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The Hypoglycemic Effect of Crackers Supplemented with Pea, Tangerine Peels and Strawberry Leaves Powder on Alloxan-Induced Diabetic Rats

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ABSTRACT:

Fruit leaves and vegetable peels are rich in phenolics and antioxidants, which are considered metabolic syndrome remedies. This study evaluated pea, tangerine peels and strawberry leaves and their mixture powder on diabetic rats fed on crackers enriched with 5% from its. Thirty-six adult male albino rats were divided into six groups (6 rats each) as follows: Group (1): Negative control fed on basal diet only. The other groups were injected with alloxan (150 mg/kg body weight) to induce diabetes. Group (2): Only positive control is fed on a basal diet. Group (3): fed on 15% crackers fortified with 5% pea peel powder from the basal diet. Group (4): fed on 15% crackers fortified with 5% mandarin peel powder from basal diet. Group (5): fed on 15% crackers fortified with 5% strawberry leaf powder fortified crackers from the basal diet. Group(6): fed on 15% crackers enriched with 5% of a mixture of pea, tangerine peels, and strawberry leaves powders, respectively, and the experiment continued for 7 weeks. At the end of the experiment, each rat was weighed separately, the rats were dissected to collect blood samples for various tests to determine glucose, liver, kidney functions and lipid levels in the serum, and a histopathological examination of the pancreas tissues was performed. The results showed that enriching the crackers with 5% pea, tangerine peels and strawberry leaves powder led to increased sensory evaluation and improved glucose levels, lipids, and liver and kidney functions.

Keywords: Diabetes Diseases, Pea Peels, Tangerine Peels, Strawberry Leaves Powder, Crackers

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1. INTRODUCTION

Diabetes mellitus (DM) is one of the most important public health problems in 21st century (1). DM becomes a global epidemic with its prevalence is increasing everywhere at a foreboding rate. DM is a fast-growing health problem in Egypt with a significant influence on morbidity, mortality, and health care resources (2&3). Diabetes continues to be a public health problem with a significant burden on the Egyptian economy. Patients with type 2 diabetes (T2D) comprise approximately 90-95% of all patients with diabetes worldwide and represent a growing epidemic (4).

Egypt recorded among the world's top 10 countries in the number of patients with diabetes (5).

The treatment of diabetes based on insulin and/or oral hypoglycemic medications (6). Although, there are several commercially available drugs for treatment of diabetes their long terms may cause unwanted side effects on the kidney, liver and stomach (7&8). So, it was necessary to exploit source of high nutritional and healthy value to reduce the risk of this disease and the cost of treatment. The concentrations of phenolic in the peels and leaves for many fruits and vegetables are higher than in their respective edible tissues (9) .The antioxidants and other bioactive compounds from these sources exhibit anti-microbial, anti-cancer, anti-oxidative and immune-modulatory effects. In addition, they reduce incidence of cardiovascular diseases, capillary fragility, prevent thrombosis, oxidative stress, osteoporosis and diabetes (10).

Specifically, the phenolic present in pea, tangerine peels and strawberry leaves, were used as ingredient in processed food products, so this study aimed to study the hypoglycemic effect of fortified crackers with pea, tangerine peels and strawberry leaves powder on Alloxan induced diabetic rats.

2. Materials and Methods

2.1. Materials:

- Pea, tangerine peels and strawberry leaves were collected from neighboring areas of Al-Mahalla Alkubra, Gharbiya Governorate, Egypt.
- Normal Thirty-six adult Albino rats weighing (150 ±10) g were obtained from the Medical Insects Research Institute, Cairo, Egypt.
- Alloxan was obtained from SIGMA and used to induce of diabetes mellitus in rats. Other chemicals in this study were purchased from El- Gomhoria Company, Cairo, Egypt.
- Casein, all vitamins, minerals, cellulose, choline and Methionine powder were obtained from Morgan Co. Cairo, Egypt.
- Wheat flour, salt, sugar, sunflower oil and yeast were ingredient of crackers were purchased from Al-Mahalla Alkubra, Gharbiya Governorate, Egypt.

2.2. Methods:

Harvested Pea, tangerine peels and strawberry leaves (SLP) powder were washed to remove impurities , dried in oven at 40 ˚C then ground into fine powder then kept in dry bottles till use.

2.2.1. Determination of Total phenolic and flavonoid compounds of Pea, tangerine peels and strawberry leaves powder:

HPLC analysis was performed according to (11) using Agilent Technologies 1100 series liquid chromatograph equipped with an auto sampler and a diode-array detector. All samples were filtered through a 0.45 µm Acrodisc syringe filter (Gelman Laboratory, MI) before injection. Peaks were identified by identical retention times and UV spectra and compared to the standards.

