JHE JOURNAL OF HOME ECONOMICS, MENOUFIA UNIVERSITY
Website: https://mkas.journals.ekb.eg
Print ISSN 2735-5934 Online ISSN 2735-590X
NUTRITION AND FOOD SCIENCES

Effect of Sidr (*Ziziphus spina christi*) Extracts on Induced-Diabetic Rats

Abrar El-Deoshy, Sherif Ragab
Department of Nutrition and Food Sciences, Faculty of Home Economics, Menoufia University, Shibin El Kom, Egypt

Article Type
Original Article

Corresponding author:
Abrar El-Deoshy
abrarhfzy@gmail.com
Mobile:+2 01096999538

DOI:10.21608/mkas.2024.269977.1287
Cite as:
El-Deoshy, A. Ragab, S., 2024, Effect of Sidr (Ziziphus spina christi) Extracts on Induced-Diabetic Rats. JHE, 34 (3), 1-17.

Received: 13 Feb 2024
Accepted: 31 May 2024
Published: 1 July 2024

ABSTRACT:

This study aims to determine how Sidr (*Ziziphus spina christi*) seeds and leaves ethanolic extract affect glucose levels in diabetic rats. Thirty adult male albino rats weighing 150 ±10 g were divided into six groups (five rats in each group). The first group was kept as a control (-ve) group, while the other 5 groups were injected with alloxan (150 mg/kg body weight) to become diabetic rats; one group was retained as a control (+ve), while four diabetic groups were treated with two concentrations of Sidr leaves and seeds ethanolic extract (200 and 400 mg/kg). After 28 days, serum glucose level and lipids profile, including total cholesterol (T.C.), triglycerides (T.G.), low-density lipoprotein cholesterol (LDL-c), high-density lipoprotein cholesterol (HDL-c), and very low-density lipoprotein cholesterol (VLDL-c), as well as kidney and liver functions indicators were measured. Oxidative enzyme levels, including malondialdehyde (MDA), superoxide dismutase (SOD), and catalase enzyme (CAT), were also assessed. Body weight gain (BWG), feed intake (F.I.), and Feed efficiency ratio (FER) were calculated. According to the findings, both Sidr leaves and seeds ethanolic extract reduced blood sugar levels and enhanced kidney and liver functions. Additionally, both leaves and seeds improved the lipid profile and oxidative enzymes compared to the positive control group. Also, enhanced F.I., FER, and BWG. A histological examination supported the biochemical experiments. In conclusion, all biochemical analysis reflects the power of Sidr leaves and seeds as nutraceutical therapy for the remedy for diabetic rats.

Keywords: *Sidr, ethanolic extract, Rats, blood glucose*

1. INTRODUCTION

Diabetes is a long-term condition in which the body cannot make enough insulin, causing blood glucose levels to rise. Numerous factors, including inheritance, an unhealthy lifestyle, inactivity, being overweight (or obese), etc., might contribute to the development of diabetes. As they get older, diabetics may also develop the disease's consequences, such as heart disease, kidney failure, blindness, etc. One cannot be classified as having diabetes if their blood sugar

levels are only slightly above the acceptable range (1).

Diabetes may be categorized broadly into the next groups: 1. diabetes type 1 (caused by autoimmune b-cell destruction, which typically results in a complete lack of insulin) 2. Diabetes Type 2 (induced by a gradual decline in insulin production from b-cells commonly) in addition to insulin resistance 3. Gestational diabetes mellitus (GDM) is a kind of diabetes that is detected in pregnancy in the second or third trimester but was not obviously present before conception. 4. Types of diabetes brought on by unrelated conditions, such as glucocorticoid use, HIV/AIDS treatment, or organ transplantation; exocrine pancreas diseases like cystic fibrosis and pancreatitis; as well as monogenic diabetes disorders (such neonatal diabetes and young-onset diabetes [MODY] (2).

Since ancient times, herbal therapy has been used to treat a wide variety of illnesses. According to (3), these herbs have been used to prevent or cure a wide range of illnesses, including diabetes mellitus, liver, and kidney disease one of these species is Sidr.

Sidr is particularly common in locations that are subtropical and warm-temperate of the world, with distinct species displaying different morphologies, such as spiky blooms or little leaf that are typically armed with stipular spikes (4) and (5).

Sidr has been utilized medicinally for many different conditions, particularly the treatment of diabetes, dermatitis, and skin infections like the common cold (6). Additionally, antioxidant, anti-inflammatory, and antiviral properties of Sidr have been reported (7) and (5). Sidr possess other properties such as antibacterial, antipyretic, antidiabetic, antidiarrheal, anticancer, antinociceptive, etc. (6). Modern phytochemical studies have shown that the seeds, leaves, barks, fruits, and roots of the genus Ziziphus contain 431 phytochemicals that include flavonoids, saponins, triterpenes, alkaloids, and other compounds (5). Terpenoids are widely distributed in the genus Ziziphus plants. Thus far, around forty-three triterpenes have been isolated from various plant materials such as fruits, flowers, leaves, and seeds of Z. celata, Z. spina Christi, Z. mauritiana, Z. jujuba, Z. lotus, etc. Several of these triterpenes have demonstrated encouraging biological properties (8) and (9).

Sidr seeds extract possesses anti-hyperglycemic efficacy that is comparable to that of the well-known hypoglycemic drug glibenclamide, whensidr seeds extract was given to diabetic rats treated with alloxan, blood glucose levels significantly decreased ($p < 0.05$). oral treatment of pure and prepared Sidr seeds extract decreased blood sugar levels while significantly increasing serum insulin (10).

Also, Sidr leaves exhibit significant hypoglycemic effects, even on the oxidative stress brought on by diabetes (11). Plant leaves and seeds not only had a positive impact on renal function and hepatic function, but they were also effective in protecting rats with lipid serum profiles from these conditions (12). Therefore, the purpose of this study was to investigate the Nutritional advantages of Sidr extracts in diabetic rats.

2. Materials and methods

2.1. Materials

2.1.1 Plants

Seeds and leaves of Sidr, were bought from the Agricultural Research Center, Al-Dokki, Giza Governorate, Egypt.

2.1.2 Experimental animals

Thirty adult male's albino rats weighing 150± 10 g were purchased from Medical Insects Research Institute, Dokki, Cairo, Egypt. According to (13) recommendations, rats were fed a regular diet while living in an environment that was regulated.

2.1.3 Chemical kits and injury material

Chemical kits for the measurements and alloxan were bought from El-Gomhoria Company for Trading Drugs, Chemical and Medical Instruments, Cairo, Egypt.

2.1.4 Basal diet

AIN (13) gave the following formula, which was used to create the basal diet: Corn starch (69.5%), protein (10%), corn oil (10%), cellulose (5%), choline chloride (0.2%), mineral and vitamin blend (1%), and methionine (0.3%). Camblle (14) and indicated the vitamin combination component that was used. Also, (15) suggested the salt mix component.

