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The effect of products containing stevia and samwa leaves on diabetic rats

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Abstract

The goal of this study was to investigate how different concentrations (2.5 and 5%) of stevia (*Stevia rebaudiana*) and samwa (*Cleome droserifolia*) leaves products affected alloxan-induced diabetes complications in rats. Fifty male albino rats weighing 140±10 g were used in this study and divided into two main groups. The first group (5 rats) was kept as a negative (-ve) control group fed on the basal diet. In comparison, the second group (45 rats) was given alloxan (dose 150 mg/kg BW) to induce diabetes and divided into nine equal sub-groups (5 rats per each) as follows: subgroup (1) served as a positive (+ve) control group that was fed on a basal diet, while subgroups (2, 3, 4, 5) diabetic groups were fed on a basal diet and 2.5, 5% of biscuits and cake that were incorporated with stevia leaves products, respectively. While subgroups (6, 7, 8, 9) diabetic groups were fed on a basal diet, 2.5 and 5% of biscuits and cake were incorporated with samwa leaves, respectively. Blood glucose, liver enzymes, lipid profile, and kidney functions were determined. The results revealed that the blood glucose, liver enzymes, kidney functions, and lipid profile significantly decreased ($P \leq 0.05$) compared to the positive control group. In contrast, HDL-c level and insulin excretion were significantly improved. So, it could be concluded that adding tested products enhanced the biochemical parameters of diabetic rats.

Key words: Bakery products, Plant leaves, Rats, Blood glucose.

Introduction

Diabetes mellitus is a rapidly spreading disease that is predicted to affect 6.6 percent of the global population and is expected to increase by 7.8 percent by 2030 [1]. Diabetes is

a serious, chronic condition that arises when the pancreas does not create enough insulin or when the body cannot efficiently use the insulin it produces, according to the World Health Organization. As a result, it is a significant public health issue [2]. Organ damage, atherosclerosis, neuropathy, poor immunity, wound healing, and infection susceptibility are all known to occur in diabetic patients as a result of the many negative impacts of insulin resistance and hyperglycemia, often leading to poor postoperative outcomes [3].
Stevia rebaudiana is a plant that is used to sweet, often known as stevia, is a plant that belongs to the Asteraceae family and is native to Paraguay, Brazil, and Argentina. Medicinal plants have been utilized as a treatment for a variety of human diseases for ages due to their antibacterial, antifungal, or antioxidant properties [4]. There are currently about 150 species of stevia, but stevia is the only one with a sweet flavor due to its high steviol glycoside content in the leaves. There are 11 main steviol glycosides in stevia, with rebaudioside A and stevioside being the most abundant. Pure stevia leaf extract can contain a single steviol glycoside or a combination of glycosides and can be 250-300 times sweeter than sucrose [5]. Alkaloids, flavonoids, chlorophyll, xanthophyll, oligosaccharides, amino acids, essential oils, lipids, proteins, free sugars, trace elements, and hydroxycinnamic acids chlorogenic acid, caffeic acid are among the phytochemical compounds found in stevia leaves [6]. Several studies have demonstrated that stevia possesses anti-diabetic, antihypertensive, antihyperlipidemic, antiobesity, anticancer, antioxidant, anti-inflammatory, antibacterial, antiviral, and anticancer characteristics, as well as enhancing liver and kidney functions [7].
Samwa (*Cleome droserifolia*), a Cleomaceae family plant, is one of these hypoglycemic plants. This genus has approximately 180-200 species that can be found in Egypt, Libya, Palestine, Syria, and other dry and semi-arid locations [8]. The dried herb of *Cleome droserifolia* is known as samwah in Egypt. Samwah was discovered to contain a variety of antioxidant and hepatoprotective chemicals, including volatile oil, gluosinolates with sulphur aglycones, flavonoids, sesquiterpenes, terpenoids, alkaloids, and sterols. The Southern Sinai Bedouins decocted leaves and stems for the treatment of diabetes and were known as an antihyperglycemic medication [9]. For healing stomachaches, skin allergies, and open wounds, as well as having anticancer and hepatoprotective qualities and anti-diabetic activities [10].
Hence, it prompted us to investigate the effect of stevia and samwa leaf powder products on some biochemical parameters and enzyme activities of diabetic rats.