2.2.2. Preparation of Crackers:

Stander crackers were prepared by according to (12) as follows:

(100g) wheat flour, (2g) salt, (2g) sugar, (5mL) sunflower oil, (2g) yeast and water with some modification. The dough was mixed and cut to small pieces then placed in the oven at a temperature of (150°C). After baking, the crackers covered with foil and stored at (5˚C). Crackers prepared in different proportions of pea, tangerine peels, strawberry leaves powder and mix of their (2.5%, 5%, 10%, 15%). Then followed by sensory evaluation to obtain the best sensory acceptable sample.

2.2.3. Biological Experiment:

2.2.3.1. Induction of diabetic mellitus:

Diabetes induced in normal healthy albino rats (30 rats) by subcutaneous injection of

Alloxan (150 mg /kg body weight) according to (13). After 7days from injection, fasting blood samples collected for estimating glucose. Rats having glucose >200 mg/dl will be considered diabetics.

2.2.3.2. Experimental design:

The Science Research Ethics Committee of The Institutional Animal Care and Use Committee (IACUC) Menoufia University accepted the research protocol No. (MUFHE /S/NFS/36/24) of the Science Research Ethics Committee of Faculty of Home Economics. Rats housed under the normal environmental condition during the experiment in the animal house of the Faculty of Home Economics, Menoufia University, Egypt. All rats were fed on basal diet prepared according to AIN-93 guidelines [18] for 7 days for adaptation. After that, all (36 rats) were divided to two groups as follows:

The first group (6 rats):Negative control, normal rats fed on basal diet only (6 rats).The second group (30 rats): Positive control, Injected by Alloxan to induce diabetes disease (30 rats).Then divided to 5 sup groups after infection by alloxan:S up G (1):Diabetic rats fed on basal diet only (6 rats).Sup G(2):Rats fed on basal diet with 15% fortified cracker by 5% pea peels powder (PPP) (6 rats).Sup G (3): Rats fed on basal diet with 15% fortified crackers by 5% tangerine peels powder (TPP) (6 rats).Sup G (4): Rats fed on basal diet with 15% fortified crackers by 5% strawberry leaves powder (SLP) (6 rats).

Sup G (5): Rats fed on basal diet with 15% fortified crackers by mix of pea, tangerine peels and strawberry leaves 5% powder (6 rats).

All rats received free access to the diet and water during the experimental period (6 week). The body weight and feed intake were estimated weekly.

2.2.3.3. Blood sampling and organs:

After fasting for 12 hours, Blood samples were collected and separated the serum and stored frozen at -20°C till analysis according to the method described by (14).

Pancreas was collected, washed and dried, then weighed and kept in formalin solution (10 %) according to (15).

2.2.3.4. Biochemical Analysis:

Hematological Analysis:

Glucose was determined calorimetrically according to (16).

Liver functions:

Determination of serum glutamic pyruvic transaminase (SGPT/ALT), serum glutamic oxaloacetic transaminase (SGOT/AST) and (ALP) by using method of (17&18).

Kidney functions:

Determination of creatinine, urea and uric acid by using method of (19).

Lipids profile:

(TC) was determined according to (20).Serum triglycerides determined by according to (21).HDL-c was determined by using method of (22).VLDL-c was calculated in mg/dl. LDL-c was calculated in mg/dl according to (23).

2.2.3.5. Biological Evaluation:

Biological evaluation was carried out by determination of body weight gain % (BWG), feed efficiency ratio (FIR) according to (23)

2.2.3.6. *Histopathological* Investigation:

The pancreas was collected from each group, kept in formalin, dehydrated in ascending concentration of ethanol (70, 80, and 90%), cleared in xylene and embedded in paraffin. Sections of (4-6) µm thickness were prepared and stained with Hematoxylin and Eosin according to (24).

2.2.4. Statistical Analysis:

The data were statistically analyzed using a computerized COSTAT Program by one-way ANOVA. The results are presented as mean ± SD. Differences between treatments at ($p<0.05$) were considered significant (25).

3. RESULTS AND DISCUSSION:

Data presented in table (1) show the content of phenolics of pea, tangerine peels and strawberry leaves powder (SLP). The results showed that the total phenolic of SLP were highest, followed by Tangerine peals powder and then Pea peal powder. The (SLP) contain a high amount of Gallic, Cateachin and Rutin, which is consistent with (26) reported that SLP had high quantity of Cateachin, Gallic and Rutin.

Our result agrees with (27) reported that phenolics in PPP depends on seed a variety .Several active phytochemicals have been identified in pea like flavonoids daidzein, genistein, apigenin, asparaginase and proanthocyanidin (28). (29) said that (PPP) contented on phenolic acids such as vanillic, benzoic and gentisic

The result of (TPP) showed that (TPP) contained high amount of Ferulic, Cateachin. These results agree with (30) who said that.