2.2. Methods

2.2.1 Sidr extract preparation

Preparation of Ethanolic Sidr seeds extract

Zizyphus spina-christi seeds were gathered, the pulp removed, and the seeds were cracked open to reveal the embryos. The seeds were then allowed to dry at room temperature before being ground into a fine powder using an electric mill. The 500g powdered sample was placed on a shaker at 35 °C after being extracted four times with 70% ethanol. Following two days of continuous shaking, the mixture was filtered. In the desiccator, the filtrate was dried under vacuum in the desiccators (10).

2.2.2 Preparation of ethanolic Sidr leaves extract

The leaves of Zizyphus Spina Christi were bought. After that, the leaves were cleaned, dried, and ground at room temperature. After extracting the powdered material using 70% ethanol, it was shaken for two days at 35 °C. Following filtration, add 50 ml of ethanol to dehydrate the extract, then dry it at 30 °C. Five days at 25 °C in an evaporator were spent mixing the extract powder with 50 milliliters of benzol (16).

2.2.3 Induction of diabetes

Alloxan injection at a dose of 150 mg/kg rat weight caused long-term harm to

pancreatic beta cells in normal and healthy rats according to (17).

2.2.4 Experimental design

The Science Research Ethics Committee of the Faculty of Home Economics accepted the research protocol(#17-SREC-7-2021).

All rats were given a basal diet for a week that was prepared in accordance with the recommendations of the AIN (13). Following this period of adaptation, six groups of five rats each were created. the first group of rats was kept as a negative control (-ve) group, and the other 5 groups were each given a single intraperitoneal alloxan dose (150 mg/kg body weight) to make them diabetic rats; one group of them was retained as a positive control (+ve), while four diabetic groups was treated with 200 and400 mg/kg body weight of leaves and seeds Sidr ethanolic extract.

2.2.5 Collecting blood samples

Following a 12-hour fast, the rats were slaughtered at the end of the experiment. Dry, sterile centrifuge tubes were used to collect blood samples from the portal vein. To get the serum, for 10 minutes, the blood was centrifuged at 3000 rpm. At - 20°C, serum samples were kept frozen pending chemical analysis. The liver was taken out simultaneously, dried with filter paper, weighed, and preserved in 10% formalin solution for histological investigation after being cleaned with saline solution (18).

2.2.6 Biological evaluation

According to (19), feed efficiency ratio (FER), feed intake (FI), and body weight gain (BWG) were calculated using the following formulas:

$$B.W.G. = \frac{(Final\ weight - Initial\ weight}{Initial\ weight} \times 100$$

$$F.E.R. = \frac{Gain\ in\ body\ weight\ (g)}{Feed\ intake\ (g)}$$

2.2.7 Biochemical analysis

Serum glucose was estimated using (20) method. Triglycerides, Total cholesterol, and High-density lipoprotein level were calculated using the method of (21), (22) and (23).

The following equation was used to calculate Low-Density Lipoprotein (LDL) and Very Low-Density Lipoprotein (VLDL) levels:

LDL-Cholesterol = Total Cholesterol – (HDL-c - VLDL).

VLDL-c = (TG/5) (24).

Using the method of (25), the alkaline phosphatase (ALP) concentration was calculated. The method of (26), along with the method of (27), were used to calculate aspartate aminotransferase transferase (AST) and the levels of the enzymes alanine aminotransferase (ALT). While the methods of (28), (29) and (30) were used to quantify serum creatinine, urea, and uric acid. According to (31), (32) and (33), the levels of superoxide dismutase (SOD), catalase enzyme (CAT), and malondialdehyde (MDA) were determined.

2.2.8 Statistical analysis

The results were statistically assessed using a computer program called One-way ANOVA. The results are shown as mean ± SD. According to (34), differences between treatments were deemed significant when ($P < 0.05$).

3. Results and Discussion

Effect of Sidr leaves and seeds extracts on BWG, FI and FER of diabetic rats

Data presented in Table (1) demonstrates the impact of the administration of Sidr leaves and seeds extract on body weight gain (BWG), food intake (FI), and feed efficiency ratio (FER) of diabetic rats.

The data revealed that the positive control group exhibited lower average values of body weight gain (BWG), feed intake (FI), and feed efficiency ratio (FER) when compared to the negative control group, resulting in a statistically significant distinction ($P \leq 0.05$).

The groups that were fed on Sidr leaves at a dosage of 200 and 400mg/kg of body weight exhibited the lowest recorded mean value of the body weight gain, and this difference was found to be statistically significant compared to groups treated with seeds extract.

The administration of Sidr seeds, at a dosage of 200 and 400 mg/kg of body weight, to the diabetic rats resulted in statistically significant increases in the average values of BWG, FI and FER in comparison to the positive control group.

The diabetic group treated with Sidr seeds, at a dosage of 400 mg/kg of body weight, exhibited the highest mean value of BWG, FI and FER when compared to the positive control group.

Table (1). Effect of Sidr leaves and seeds extract on BWG, FI and FER of diabetic rats

Groups	BWG (g/day)	FI (g/day)	FER
Group (1): negative control(-ve)	2.33 a±0.057	22.06a±0.56	0.105a±.012
Group (2): positive control(+ve)	0.73 d ±0.305	12.3c±1.55	0.0603c±.010
Group (3): Ethanolic extract of Sidr leaves 200mg/kg	0.66d±0.208	14.5bc±0.95	0.045d±.011
Group (4): ethanolic extract of Sidr seeds 200mg/kg	1.8b±.1	18.62ab±1.9	0.096ab±.0045
Group (5): ethanolic extract of Sidr leaves 400mg/kg	1.26c±0.152	15.26bc±3.05	0.083b±.007
Group (6): ethanolic extract of Sidr seeds 400mg/kg	2.3 a±0.264	21.8a±2.52	0.1003a±.0055
LSD	0.282	3.13	5.88

Means with different superscript letters in the same column are significantly different at P≤0.05.

During treatment, diabetic rats administered with Sidr seeds extract (2 doses: 200 and 400 mg/kg) and glibenclamide (0.6 mg/kg) had a progressive increase in body weight of 9.54%, 11.98%, and 9.92%, respectively. The dose of 400 mg/kg resulted in the greatest increase in body weight (10).

Also, these results concur with those made by (35), who showed that when comparing the BWG of the treated diabetes groups to the untreated diabetic group, a substantial increase was observed in the end weight. The best treatment was Sidr seeds powder, which

was followed by Sidr leaves powder in final weight and BWG values.

Results from studies by (36) and (37) corroborated the previous findings, they showed that Sidr leaves extract therapy can raise BW and FI.