Material & Methods

Materials

Commercially available stevia (*Stevia rebaudiana*) and samwa (*Cleome droseriloia*) leaves were provided by the Agriculture Research Center farm in Giza, Egypt. SIGMA

Chemical Company, USA provided pure white crystalline cholesterol powder and saline solutions. Casein, cellulose, cholinechloride powder, and DL methionine powder, were obtained from Morgan Co. Cairo, Egypt. 50 mature normal male albino rats of the Sprague Dawley strain, weighing 140±10g were purchased from the Vaccine and Immunity Organization, Ministry of Health, Helwan Farm, Cairo, Egypt. Chemical kits for the determination of TC, TG, HDL-c, ALT, AST, ALP, urea, uric acid, creatinine, and alloxan were obtained from Al-Gomhoria Company for Chemical, Drugs Trading and Medical Instruments, Cairo, Egypt.

Material of products

Wheat flour (72 percent extraction) was provided from The South Cairo mills company, Cairo government, Egypt. Sucrose, butter, fresh whole eggs, skim milk powder, baking powder, vanilla powder, and water are all ingredients in the dough for biscuits and cake dough. These items were purchased in Cairo, Egypt, at a local market.

Methods

Preparation of stevia and samwa leaves powder

The dust, dirt, and undesired material from the stevia and samwa leaves were removed with tape water, and the green fresh leaves were dried in a 50^{o}C oven for 24 hours. After drying, fine powder was formed with a grinder (Molunix, Al-Araby Company, Benha, Egypt), sieved, and stored in sealed plastic bags.

Preparation of cake samples

According to Raeker and Johnson, [11], approved methods for cake preparation were slightly altered to make dry cake ingredients except sugar were blended. The butter and additional components were creamed at medium speed for 3 minutes, then sugar was added and beaten for 3 minutes, and the beaten eggs and vanilla were added and whipped for 2 minutes before being fastened to the creamed fat-sugar mix and easily beaten at low speed for 5 transactions. The prior mixture was progressively added to and beaten for 5 minutes with wheat flour (WF) and other ingredients. The mixture was poured into size 30 tin mold pans, sized into a greased cup, and baked at 180°C for 25 minutes in a preheated oven, then allowed to cool at room temperature before being packaged in plastic bags. At varying quantities of 2.5 and 5%, stevia and samwa leaves powder were applied.

Preparation of biscuits

Tiwari *et al.,* [12] used fat, sugar, and eggs to make biscuits, which were then combined for 3-4 minutes in a Hobart mixer. In a mixing basin, wheat flour, packing powder,

vanillin, and water were combined to make the dough. During continuous mixing, the appropriate amount of water was gradually added until a slightly firm dough was created. Using a 45 mm diameter cutter, the dough was placed on a clean flat surface and cut into beautiful circles and stars of biscuit. Biscuits were placed to metal pans and baked for 30 minutes at 150°C in a preheated oven. The biscuits were allowed to cool for 30 minutes after preparation before being placed in polyethylene bags and stored under desiccation. At varying quantities of 2.5 and 5%, stevia and samwa leaves powder were applied.

Induction of diabetes

The rats with blood glucose level>200 mg/dl were considered to be diabetic according to the procedure reported by Desai and Bhide [13].

Experimental design

In this experiment, fifty mature male white albino rats, Sprague Dawley Strain, 10 weeks old, weighing (14010g) were used. For 7 days, all rats were fed a basal diet [casein diet) prepared according to the American Institute of Nutrition (AIN) [14]. After this period of adaptation, rats are divided into ten groups, each of which has five rats: Group (1): A negative control group of rats fed a baseline diet. Group (2): A positive control group that animals were injected with alloxan at a dose of 150 mg per kg BW interperitoneally. Group (3): Diabetic group was fed on biscuits supplemented with 2.5 percent of the diet's weight in stevia leaves powder. Group (4): Diabetic group was fed on biscuits supplemented with stevia leaves powder at a rate of 5% of the total meal weight. Group (5): Diabetic group was fed on cake supplemented with 2.5 percent of the diet's weight in stevia leaves powder. Group (6): Diabetic group was fed on cake supplemented with stevia leaves powder at a rate of 5% of the diet's weight. Group(7): Diabetic group was fed on biscuits supplemented with 2.5 percent of the diet's weight in samwa leaves powder. Group [8): Diabetic group was fed on biscuits supplemented with samwa leaves powder, which accounts for 5% of the diet's weight. Group (9): Diabetic group was fed on cake supplemented with 2.5 percent of the diet's weight in samwa leaves powder. Group (10): Diabetic group was fed on cake supplemented with samwa leaves powder at a rate of 5% of the diet's weight.

