glibenclamide (5mg/kg) which produced significant reduction in fasting blood glucose level 55.6 mg/dl with *P-value* 0.001. The results were presented in the table 1 as mean of readings at each time interval, with *p value* for all groups.

Groups	Blood glucose level (mg/dl, mean \pm S.E.M.)				Reduction	P-value
	0 hour	1 hour	2 hour	4 hour		
Negative Control (group I)	70.1 \pm 12.181	71.0 \pm 12.461	70.7 \pm 12.348	58.2 \pm 10.58	11.9	0.8454
Positive control (group II)	105.6 \pm 5.535	76.9 \pm 6.5378	50.7 \pm 4.0001	50 \pm 6.1518	55.6	0.001
E.E. 150 mg/kg (group III)	105.3 \pm 4.3283	115.5 \pm 4.5074	117.5 \pm 4.5148	107.1 \pm 6.531	-1.8	0.2492
E.E. 300 mg/kg (group IV)	103.2 \pm 5.042	104.9 \pm 5.986	113.2 \pm 11.381	88.5 \pm 4.752	14.7	0.1345

Table 1: Fasting blood glucose level of normal albino rats receiving water, glibenclamide 5mg/Kg, hydroethanolic extract of *S. oleraceus* (150, 300 mg/kg).
E.E: hydroethanolic extract of *S. oleraceus*.

In contrast to hydroethanolic extract groups, when rats treated with hexane (group V and VI) significant reduction obtained was 22.8, 17.3 mg/dl with *P-value* 0.001 respectively, compared to the same control groups (group I and II). The results were presented in the table 2 as mean of readings at each time interval, with *p value* for all groups.

Groups	Blood glucose level (mg/dl, mean ± S.E.M.)				Reduction	P-value
	0 hour	1 hour	2 hour	4 hour		
Negative Control (group I)	70.1 ± 12.181	71.0 ± 12.461	70.7 ± 12.348	58.2 ± 10.58	11.9	0.8454
Positive control (group II)	105.6 ± 5.535	76.9 ± 6.5378	50.7 ± 4.0001	50 ± 6.1518	55.6	0.001
H.E. 150 mg/kg (group V)	79.4 ± 3.3572	82.4 ± 2.1664	64.5 ± 2.391	56.6 ± 2.4459	22.8	0.001
H.E. 300mg/ kg (group VI)	60.8 ± 2.6026	68.2 ± 2.7641	64.4 ± 3.76	43.5 ± 4.2197	17.3	0.001

Table 2: Fasting blood glucose level of normal albino rats receiving water, glibenclamide 5mg/Kg, hexane extract of *S. oleraceus* (150, 300 mg/kg).
H.E: hexane extract of *S. oleraceus*.

The administration of the hydroethanolic extract (150, 300 mg/kg) of *S. oleraceus* leaves registered insignificant result (0.2492, 0.1345), in contract to the study conducted by (Teugwa., *et al*; 2013), which showed significant hypoglycemic effect of hydroethanolic extract to whole plant. However same doses registered highly significant result, when used hexane as extraction solution compared to the positive control (*p* < 0.01). Glibenclamide is known to increase the release of insulin from pancreatic β- cell [11], however it may also increase oxidative stress [13]. The reduction in negative control group (group I) may be due to fasting.

Glucose tolerance test (GTT)

Blood glucose level for group I reduced 15.5 mg/dl from zero hour with *P-value* 0.5366, whereas group II, group III and group IV showed a total reduction of 28.6, 20.3 and 11.2 mg/dl with *P-value* 0.001, 0.3173 and 0.0305 respectively. The results were presented in the table 3 as mean of readings at each time interval, with *p value* for all groups.

Groups	Blood glucose level (mg/dl, mean ± S.E.M.)				Reduction	P-value
	0 hour	1 hour	2 hour	4 hour		
Negative Control group	60.5 ± 13.364	70.8 ± 16.555	50.7 ± 11.968	45 ± 10.113	15.5	0.5366
Positive control group	68.2 ± 4.6876	58.2 ± 3.7618	44.7 ± 3.0186	39.6 ± 2.3055	28.6	0.001
H.E. 150 mg/kg	77 ± 3.7208	71.8 ± 8.2527	69.2 ± 8.2068	56.7 ± 9.7263	20.3	0.3173
H.E. 300mg/ kg	73.3 ± 3.827	78.3 ± 5.0685	69 ± 3.0441	62.1 ± 2.6769	11.2	0.0305

Table 3: Glucose tolerance test for normal albino rats receiving water, glibenclamide 5mg/Kg, hexane extract of *Sonchus oleraceus* (150, 300 mg/kg).
H.E: hexane extract of *S. oleraceus*

For glucose tolerance test the hydroethanolic extract of *S. oleraceus* leaves was excluded due to its insignificant hypoglycemic effect in fasting blood glucose test. The blood glucose level in all groups was raised after one hour, due to induction of hyperglycemia after administration of glucose. The administration of the hexane extract (300mg/ kg) registered significant result with *P-value* 0.0305, whereas the concentration 150mg/kg conducted insignificant result with *P-value* 0.3173, in spite of the reduction was 20.3, compared to the positive control which was 28.6mg/dl with *P-value* 0.001. The insignificant result in group V may be due to the dose of extraction 150mg/kg could not reduce the blood glucose level after hyperglycemia compared to group VI which the dose was 300mg/ kg. Yet the use of hexane as extract solution for *S. oleraceus* in evaluation of hypoglycemic effect of plant is not supported with previous studies; this study appeared more effective comparison to hydroethanolic extract, which had hypoglycemic effect at doses (150, 300 mg/kg) in the study conducted by [8].