Effect of Sidr leaves and seeds extract on serum glucose level of diabetic rats

Data in Table (2) demonstrate how Sidr extract effects on blood glucose of diabetic rats. These results show that the mean value of serum glucose level of diabetic rats' group was significantly higher than those of normal rats. The mean values were 256and 83mg/dl, respectively. Compared to the control positive group, all variable treatments (G3, G4, G5, and G6) exhibited significant reductions in serum glucose value, the mean values were 212, 163, 21, 190,605 and 157 mg/dl, respectively. When compared to diabetic rats' group, group 6 obtained the most significant value.

Table (2). Effect of Sidr leaves and seeds extract on serum glucose level of diabetic rats

Groups	Glucose (mg/dl)
Group (1): negative control(-ve)	83f ±4.35
Group (2): positive control(+ve)	256a±2.64
Group (3): Ethanolic extract of Sidr leaves 200mg/kg	212b±1.0
Group (4): Ethanolic extract of Sidr seeds 200mg/kg	163d±3.21
Group (5): Ethanolic extract of Sidr leaves 400mg/kg	190c±3.605
Group (6): Ethanolic extract of Sidr seeds 400mg/kg	157e±2.0
LSD	5.35

Means with different superscript letters in the same column are significantly differentatP≤0.05.

These results concur with those made by (11), who showed that treatment with Sidr extract orally caused a considerable drop in blood sugar level. Comparing treated diabetic rats' groups with control STZ diabetic rats, the ziziphus extract considerably also significantly raised serum insulin levels.

impact of giving aqueous extracts derived from the leaves and seeds of buckthorn to STZ-diabetic mice on blood glucose and gluco-hemoglobin (glycated hemoglobin). The treatment with buckthorn aqueous extracts of leaves and seeds dramatically reduced these parameters pushing them to the normal range (38).

Also, these findings concur with those made by (39), they showed that Sidr leaves hydro-ethanol extract has anti-hyperglycemic, anti-dyslipidemia and liver and kidney protective properties.

Effect of Sidr leaves and seeds extract on liver functions level of diabetic rats

Table (3) presents an exposition of the influence of Sidr on the hepatic enzymes found in the serum of rats afflicted with diabetes, specifically as it pertains to the enzymatic activities of ALT, AST, and ALP. Data indicates that the average values of ALT, AST, and ALP enzymes in the group of rats with diabetes (control positive) were 101.83, 209.5 and 258.46 (u/l), respectively. On the other hand, in normal rats, these values were 75.66, 104.73 and 155.63 (u/l), respectively. The AST levels in all treatment groups were found to be improved by Sidr extract,

according to the results. Regarding ALT and ALP, the findings indicated noteworthy declines in ALT and AlP among diabetic rats that were nourished with Sidr extracts in comparison to the control positive group. Group (6) achieved the best performance in ALT, AST and ALP the mean values were 73.33, 121.83 and 155.3 (u/l), respectively.

Table (3): Effect of Sidr leaves and seeds extract on liver functions level of diabetic rats

Groups	ALT(U/L)	AST(U/L)	ALP(U/L)
Group (1): Negative control(-ve)	75.66de±2.51	104.73f±1.56	155.63e±2.27
Group (2): Positive control (+ve)	101.83a±2.11	209.5a±1.96	258.46a±1.26
Group (3): Ethanolic extract of Sidr leaves 200mg/kg	83.36b±3.2005	153.6b±3.55	177.33b±2.85
Group (4): Ethanolic extract of Sidr seeds 200mg/kg	78.03cd±1.56	128.26d±1.02	161.3d±1.21
Group (5): Ethanolic extract of Sidr leaves 400mg/kg	80.43bc±1.16	133.16c±2.05	168.6c±2.88
Group (6): Ethanolic extract of Sidr seeds 400mg/kg	73.33e±0.862	121.83e±2.74	155.3e±3.1
LSD	3.67	4.091	4.25

Means with different superscript letters in the same column are significantly different at$P \leq 0.05$.

Thes results are consistent with (40), who demonstrated that Sidr extracts can decrease the activities of ALP, AST, and ALP. However, the liver enzymes were greatly restored to normal levels by the aqueous extract derived from the seed of Sidr.

Administering water extracts of buckthorn seeds and leaves to diabetic rats significantly reduced the elevated liver function enzyme action, but the induction of diabetes to rats resulted in a noteworthy elevation in the concentrations of the scrutinized hepatic functional enzymes (AST, ALT and ALP) when compared to the negative control (38).

Also, (39) showed that the serum levels of alanine transaminase, aspartate transaminase, and alkaline phosphatase activities which have been determined were considerably lower in the Sidr extract and standard drug treatment groups, compared to the control positive diabetic rats.

Christ's Thorn fruit were effective in protecting against hepatic rats not only decreased the level of AST, ALT and ALP but also has beneficial effect on lipids profile and renal profile. Therefore, data recommend as tested Christ's Thorn by a moderate amount to be included in our daily diets (41).

Effect of Sidr leaves and seeds extract on kidney functions of diabetic rats

The information in Table (4) shows the effect of Sidr on the kidney capabilities of diabetic rats (urea, creatinine, and uric acid). Data indicated that the urea levels of the positive group exhibited the highest value in comparison to the negative group with a significant disparity. The mean values were 57.83 and 44.16 mg/dl for positive and negative group. While the lowest levels of urea were observed in group of rats that were fed with Sidr seeds at a dosage of 400

mg/kg body weight. Also, a significantly lower value was observed in the group that consumed Sidr seeds extract at a dosage of 200 mg/kg body weight. The average values for urea were 41 and 46.33mg/dl, respectively.

Information about creatinine levels indicated that the positive group had the highest value when compared to the negative group with a significant difference. The average values were 1.73 and 0.74 mg/dl, respectively. Creatinine levels were low in the group that consumed 400 mg/kg of Sidr seeds. On the other hand, creatinine levels were the highest in the group that consumed 200 mg/kg of Sid leaves powder. Individually, the mean values were 0.52and 1.3mg/dl.

According to uric acid, it is clear to see that the positive control recorded the highest values when compared to the negative control group with a significant difference. The mean values were 4.3 and 2.53mg/dl, respectively while the lowest levels of uric acid were observed in the group that consumed 400 mg/kg of Sidr seeds.

Table (4): Effect of Sidr leaves and seeds extract on kidney functions of diabetic rats

Groups	Urea (mg/dl)	Creatinine (mg/dl)	Uric acid(mg/dl)
Group (1): Negative control (-ve)	44.16de±1.33	0.74c±0.215	2.53c±0.25
Group (2): Positive control(+ve)	57.83a±1.73	1.73a±0.865	4.3a±0.2
Group (3): Ethanolic extract of Sidr leaves 200mg/kg	54 b±1	1.3b±0.1	3.96a±0.15
Group (4): Ethanolic extract of Sidr seeds 200mg/kg	46.33d±2.47	0.79bc±0.131	2.53c±0.37
Group (5): Ethanolic extract of Sidr leaves 400mg/kg	50.4c±2.69	0.96c±0.294	3.2b±0.1
Group (6): Ethanolic extract of Sidr seeds 400mg/kg	41e±2	0.52c±0.049	1.2d±0.32
LSD	3.49	0.359	0.449

Means with different superscript letters in the same column are significantly different at P≤0.05.