The rats' body weight and food consumption were measured weekly during the trial, and their general behavior was observed. The experiment will be 28 days, after which each rat will be weighted independently, and the rats will be slain and blood samples taken.

Blood sampling

At the end of each trial, blood samples were taken from the hepatic portal vein after a 12-hour fast. Blood samples were collected into dry, clean centrifuge glass tubes and allowed

to clot for 10 minutes in a water bath (37°C), after which they were centrifuged for 10 minutes at 3000 rpm to separate the serum, which was carefully aspirated and transferred into a clean cuvette tube and stored frozen at -20°C until analysis according to Schermer's method [15].

Biochemical analysis

Enzymatic determination of serum glucose and was carried out calorimetrically according to the method of [16] and serum insulin were measured according to method of [17]. Total cholesterol, Triglycerides (T.G), High Density Lipoprotein (HDL-c), Low Density Lipoprotein (LDL-c), and Very Low Lipoprotein (VLDL-c) were determined according to [18-20]. Determination of serum alanine aminotransferase (ALT), serum asparatate aminotransferase (AST), serum alkaline phosphatase (ALP) were carried out according to the method of [22-24] , respectively. Serum urea and serum creatinine were determined by enzymatic technique according to [25,26]. In contrast, serum uric acid was measured calorimetrically using the method of [27].

Statistical analysis

The results were expressed as mean ± SD, using student (t) test. Using one way analysis of variance (ANOVA) (SAS, 28).

Results And Discussion

Table (1) shows the effect of stevia and samwa leaves products on fasting blood glucose and insulin levels in hyperglycemic rats. With significant differences, the greatest glucose was reported for the positive control group, while the lowest glucose was recorded for the negative control group. The average readings were 342.66 and 118.23 mg/dl, respectively.

On the other hand, stevia biscuits had the greatest effect on glucose level among the treated groups (diabetic groups) at 5 %, with non-significant differences.

The data in the same table showed that the positive control group's mean insulin value was lower than the negative control groups, with significant differences between them. 0.35 ng/ml and 8.22 ng/ml, respectively.

On the other hand, the samwa cake had the highest insulin among the treated groups (diabetic groups) at 5%, while the stevia biscuits had the lowest insulin at 2.5 percent, with significant differences. In comparison to the negative control group, group 10 (samwa cake at 5%) revealed the best treatment. Alloxan's diabetic influence is mostly due to fast absorption by -cells and the generation of free radicals. As a result, alloxan-induced diabetes mellitus can be used as a pathogenic bio-model for assessing an antioxidant chemical in vivo [29]. List of plants and active substances that have been

studied in diabetic rats produced by alloxan is available. Diabetes occurs in alloxan-induced diabetic rats due to pancreatic-cell death, which leads to degranulation and diminished insulin production [30]. These findings support those of [Carrera-Lanestosa *et al.*, 31] who demonstrated that chemicals present in stevia can lower plasma glucose levels. Stevioside, the primary ingredient in stevia, lowers blood glucose levels via increasing insulin secretion and sensitivity while also lowering glucagon secretion. Furthermore, Abdelfattah *et al.*, [9] discovered that a single daily oral treatment of *Cleome droserifolia* extract for four weeks reduced diabetic rats' serum glucose and generated a significant increase in glucagon and insulin levels. When insulin levels were brought to normal, they found that treating diabetic rats with *Cleome droserifolia* callus extract increased thyroid hormone (T3 and T4) levels compared to the diabetic group.