S. oleraceus is rich with polyphenolic compounds [11]. Polyphenols may also exert important antidiabetic effects by improving glucose uptake in muscle and adipocytes or may also by increasing hepatic glucokinase activity, which augments glucose utilization to promote energy storage in the form of glycogen, and by suppressing hepatic glucose output [12] so that polyphenolic compounds in the plant may be responsible for reduction in blood glucose level in group V and VI, while in group I is the reduction due to fasting. The negative result in lowering blood glucose level of the hydroethanolic extract may be explained by defatting of residue caused by hexane which lead to absence of fats - which may be responsible of the activity in the hydroethanolic extract.

Conclusions

The results obtained in the present study indicated that the hexane extract of *S. oleraceus* leaves in concentrations of 300 mg/kg had significant hypoglycemic activity in normal albino rats in both fasting blood glucose level and glucose tolerance test (*p-value* 0.001 and *P-value* 0.0305 respectively) while 150 mg/kg had significant hypoglycemic effect in fasting blood glucose level (*P-value* 0.001) and insignificant effect in glucose tolerance test (*P-value* 0.3173). The hydroethanolic extracts of *S. oleraceus* (150 mg/kg and 300 mg/kg) had insignificant hypoglycemic effect in normal albino rats in fasting blood glucose level (*P-value* 0.2492 and *P-value* 0.1345 respectively). Therefore the hexane extract from leaves of *S. oleraceus* showed a hypoglycemic activity in normal albino rats.

Bibliography

1. American Diabetes Association. "2. Classification and diagnosis of diabetes". *Diabetes Care* 38.1 (2015): S8-S16.
2. Bagust Adrian., *et al.* "An economic model of the long-term health care burden of Type II diabetes". *Diabetologia* 44.12 (2001): 2140-2155.
3. Saleem Tahira., *et al.* "Comparison of Hypoglycemic Effects of Azadirachta indica Seeds and Leaves on Alloxan Induced Diabetes in Male Albino Rats". *Pakistan Journal of Medical and Health Sciences* 12.2 (2018): 753-756.
4. Golbidi Saeid S., *et al.* "Antioxidants in the treatment of diabetes". *Current Diabetes Reviews* 7.2 (2011): 106-125.
5. Lobo Vijaya., *et al.* "Free radicals, antioxidants and functional foods: Impact on human health". *Pharmacognosy Reviews* 4.8 (2010): 118.
6. Jain SK and GK Singh. "Preliminary Phytochemical Screening and in Vitro antioxidant Activity of Extracts of whole Plant of *Sonchus Oleraceus* Asteraceae". *Research Journal of Pharmaceutical Sciences ISSN* 2319 (2014): 555X.
7. Vilela Fabiana C., *et al.* "Anti-inflammatory and antipyretic effects of *Sonchus oleraceus* in rats". *Journal of Ethnopharmacology* 127.3 (2010): 737-741.

8. Teugwa Clautilde Mofor, *et al.* "Antioxidant and antidiabetic profiles of two African medicinal plants: *Picralima nitida* (Apocynaceae) and *Sonchus oleraceus* (Asteraceae)". *BMC Complementary and Alternative Medicine* 13.1 (2013): 175.
9. Ahmed OM., *et al.* "Biochemical effects of *Cichorium intybus* and *Sonchus oleraceus* infusions and esculetin on streptozotocin-induced diabetic albino rats". *The Journal of American Science* 7.12 (2011): 1124-1138.
10. Hassan Hozeifa., *et al.* "Effects of methanolic extract of *Pausinystalia yohimbebark* on blood glucose level in normal fasting rats." (2012).
11. Katzung Bertram G. "Basic and clinical pharmacology". *Mc Graw Hill* (2012).
12. Anhô Fernando F., *et al.* "Polyphenols and type 2 diabetes: A prospective review". *Pharma Nutrition* 1.4 (2013): 105-114.
13. Pandarekandy ST., *et al.* "Hypoglycaemic Effect of Glibenclamide: A Critical Study on the Basis of Creatinine and Lipid Peroxidation Status of Streptozotocin-induced Diabetic Rat". *Indian Journal of Pharmaceutical Sciences* 79.5 (2017).

Volume 9 Issue 2 February 2021

© All rights reserved by Ronald L Hickman., *et al.*