These findings follow the same pattern reported by (38), who found that rats in the diabetic positive control group had higher renal function in comparison to those in the negative control group. The aqueous buckthorn seeds and leaves significantly improved renal function restoration.

Also, (39), found that the extract of Sidr leaves significantly decreased urea concentrations in comparison to the diabetic control group, and Sidr demonstrates kidney protective properties in a diabetic rat, validating its conventional use in diabetes.

Effect of sidr leaves and seeds extract on lipid profile level of diabetic rats

The influence of Sidr on the lipid profile (TG -TC HDL-c, LDL-c, and VLDL-c,) in the serum of rats afflicted with diabetes is presented in Table (5). The TG level of the positive group exhibited the highest value in comparison to the negative group, with a statistically significant difference. The mean values were 144.00and 84.4mg/dl, respectively. While the lowest TG level was observed in the group that consumed 400 mg/kg of sidr seeds extract.

Data also indicated that the positive group exhibited significantly higher cholesterol levels compared to the negative group, with a significant difference. The mean values were 163.7and 101.56 mg/dl.While the group that consumed 400 mg/kg of Sidr seeds had the lowest recorded cholesterol levels, the group that consumed 200 mg/kg of Sidr leaves had the highest recorded levels, exhibiting a significant contrast. The average values were 128.20 and 146.63 mg/dl, respectively.

The obtained results indicated that the levels of high-density lipoprotein cholesterol (HDL-c) in the positive group exhibited the lowest value when compared to the negative control group, with a significant difference. The average values were 13.7and 55.7 mg/dl.While the most minimal (HDL-c) levels recorded that group fed on 200 mg/kg form Sidr leaves, the most noteworthy worth recorded for that group fed on 400 mg/kg form Sidr seeds with huge distinction (P≤0.05). The mean values were 36.5 and 56mg/dl. Also, group (6) showed non-significant differences compared to normal rats.

Data also indicated that the positive group exhibited the highest value in terms of low-density lipoprotein (LDL-c) levels when compared to the negative group, with a significant difference. The average values were 121.2and 28.92mg/dl, respectively. While the lowest levels of low-density lipoprotein cholesterol (LDL-c) were observed in the group that consumed 400 mg/kg of Sidr seeds, the highest levels were observed in the group that consumed 200 mg/kg of Sidr leaves, resulting in a significant difference. The average values were 52.72 and 84.1 mg/dl, respectively.

Table (5): Effect of Sidr leaves and seeds extract on lipid profile level of diabetic rats

Group	T.G (mg/dl)	Chol. (mg/dl)	HDL (mg/dl)	LDL (mg/dl)	VLDL (mg/dl)
Group (1): Negative Control(-ve)	84.4e±1.45	101.56f±2.8	55.7a±1.0	28.92f±3.15	16.82e±0.31
Group (2): Positive control(+ve)	144.0a±2.55	163.7a±1.9	13.7e±2.7	121.2a±4.33	28.8a±0.51
Group (3): Ethanolic extract of Sidr leaves 200mg/kg	129.96b±2.9	146.63b±3.4	36.5d±1.2	84.14b±3.07	25.99b±0.57
Group (4): Ethanolic extract of Sidr seeds 200mg/kg	124.36c±1.1	135.73d±1.8	50.56b±1.62	60.29d±0.75	24.87c±0.22
Group (5): Ethanolic extract of Sidr leaves 400mg/kg	124.56c±2.1	141.33c±1.1	45.23c±3.12	71.15c±3.71	24.91c±0.41
Group (6): Ethanolic extract of Sidr seeds 400mg/kg	97.7d±3.47	128.20e±2.3	56a±2.36	52.72e±1.64	19.54d±0.69
L.S.D	4.26	4.37	3.81	5.39	0.856

Means with different superscript letters in the same column are significantly different atP≤0.05.

According to low-density lipoprotein (VLDL-c) levels, the group with positive results exhibited the highest value in comparison to the negative group,

showing a significant difference. The average values were 28.8and 16.82 mg/dl, respectively. While the group fed on 400 mg/kg of Sidr seeds had the lowest levels of (VLDL-c), the group fed on 200 mg/kg of Sidr leaves had the highest levels, which differed significantly compared to positive control group.

These findings are corroborated by (11), who revealed that sidr extract significantly decreased triglycerides in comparison to control rats with diabetes, indicating that it has a hypolipidemic impact. The diabetic rats treated with extract had lower cholesterol levels than the control positive group.

Also, these findings concur with those of (38), who examined the impact of buckthorn aqueous leaf and seed extracts on lipid profile in STZ diabetic rats. In positive control group as opposed to the group of negative control, the levels of triglycerides, totalcholesterol,VLDL, and LDL were basically higher, while the levels of HDL were significantly lower. Total cholesterol, triglycerides, LDL, and VLDL levels were significantly reduced while HDL levels were elevated in diabetic rats treated with the aqueous solution derived from buckthorn seeds and leaves.

The groups treated with the Sidrl eaves extract had reduced levels of triacylglycerol and low-density lipoprotein, indicating a healthy lipid profile (39).

The potential slimming effect of brown algal diets, particularly at 5% as compared to 3% level in obese rats, has been reported for Nabka (fruit, leaves, and seeds) (Ziziphus jujuba) (42).

Effect of Sidr leaves and seeds extract on oxidative parameters of diabetes rats

The findings in Table (6) demonstrated how Sidr extract affected oxidant and antioxidative parameters in diabetic rat. Table (6) shows that in rats given alloxan intoxication without therapy, enzymatic antioxidants CAT and SOD were respectively 3.95and 1.9 mg/dl. The levels of the enzymes were 17.05and 8.7mg/dl respectively, in normal rats. These results show that the enzymatic antioxidants in the control positive group significantly decreased. All groups that received Sidr extracts showed increases in CAT and SOD levels compared to positive groups. Comparing all groups, Group 6 had the biggest increase in SOD and CAT. Regarding MDA levels, it is noteworthy to observe a substantial surge in positive control group(+ve) when contrasted with negative control group (-ve). Moreover, a significant decrease in MAD levels was observed in all treated groups compared to the positive control group.

The data from this study are comparable to those from a study by (43), who reported that Sidr was found to have antioxidant activity.