Table (1): Effect of biscuits and cake supplemented with stevia and samwa leaves on blood glucose and insulin of hyperglycemic rats

	Glucose mg/dl Mean±SD	Insulin ng/ml Mean±SD
G_1 C (-)	$118.23^{e} \pm 24.98$	$8.22^{a} \pm 0.34$
G_2 C (+)	$342.66^{a} \pm 75.44$	$0.35^{d} \pm 0.06$
G_3 (Stevia biscuits at 2.5%)	$282.63^{b} \pm 32.92$	$0.60^{d} \pm 0.11$
G_4 (Stevia biscuits at 5%)	$187.46^{cd} \pm 21.33$	$5.23^{b} \pm 1.12$
G_5 (Stevia cake at 2.5%)	$219.10^{c} \pm 24.92$	$1.00^{d} \pm 0.03$
G_6 (Stevia cake at 5%)	$186.20^{cd} \pm 16.93$	$2.55^{c} \pm 0.66$
G_7 (Samwa biscuits at 2.5%)	$166.33^{cde} \pm 18.37$	$1.11^{d} \pm 0.20$
G_8 (Samwa biscuits at 5%)	$145.03^{de} \pm 18.05$	$3.41^{c} \pm 0.60$
G_9 (Samwa cake at 2.5%)	$171.70^{cde} \pm 10.26$	$3.30^{c} \pm 1.06$
G_{10} (Samwa cake at 5%)	$141.33^{de} \pm 26.33$	$5.49^{b} \pm 0.68$
LSD	54.460	1.050

Each value is represented as mean ± standard deviation (n = 3). Mean under the same column with different superscript letters are different significantly (P ≤ 0.05)

The effect of stevia and samwa leaves added to biscuits and cake on liver functions (ALP, AST, and ALT) in diabetic rats is shown in Table (2). With significant differences, the highest ALP was reported for the positive control group, while the lowest ALP was obtained for the negative control group. Adding 5% of tested plants to cake and biscuits led to significant decreasing in the liver enzymes as compared to positive control group and 2.5% products groups. Stevia products was more effective on liver enzymes than samaw products. These findings are consistent with Ramos-Tovar *et al.*, [32], who found

that stevia can prevent liver cirrhosis in rats (CCl_4-induced) by preserving serum necrosis (ALT), cholestasis (AP,-GTP, and bilirubin), and normal liver parenchyma structure. The process is related to stevia's antioxidant activity, which prevents increased lipid peroxidation and 4-HNE (an oxidative stress marker in the membrane), as well as hepatic glutathione peroxidase downregulation (GSH, oxidative stress marker in the cytosol). Samowa can also improve the functioning of the liver by inhibiting proinflammatory mediators and protecting hepatocytes, according to Abdelfattah *et al.*, [9]. The improvement in liver functions could be due to beta-trophin hormone, which is produced primarily in the liver and adipose tissues and has recently been identified as a key stimulator of beta-cell mass expansion in response to obesity and insulin resistance. This hormone encourages beta cells in the pancreas to multiply and produce more insulin. As a result, it was discovered that samwa exhibited a hepatoprotective effect, reducing liver damage and improving liver functioning.

Table (2): Effect of biscuits and cake supplemented with stevia and samwa leaves on liver functions of diabetic rats

	ALP (U/L) Mean±SD	AST (U/L) Mean±SD	ALT (U/L) Mean±SD
G_1 C (-)	$105.14^{d} \pm 24.66$	$90.78^{g} \pm 11.68$	$117.50^{d} \pm 17.58$
G_2 C (+)	$344.06^{a} \pm 76.33$	$221.33^{a} \pm 29.61$	$242.60^{a} \pm 23.14$
G_3 (Stevia biscuits at 2.5%)	$260.83^{b} \pm 40.92$	$149.60^{cde} \pm 20.31$	$182.66^{bc} \pm 34.32$
G_4 (Stevia biscuits at 5%)	$174.00^{c} \pm 25.37$	$133.80^{def} \pm 32.50$	$147.70^{cd} \pm 24.73$
G_5 (Stevia cake at 2.5%)	$213.46^{bc} \pm 26.84$	$171.06^{bcd} \pm 32.32$	$196.96^{b} \pm 36.92$
G_6 (Stevia cake at 5%)	$178.00^{c} \pm 29.07$	$120.90^{efg} \pm 22.49$	$133.30^{d} \pm 15.99$
G_7 (Samwa biscuits at 2.5%)	$211.63^{bc} \pm 23.08$	$184.63^{abc} \pm 9.61$	$245.06^{a} \pm 19.41$
G_8 (Samwa biscuits at 5%)	$155.10^{cd} \pm 23.14$	$109.26^{fg} \pm 21.17$	$122.36^{d} \pm 19.29$
G_9 (Samwa cake at 2.5%)	$271.23^{b} \pm 44.80$	$194.20^{ab} \pm 11.07$	$215.63^{ab} \pm 20.06$
G_{10} (Samwa cake at 5%)	$173.26^{c} \pm 6.70$	$152.86^{cde} \pm 11.45$	$181.53^{bc} \pm 20.45$
LSD ($P \leq 0.05$)	62.44	37.42	41.10