These findings concur with those made by (44), who reported that Sidr leaves include secondary metabolites like flavonoids, polyphenols, saponins,

triterpenoids, and tannins that can serve as a source of antioxidants.

Table (6): Effect of Sidr leaves and seeds extract on oxidative parameters of diabetes rats

Groups	CAT (mg/dl)	SOD (mg/dl)	MDA (mg/dl)
Group (1): Negative control(-ve)	17.05a±1.65	8.7a±0.6	61e±0.6
Group (2): Positive control(+ve)	3.95d±0.15	1.9b±0.7	92.45a±2.25
Group (3): Ethanolic extract of Sidr leaves 200mg/kg	8.55 c±1.65	3.35cd±2.25	85.2b±3.1
Group (4): Ethanolic extract of Sidr seeds 200mg/kg	14.2ab±2.4	5.5bc±1.1	73.75d±1.75
Group (5): Ethanolic extract of Sidr leaves 400mg/kg	11.2bc±1.1	7.2ab±2.1	79.65c±0.85
Group (6): Ethanolic extract of Sidr seeds 400mg/kg	17.7a±2.8	9.25a±0.25	63.5e±2.5
LSD	3.27	2.47	3.63

Means with different superscript letters in the same column are significantly different at$P \leq 0.05$.

Histopathological examination of liver

Microscopically, the liver sections of rats in group (1) negative control (-ve) displayed the typical histological structure of hepatic lobules, including a normal central vein and normal hepatocytes (photos 1, 2 and 3). On the contrary, the liver of rats in group (2) positive control (+ve) exhibited hepatocellular vacuolar degeneration, fibroplasia in the portal triad (photo 4), focal hepatocellular necrosis accompanied by infiltration of inflammatory cells (photos 5, 6 and 7), activation of Kupffer cells, and portal infiltration with inflammatory cells (photo 7). Concurrently, sections originating from group (3) (ethanolic extract of Sidr leaves 200mg/kg) exhibited activation of Kupffer cells (photos 8, 9 and 10), engorgement of the central vein (photo 9), and infiltration of inflammatory cells in the portal region (photo 10). However, certain segments from group (4) (ethanolic extract of Sidr seeds 200mg/kg) demonstrated the presence of central vein congestion (photo 11), hepatoportal blood vessel congestion, and portal infiltration with a limited number of inflammatory cells (photo 12). Conversely, other segments displayed no discernible histopathological changes (photo 13). Otherwise, the liver of rats from group (5) (ethanolic extract of Sidr leaves 400mg/kg) exhibited the activation of Kupffer cells and a minor vacuolar degeneration of centrilobular hepatocytes (photos 14 and 15). Examined sections obtained from group (6) (ethanolic extract of Sidr seeds 400mg/kg) demonstrated an activation of Kupffer cells (photos 16, 17, and 18), sporadic hepatocyte necrosis (photo 17), and congestion of the central vein (photo18). These results agree with (45), who reported that the protective effect of Sidr leaves on hepatic and splenic tissues through reinstatement the normal levels of the oxidative markers and impeding the progression of hepatic and splenic fibrosis upon *P. berghei* induced hepatic and splenic inflammation.

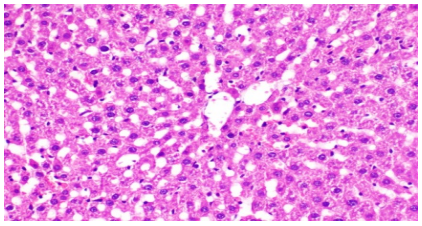

Photo. (1): Phototomicrograph of the liver of a rat from group (1) negative control(-ve) exemplifies the typical histological conphotouration of the hepatic lobule (H & E, x400).

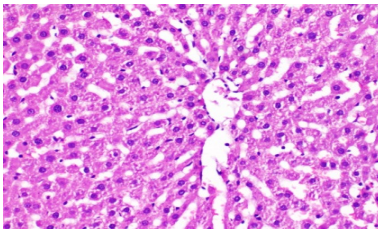

Photo. (2): A phototomicrograph of a rat's liver from group (1) negative control(-ve) demonstrates the typical histological structure of the hepatic lobule (H & E, x400).

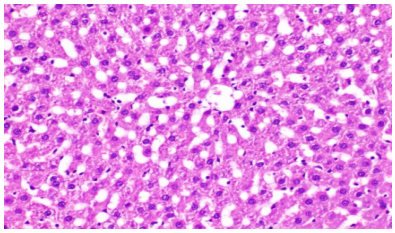

Photo. (3): A phototomicrograph depicting the liver of a rat in group 1 displays the typical histological arrangement of the hepatic lobule (H & E, x400).

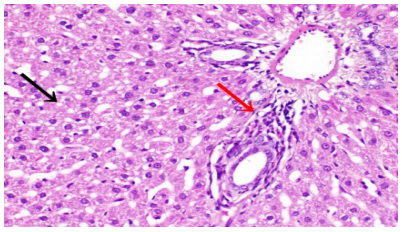

Photo. (4): Phototomicrograph of the liver of a group (2) positive control(+ve) rat demonstrating fibroplasia in the portal triad (red arrow) and hepatic vacuolar degeneration (black arrow) (H & E, x400).

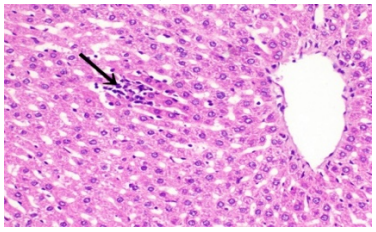

Photo. (5): The phototomicrograph of a rat from group (2) positive control(+ve) liver demonstrates focal hepatocellular necrosis linked to inflammatory cell infiltration (arrow) (H & E, x400).

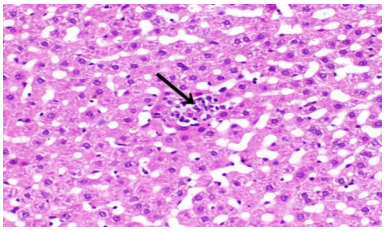

Photo. (6): The phototomicrograph of a rat from group (2) positive control(+ve) liver demonstrates focal hepatocellular necrosis linked to inflammatory cell infiltration (arrow) (H & E, x400).

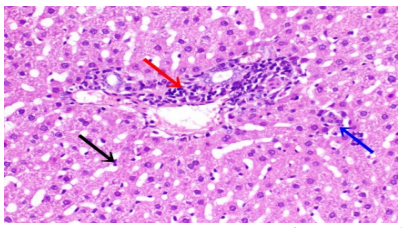

Photo. (7): Phototomicrograph of the liver of a group (2) positive control(+ve) rat demonstrating activation of Kupffer cells, focal hepatocellular necrosis linked to inflammatory cell infiltration, and portal infiltration with inflammatory cells (H & E, x400).

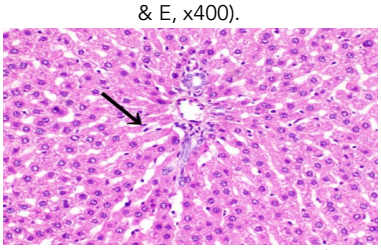

Photo. (8): Phototomicrograph of the rat's liver in group (3) ethanolic extract of sidr leaves 200mg/kg demonstrating Kupffer cell activity (black arrow) (H & E, x400).

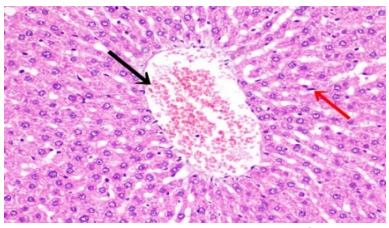

Photo. (9): Phototomicrograph of the rat's liver in group (3) ethanolic extract of sidr leaves 200mg/kg demonstrating central venous obstruction (black arrow) and Kupffer cell activity (red arrow) (H & E, x400).

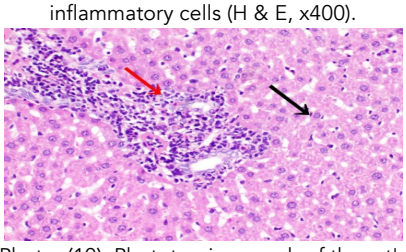

Photo. (10): Phototomicrograph of the rat's liver in group (3) (ethanolic extract of sidr leaves 200mg/kg) exhibits the activation of Kupffer cells (indicated by the black arrow) and the infiltration of inflammatory cells in the portal (indicated by the red arrow) (H & E, x400).

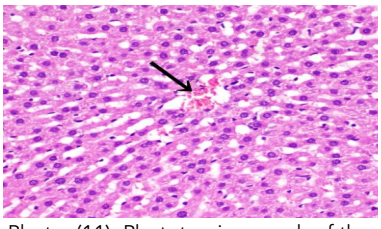

Photo. (11): Phototomicrograph of the central vein congested in the liver of a group (4) (ethanolic extract of sidr seeds 200mg/kg) (black arrow) (H & E, x400).

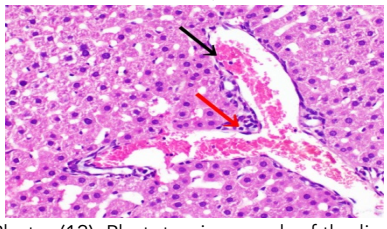

Photo. (12): Phototomicrograph of the liver in a group (4) (ethanolic extract of sidr seeds 200mg/kg) demonstrating portal infiltration with few inflammatory cells and congested hepatoportal blood vessels (black arrow) (H & E, x400).

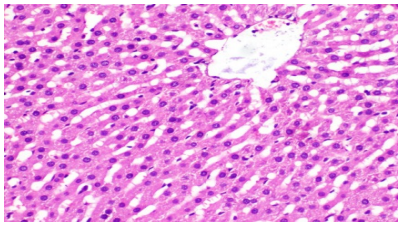

Photo. (13): Phototomicrograph of the liver of a group (4) (ethanolic extract of sidr seeds 200mg/kg) demonstrating no histological changes (H & E, x400).

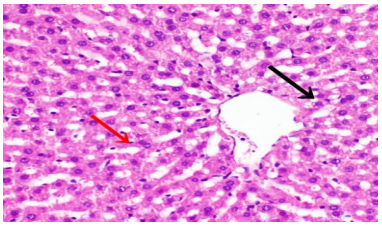

Photo. (14): Phototomicrograph of the liver of a rat from group (5) (ethanolic extract of sidr leaves 400mg/kg) demonstrating mild vacuolar degeneration of centrilobular hepatocytes (black arrow) and activation of Kupffer cells (red arrow) (H & E, x400).

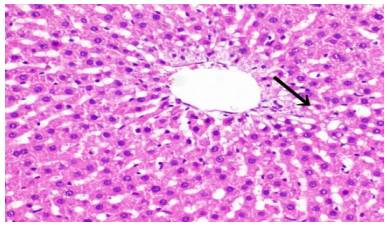

Photo. (15): A phototomicrograph exhibiting centrilobular hepatocytes in the liver of a rat from group (5) (ethanolic extract of sidr leaves 400mg/kg) is presented herein, showcasing slight vacuolar degeneration. (black arrow) (H & E, x400).

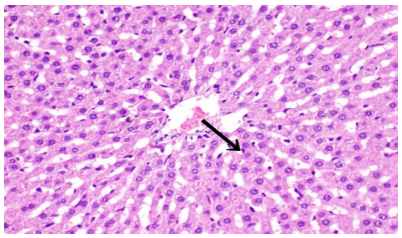

Photo. (16): Phototomicrograph of the liver of a group (6) (ethanolic extract of sidr seeds 400mg/kg) demonstrating the activation of Kupffer cells (black arrow) (H & E, x400).

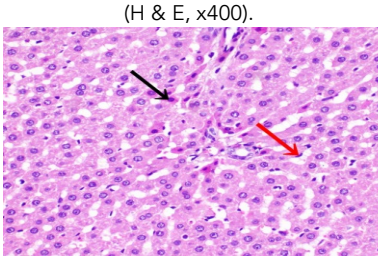

Photo. (17): Phototomicrograph of the liver of a rat from group (6) (ethanolic extract of sidr seeds 400mg/kg) demonstrating necrosis of sporadic hepatocytes (black arrow) and activation of Kupffer cells (red arrow) (H & E, x400).

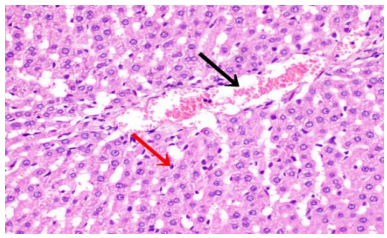

Photo. (18): Phototomicrograph of the liver of a group (6) (ethanolic extract of sidr seeds 400mg/kg) rat demonstrating the activation of Kupffer cells (red arrow) and obstruction of the central vein (black arrow) (H & E, x400).

Conclusion

Sidr leaves, and seeds efficiently decreased glucose levels and lipid profiles. These findings confirm our supposition that the tested leaves and seeds contained several important compounds, such as saponin glycosides, polyphenols, flavonoids, and terpenoids, which act as antidiabetic, anti-hyperlipidemia, antioxidant, anti-inflammatory, and antitoxic. Therefore, we recommend these leaves and seeds in modest amounts in our daily diets or drinks.