Each value is represented as mean ± standard deviation (n = 3). Mean under the same column with different superscript letters are different significantly ($P \leq 0.05$).

The effect of stevia and samwa leaves supplemented biscuits and cake on serum urea, uric acid, and creatinine level in diabetic rats is shown in Table (3). After 28d feeding, the levels of nitrogen urea, uric acid and creatinine in the plasma were higher in the

positive control group than in negative control group. The levels of nitrogen urea, uric acid and creatinine in the plasma of rats were decreased with adding plant products in the diet. When the diet was with 5% plant products added, the levels of nitrogen urea, uric acid and creatinine were significantly reduced ($P<0.05$) and the reduction was high in the group received samwa products.

These findings are matched with those of Rizwan *et al.*, [33], who found that rats administered stevia had a strong protective effect against kidney failure which toxic with gentamicin. According to Nagy and Amin [34], kidney function indices such as urea and creatinine were higher in alloxan-induced diabetic rats compared to normal rats. In a dose-dependent way, samwa lowered both levels.

Table (3): Effect of biscuits and cake supplemented with stevia and samwa leaves on serum urea, uric acid and creatinine of diabetic rats

	Urea (mg/dL)	Uric acid (mg/dL)	Creatinine (mg/dL)
	Mean±SD	Mean±SD	Mean±SD
G_1 C (-)	$21.93^{e} \pm 3.55$	$4.40^{cde} \pm 1.36$	$0.55^{e} \pm 0.08$
G_2 C (+)	$74.47^{a} \pm 9.36$	$7.56^{a} \pm 0.71$	$1.20^{a} \pm 0.17$
G_3 (Stevia biscuits at 2.5%)	$74.87^{a} \pm 5.46$	$5.82^{b} \pm 0.26$	$0.94^{b} \pm 0.04$
G_4 (Stevia biscuits at 5%)	$49.32^{bcd} \pm 5.31$	$5.68^{bc} \pm 1.16$	$0.85^{bc} \pm 0.07$
G_5 (Stevia cake at 2.5%)	$56.72^{b} \pm 4.35$	$4.00^{e} \pm 0.24$	$0.83^{bc} \pm 0.14$
G_6 (Stevia cake at 5%)	$47.77^{bcd} \pm 8.03$	$4.38^{de} \pm 0.56$	$0.67^{cde} \pm 0.04$
G_7 (Samwa biscuits at 2.5%)	$55.23^{bc} \pm 5.62$	$5.37^{bcd} \pm 0.59$	$0.64^{de} \pm 0.12$
G_8 (Samwa biscuits at 5%)	$38.62^{d} \pm 2.87$	$5.36^{bcd} \pm 0.86$	$0.60^{de} \pm 0.15$
G_9 (Samwa cake at 2.5%)	$42.08^{cd} \pm 11.45$	$4.14^{de} \pm 0.40$	$0.77^{bcd} \pm 0.07$
G_{10} (Samwa cake at 5%)	$46.29^{bcd} \pm 13.81$	$3.99^{e} \pm 0.42$	$0.83^{bc} \pm 0.08$
LSD ($P \leq 0.05$)	13.230	1.281	0.182

Each value is represented as mean ± standard deviation (n = 3). Mean under the same column with different superscript letters are different significantly ($P \leq 0.05$).

Data in table (4) confirmed that all diabetic rats fed on diet containing with 2.5 and 5%, plant products were markedly decreased significantly ($P \leq 0.05$) in triglycerides and cholesterol as compared to positive control (+) group, addition to that the best treatment were recorded of groups which had 5% tested plants products. These findings are consistent with Ahmad *et al.*, [35], who found that stevia reduced triglyceride levels by stimulating the liver's lipase enzyme activity, resulting in lipid catabolism and enhanced triglyceride excretion through faeces. El-Komy *et al.*, [36], found a substantial drop in all

lipid profiles assessed (TL, TC, TG, LDL-C, and VLDL-C) in the STZ+ samwa treated group when compared to the STZ group, as well as a significant rise in HDL-C.

Table (4): Effect of biscuits and cake supplemented with stevia and samwa leaves on serum triglycerides and total cholesterol of diabetic rats

	Triglycerides (mg/dL) Mean±SD	Total cholesterol (mg/dL) Mean±SD
G_1 C (-)	$84.85^{c} \pm 22.20$	$80.15^{e} \pm 5.71$
G_2 C (+)	$184.33^{a} \pm 19.25$	$189.87^{a} \pm 13.96$
G_3 (Stevia biscuits at 2.5%)	$138.63^{b} \pm 23.92$	$159.16^{bc} \pm 21.53$
G_4 (Stevia biscuits at 5%)	$130.80^{b} \pm 18.86$	$140.96^{cd} \pm 21.60$
G_5 (Stevia cake at 2.5%)	$145.50^{b} \pm 13.47$	$173.16^{ab} \pm 6.13$
G_6 (Stevia cake at 5%)	$119.76^{bc} \pm 17.19$	$146.76^{cd} \pm 13.96$
G_7 (Samwa biscuits at 2.5%)	$148.53^{b} \pm 30.57$	$194.36^{a} \pm 13.38$
G_8 (Samwa biscuits at 5%)	$115.03^{bc} \pm 18.94$	$142.80^{cd} \pm 7.03$
G_9 (Samwa cake at 2.5%)	$120.70^{b} \pm 24.55$	$182.30^{ab} \pm 20.36$
G_{10} (Samwa cake at 5%)	$117.33^{bc} \pm 13.63$	$128.86^{d} \pm 14.41$
LSD ($P \leq 0.05$)	35.521	25.500

Each value is represented as mean ± standard deviation (n = 3). Mean under the same column with different superscript letters are different significantly ($P \leq 0.05$).

Results in table (5) exhibited that activating levels of LDL-c and VLDL-c of positive control (+) group were dramatically increased significantly ($P \leq 0.05$) as compared to control (-) group while, HDL-c was decreased in positive control group as compared to negative control group. With respect to all rats fed on treated with 5% tested plant products achieved significantly ($P \leq 0.05$) gradual increases in HDL-c levels comparison to positive control (+) group and decreased the levels of LDL-c and VLDL-c. The best treatment was observed for groups fed samwa at level of 5%. These findings are consistent with Nagy and Amin [34], who found that the conventional medicines and *Cleome droserifolia* used in the experimental investigation significantly reduced ($P \leq 0.05$) cholesterol and triglyceride levels while increasing HDL-c cholesterol. In addition, Brijesh and Kamath [37] found that stevia can lower total cholesterol, triglyceride, LDL-c, and VLDL-c levels while increasing HDL-c levels. The process of increased bile acid excretion by inhibiting small intestine reabsorption through disruption of micelle formation explains the drop in total cholesterol levels. Increased bile acid excretion activates cholesterol 7α hydroxylase, which accelerates the conversion of liver cholesterol to bile acid, lowering cholesterol.

Table (5): Effect of biscuits and cake supplemented with stevia and samwa leaves on HDL-c, LDL-c and VLDL-c of hyperglycemic rats