References

1. Rahayu, W.; Santi, V. M. and Putri, B. S. Classification of diabetes events using discriminant analysis. In Journal of Physics: Conference Series (2019); (Vol. 1402, No. 7, p. 077102). IOP Publishing.
2. American Diabetes Association. 2. Classification and diagnosis of diabetes: standards of medical care in diabetes— Diabetes care, 41:(2018); 13-27.
3. Alsayari, A.; Muhsinah, A. B.; Almaghaslah, D.; Annadurai, S. and Wahab, S. Pharmacological efficacy of ginseng against respiratory tract infections. Molecules, (2021); 26(13): 4095.

4. Wojdyło, A.; Carbonell-Barrachina, Á. A.; Legua, P. and Hernández, F. Phenolic composition, ascorbic acid content, and antioxidant capacity of Spanish jujube (Ziziphus jujube Mill.) fruits. Food Chemistry, (2016); 201: 307-314.

5. El Maaiden, E.; El Kharrassi, Y.; Qarah, N. A.; Essamadi, A. K.; Moustaid, K. and Nasser, B. Genus Ziziphus: A comprehensive review on ethnopharmacological, phytochemical and pharmacological properties. Journal of Ethnopharmacology, (2020); 259, (15): 112950.

6. Ji, X.; Peng, Q.; Yuan, Y.; Shen, J.; Xie, X. and Wang, M. Isolation, structures, and bioactivities of the polysaccharides from jujube fruit (Ziziphus jujuba Mill.): A review. Food Chemistry, (2017); 227: 349-357.

7. Ouelbani, R.; Bensari, S.; Mouas, T. N. and Khelifi, D. Ethnobotanical investigations on plants used in folk medicine in the regions of Constantine and Mila (North-East of Algeria). Journal of Ethnopharmacology, (2016); 194: 196-218.

8. Ríos, J. L.; Recio, M. C.; Maáñez, S. and Giner, R. M. Natural triterpenoids as anti-inflammatory agents. Studies in Natural Products Chemistry, (2000); 22, 93-143.

9. Ahmad, R.; Ahmad, N. and Naqvi, A. A. "Ziziphus oxyphylla": Ethnobotanical, ethnopharmacological and phytochemical review. Biomedicine and Pharmacotherapy, (2017);91: 970-998.

10. Al-Awar, M. Anti-diabetic activities of Zizyphus spina-christi seeds embryos extract on general characteristics of diabetes, carbohydrate metabolism enzymes and lipids profile in rats. Jordan Journal of Pharmaceutical Sciences, (2019); 12(2): 1-17.

11. Khaleel, S. M.; Almuhur, R. A.; Al-Deeb, T. M.; Jaran, A. S.; Al-Jamal, A. A. and Abu-zaiton, A. S. Antidiabetic and hypolipidemic effects of ethanolic leaf extract of Ziziphus spina-christi on normal and streptozotocin-induced diabetic rats. EurAsian Journal of Bio Sciences, (2020); 14(2): 5865-5870.

12. El-Hassaneen, Y. and Esraa Matter, E. Study the effect of papaya leaves and seeds on liver disorders in carbon tetrachloride-induced hepatic rat. . Journal of Home Economics, (2020); 30 (4): 26-46.

13. AIN, A. American Institute of Nutrition purified diet for laboratory rodent: final Report to Journal of Nutrition, (1993); 123: 1939-1951.

14. Campbell, J.B. Methodology Evaluation, Nutrition, Doc. R. 101 Add 37, WHO/ FAO UNICEF. PAG. (1961).

15. Hegsted, D.M.; Mills, R.C.I.; Elvehjen, C.A. and Hart, E.B. Choline in the nutrition of chicks. Journal of Bio.Chem., (1941); 138:459.

16. Parsaeyan, N. and Rezvani, M. E. The effect of christ's thorn (Ziziphus spina christi) leaves extract on lipid profile, lipid peroxidation and liver enzymes of diabetic rats. Iran Journal of Diabetes Obesity, (2014); 6(4):163-167.

17. Zhao, Z. H.; Watschinger, B.; Brown, C. D.; Beyer, M. M. and Friedman, E. A. Variations of susceptibility to alloxan induced diabetes in the rabbit. Hormone and Metabolic Research, (1987); 19(11): 534-537.

18. Drury, R. A. B. and Wallington, E. A. Carlton's Histological Techniques .5th Ed., Oxford University Press. (1980).

19. Chapman, D.G.; Castilla, R. and Campbell, J.A. Evaluation of protein in food. LA. method for the determination of protein efficiency ratio. Can. Journal of Biochem. Physiol., (1959); 37: 679 – 686.

20. Kaplan, L. A. Clinical Chemistry. The C.V. Mosby Co. St Louis. Toronto. Princeton, (1984); 1032-1036.

21. Fassati, P. and Prencipe, L. Triglyceride enzymatic colorimetric method. Journal of Clinical Chemistry, (1982); 28:2077.

22. Allain, C.C. Cholesterol enzymatic colorimetric method. Journal of Clinical Chemistry, (1974); (20): 470.

23. Lopez, m. F. HDL-Cholesterol colorimetric method. Journal of Clinical Chemistry, (1977); 23: 882.

24. Lee, R. and Nieman, D. Nutrition Assessment. 2nd Ed. Mosby, Missouri, USA. (1996)

25. International Federation of Clinical Chemistry (IFCC). Methods for the measurement of catalytic concentration of enzymes, part 5: IFCC, methods for alkaline phosphatase. Journal of Clinical Chemistry and Clinical Biochemistry, (1983); 21:731-748.

26. Yound, D.S. Determination of GOT. Journal of Clinical Chemistry, (1975); 1:21.

27. Henry, R. j.; Cannon, D.C. and Winkelman, J. w. Clinical Chemistry, principles, and techniques. 2nd Ed., Harper, and Row Company, (1974); 337: 993.

28. Schirmeister, J. Creatinine standard and measurement of serum creatinine with picric acid. Deutsche Medizinische Wochenschrift, (1964); 89: 1018-1021.

29. While, B.A.; Erickson, M.M. and Steven, S.A. Chemistry for Medical Theologists. 3 rd Ed., C. V. Mosby Company Saint Louis, (1970); USA, p. 662.

30. Malhotra, V. K. Practical Biochemistry for Students. Fourth Edition, Jaypee Brothers Medical Publishers (p) LT, New Delhi, India (2003).

31. Nishikimi, M.; Appaji, N. and Yagi, K. The occurrence of superoxide anions in the reaction or reduced phenazine methosulfate and molecular oxygen. Biochemical and Biophysical Research Communications, (1972); 46 (2): 849-854.

32. Ohkawa, H.; Ohishi, W. and Yagi, K. Assay for lipid peroxides in animal tissues by the Thio barbituric acid reaction. Analytical Biochemistry, (1979); 95(2):351–358.

33. Aebi, H. Catalase in vitro. In: Methods in Enzymology, Academic Press, New York, pp., (1984); 479-500.

34. Steel, R. G. and Torrie, J. H. Principles and Procedures of Statistics McGraw-Hill Book. Co. Inc., New York, (1980); 2-633.