	HDL-c (mg/dL) Mean±SD	LDL-c (mg/dL) Mean±SD	VLDL-c (mg/dL) Mean±SD
G_1 C (-)	$48.64^{a} \pm 1.94$	$14.54^{f} \pm 6.19$	$16.96^{c} \pm 4.44$
G_2 C (+)	$41.04^{c} \pm 2.79$	$111.95^{ab} \pm 14.45$	$36.86^{a} \pm 3.85$
G_3 (Stevia biscuits at 2.5%)	$45.71^{abc} \pm 1.85$	$85.72^{cd} \pm 18.15$	$27.72^{b} \pm 4.78$
G_4 (Stevia biscuits at 5%)	$48.70^{a} \pm 1.86$	$66.10^{de} \pm 19.79$	$26.16^{b} \pm 3.77$
G_5 (Stevia cake at 2.5%)	$47.88^{ab} \pm 4.04$	$96.18^{bc} \pm 7.40$	$29.10^{b} \pm 2.69$
G_6 (Stevia cake at 5%)	$48.13^{a} \pm 1.39$	$74.68^{cde} \pm 9.81$	$23.95^{bc} \pm 3.43$
G_7 (Samwa biscuits at 2.5%)	$42.86^{bc} \pm 3.94$	$121.79^{a} \pm 10.98$	$29.70^{b} \pm 6.11$
G_8 (Samwa biscuits at 5%)	$45.18^{abc} \pm 5.73$	$74.61^{cde} \pm 7.13$	$23.00^{bc} \pm 3.78$
G_9 (Samwa cake at 2.5%)	$46.30^{ab} \pm 1.82$	$111.85^{ab} \pm 21.80$	$24.14^{b} \pm 4.91$
G_{10} (Samwa cake at 5%)	$47.60^{ab} \pm 2.33$	$57.79^{e} \pm 9.38$	$23.46^{bc} \pm 2.72$
LSD	5.21	23.19	7.10

Each value is represented as mean ± standard deviation (n = 3).Mean under the same column bearing different superscript letters are different significantly (P≤0.05).

Conclusion:

Stevia and samwa leaves powder added to biscuits and cakes can improve blood glucose, insulin, lipid profile, liver, and kidney functions. All of these effects can be linked to the high bioactive chemicals content of certain plant components, which gives them strong antioxidant properties. These data support the use of stevia and samwa leaves powder to reduce the problems associated with type 2 diabetes.

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تأثير المنتجات المحتوية على أوراق الإستيفيا والسموة على الفئران المصابة بمرض السكر

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الملخص العربى

الهدف من هذه الدراسة معرفة مدى تأثير التركيزات المختلفة (٢,٥ ، ٥٪) من منتجات أوراق الإستيفيا والسموة على مضاعفات مرض السكر التي يسببها الألوكسان في الفئران. تم إستخدام خمسين من ذكور فئران الألبينو وزنها ١٤٠ ± ١٠ جرام في هذه الدراسة ، وتم تقسيمهم إلى مجموعتين رئيسيتين. المجموعة الأولى (٥ فئران) إستخدمت كمجموعة ضابطة سالبة والتى تغذت على النظام الغذائي الأساسي ، بينما المجموعة الثانية (٤٥ فأر) أعطيت الألوكسان (جرعة ١٥٠ مجم / كجم من وزن الجسم) للإصابة بمرض السكر وقسمت إلى تسعة مجاميع متساوية. المجموعات الفرعية (٥ فئران لكل منهما) على النحو التالي: المجموعة الفرعية (١) إستخدمت كمجموعة ضابطة موجبة تم تغذيتها على النظام الغذائي الأساسي ، بينما تم تغذية المجموعات الفرعية (٢ ، ٣ ، ٤ ، ٥) ، (٦ ، ٧ ، ٨ ، ٩) مجموعات مصابة بمرض السكرعلى النظام الغذائي و 2.5 ، 5٪ من البسكويت والكيك المدعومين بأوراق الإستيفيا والسموة فى صورة مسحوق على التوالى. تم ذبح الفئران ، وتم الحصول على عينات دم لتحليلها في نهاية التجربة التي إستمرت ٢٨ يومًا. وتم تقدير كلا من نسبة الجلوكوز في الدم ، أنزيمات الكبد ، صورة دهون الدم ووظائف الكلى. أوضحت النتائج المتحصل عليها إلى أن العلاجات خفضت مستويات الجلوكوز في الدم ، TG ، TC ، LDL-c، VLDL-c وأنزيمات الكبد (ALT ، AST ، ALP) ووظائف الكلى (حمض البوليك واليوريا والكرياتينين) مع وجود فرق معنوى عند المقارنة بالمجموعة الضابطة الموجبة. بينما تحسن مستوى HDL-C وإفراز الأنسولين. لذلك يمكن الإستنتاج أن إضافة المنتجات المختبرة يحسن جميع التحاليل الكيميائية الحيوية, وخاصة مستويات الجلوكوزفى الفئران المصابة بمرض السكر.

الكلمات المفتاحية: منتجات المخابز ، أوراق النباتات ، الفئران ، سكر الدم.