35. El-Hashash, S. A. Co-therapeutic effects of metformin and sidr fruits and leaves in experimental diabetic rats. Egyptian Journal of Nutrition and Health, (2020); 15(1): 17-37.

36. Ewenighi, C. Estimation of glucose level and body weight in alloxan induced diabetic rat treated with aqueous extract of Garcinia kola seed. The Ulutas Medical Journal, (2015); 1(2): 26-30.

37. Udia, P. M.; Takem, L. P.; Ufot, U. F.; Antai, A. B. and Owu, D. U. Insulin and alpha amylase levels in alloxan-induced diabetic rats and the effect of Rothmannia hispida (K. Schum) Fagerl leaf extract. The Journal of Phytopharmacology, (2016); 5(1): 1-5.

38. Alsieni, M. A.; El Rabey, H. A.; Al-Sieni, A. I. and Al-Seeni, M. N. Comparison between the antioxidant and antidiabetic activity of fenugreek and buckthorn in streptozotocin-induced diabetic male rats. BioMed Research International, (2021); 1-12.

39. Mohammed, A.; Abdulrasak, M. A.; Musa, A. L.; Liman, J. H.; Israel, E.; Harry, U. and Dickson, O. Anti- hyperglycemic and selected organ protective effects of Ziziphus spina-christi hydroethanol leaf extract in alloxan induced diabetic rats. Gadau Journal of Pure and Allied Sciences, (2023); 2(2): 146-155.

40. Al-Sieni, A. I.; El Rabey, H. A. and Al-Seeni, M. N. The aqueous extract of Sidr (Ziziphus spina-christi) seed modulates hyperlipidemia in hypercholesterolemic male rat. Biomedical Research, (2020); 31(3): 71-78.

41. Khader, S.A.; El-Khatib, B.R. and El-Sheikh, Y.E. Effect of christ's thorn (Ziziphus Spina- Christi) and tiger nut fruits on liver disorder in carbon tetrachloride induced hepatic rats. Journal of Home Economics, (2017); 27 (3): 75-93.

42. El-Hassaneen, Y.A.; Ahmed, A.A.; El-Dashlouty, M.S.; Bakry, A.A. and Moghawry, M.Z. Effect of diets containing evening primrose flower brown algae and Nakba plant parts on obese male albino rats. Journal of Home Economics, (2019); 29 (2): 1-18.

43. Hamadnalla, H. M.; Ali, M. A. A. M.; Ahmed, A. A. and Almakki, A. A. Anti-microbial and antioxidant activities of Ziziphus spina christi, Sudanese medicinal plant. Journal of Biotechnology and Bioinformatics Research, (2020); 2(2): 1-3.

44. Rialdi, A. P.; Prangdimurti, E. and Saraswati, S. Effect of different solvent on the Antioxidant capacity of bidara leaves extract (Ziziphus Spina-Christi). Devotion Journal of Community Service, (2023); 4(6): 1222-1233.

45. Hafiz T.A. and Mubaraki M.A. The potential role of Ziziphus spina-christi leaf extracts against Plasmodium berghei-induced liver and spleen injury. Biomedical Research-India (2016); 27: 1027-1032.

مجلة الاقتصاد المنزلي، جامعة المنوفية

https://mkas.journals.ekb.eg

الترقيم الدولي اون لاين 2735-590X

الترقيم الدولي للطباعة 2735-5934

التغذية وعلوم الاطعمة

تأثير مستخلص السدر على الفئران المصابة بالسكري

أبرار الدعوشي، شريف رجب

قسم التغذية وعلوم الأطعمة .كلية الاقتصاد المنزلي .جامعة المنوفية، شبين الكوم، مصر

نوع المقالة

بحوث اصلية

المؤلف المسئول

أبرار الدعوشي

abrarhfzy@gmail.com

الجوال 01096999538 2+

DOI:10.21608/mkas.2024.269977.1287

الاستشهاد الي:

El-Deoshy, A. Ragab, S., 2024, Effect of Sidr (Ziziphus spina christi) Extracts on Induced-Diabetic Rats. JHE, 34 (3), 1-17.

تاريخ الاستلام: ١٣ فبراير ٢٠٢٤

تاريخ القبول: ٣١ مايو ٢٠٢٤

تاريخ النشر: ١ يوليو ٢٠٢٤

الملخص العربى:

الغرض من هذه الدراسة هو تقدير تأثير المستخلص الإيثانولى لبذور وأوراق نبات السدر على مستويات الجلوكوز فى الفئران المصابة بداء السكري. تم تقسيم ثلاثين فأراً بالغاً من الفئران البيضاء بوزن ١٥٠±١٠ جرام إلى ست مجموعات (خمسة فئران في كل مجموعة). تم الاحتفاظ بالمجموعة الأولى كمجموعة ضابطة سالبة، بينما تم حقن الخمس مجموعات الأخرى بمادة الألوكسان (١٥٠ ملجم/كجم من وزن الجسم) لتصبح فئران مصابة بداء السكري؛ تم الاحتفاظ بمجموعة واحدة منها كمجموعة ضابطة موجبة، فى حين عولجت الأربع مجموعات المصابة بالسكري بتركيزين من المستخلص الإيثانولى لأوراق وبذور السدر (٤٠٠، ٢٠٠ ملجم / كجم). بعد 28 يومًا، تم قياس مستوى الجلوكوز فى الدم، وصورة دهون الدم بما فى ذلك الكوليسترول الكلى، والدهون الثلاثية، والبروتينات منخفضة الكثافة، والبروتينات عالية الكثافة، والبروتينات منخفض الكثافة جدًا، ومؤشرات، وظائف الكبد، والكلى. كما تم تقييم الإنزيمات المؤكسدة مثل المالونالدهيد والسوبر أكسيد ديسموتيزوالكتاليز. وتم حساب نسبة كفاءة استخدام الغذاء والغذاء المتناول ومعدل الزياده فى وزن الجسم. ووفقا للنتائج، فإن المستخلص الإيثانولى لأوراق وبذور السدر خفض مستويات السكر ويعزز وظائف الكلى والكبد. أدت كل من الأوراق والبذور إلى تحسين مستوى الدهون والإنزيمات المضادة للأكسدة. كما أدت الى تعزيز كلاً من وزن الجسم المكتسب والمأخوذ من الغذاء ونسبة الاستفادة من الغذاء. ويدعم الفحص النسيجي التقييم الكيميائى الحيوي. وفى الختام، فإن جميع التحاليل البيوكيميائية تعكس قوة أوراق وبذور السدر كعلاج غذائي لعلاج مرض السكري في الفئران.

الكلمات الكاشفة: السدر، المستخلص الكحولي، الفئران سكر الدم