TPP is a source of flavone glycosides and polymethoxy flavones. (TP) has strong anti-inflammatory potential. (31) Revealed that PPP, TPP and SLP are rich sources of phenolics (32). Dried peels are known to be rich in phenolic compounds such as flavonoids and phenolic acid (33).

Table (1): HPLC Analysis of phenolic compounds

Compound	RT (min)	Concentration (µg/g)		
		Strawberry Leaves	Pea Peel	Tangerine Peel
Gallic	4.51	1029.09	0	9.75
Protocatechuic	7.77	92.6	8.2	56.48
Gentisic	11.6	0	0	0
p-hydroxybenzoic	13.9	59.15	4.85	54.15
Cateachin	15.3	1450.02	0	1009.25
Chlorogenic	16.0	4.47	0	0
Caffeic	17.9	428.81	4.57	60.29
Syringic	22.9	33.03	5.25	0
Vanillic	23.5	79.7	15.71	33.41
Ferulic	20.6	240.46	185.17	1473.55
Sinapic	26.5	57.6	90.92	56.89
Rutin	28.7	823.45	0	0
p-coumaric	31.9	4.85	0	4.54
Apigenin-7-glucoside	32.7	192.8	27.24	1.42
Rosmarinic	36.9	269.32	5.18	1.69
Cinnamic	37.6	9.38	2.22	7.75
Qurecetin	38.6	23.43	9.48	40.82
Apigenin	41.8	0	0	23.42
Kaempferol	43.11	6.26	0	0
Chrysin	54.20	1.05	1.18	19.59
		4805.4748	359.97	2953

The experiment is applied using a sensory acceptable sample (5%).

The Data provided in Table (2), showed the effect of feeding 15% fortified crackers with PPP, TPP, SLP and their mixture on glucose level of rats was reported that the blood glucose was increased with significant different ($p \leq 0.05$) in all groups of diabetic rats compared to negative control. A significant decrease in blood glucose levels in groups fed on fortified crackers compared to the positive group. The rats fed on crackers mixture had the best effect as compare with the others. The groups received SLP and TPP showed nearly the same effect with no significant effect. These decreases may be due to the increase in dietary fiber found in fortified crackers.

This result agreed with (34) who showed that TPP decreased blood glucose by increased intake of fiber and flavonoids (35). SLP had a good effect in decreasing the blood glucose to contain high level of flavonoids, Vitamin C and essential oil. Vitamin C and flavonoids had a good antioxidant compounds so, (SLP) are used in medicine to treat diabetic (36). The (PPP) are mainly insoluble fiber and contain polyphenolic flavonoid compounds such as proanthocyanidins. Pea peels powder, which are of interest nutritionally for their antioxidant properties (37).

Table (2): Effect of feeding 15% crackers fortified with pea, tangerine peels, strawberry leaves powder and their mixture on Glucose level of experimental rats

Variables	Groups					
	Negative control	Positive control	(G3) 15% pea peels cracker	(G4) 15% tangerine peels crackers	(G5) 15% strawberry leaves crackers	(G6)15% mix of pea, tangerine peels and strawberry leaves crackers
Glucose (mg/dL)	111.8±4.21e	296.8±6.87a	232.2±4.65b	207.0±3.52c	205.7±6.45c	169.40±4.72 d

Values are means ± standard deviations of three replicate measurements. Means under the same column subscribed with different letters are significantly different (P≤0.05).

Data in Table (3) showed that, the mean value of liver enzymes including ALT, AST and ALP (U/L) of diabetic rats fed on crackers fortified with 15% PPP, TPP ,SLP and their mixtures. Founding that the mean value of liver enzymes of positive control was significantly higher than negative control, the mean values were 59.65±7.09, 63.97±8.72 and171.59±9.76 for ALT, AST and ALP respectively.

As shown in the current table, the positive control group recorded highest mean value as compared with the other groups with significant difference. The groups fed on fortified cracker mixture showed significant reduction when compared with the other cracker groups. There was no significant difference between groups fed on cracker with TPP or strawberry leaves. Rats who fed on cracker with PPP gave the lowest effect.

These results agree with (38) who showed elevation in ALT and AST levels for diabetic rats(39) also observed a statistically significant increase in ALT levels in diabetic patients as compared to the control group.

(40) showed that the (PPP)demonstrated antioxidant and antimicrobial activities to contain 17 flavonoids and 18 phenolics as hesperidin as a major flavonoid, Apigenin and its 7-O-glucoside which had cytoprotective and anticancer activities. In another study by (41) revealed that leaves are a good source of phenols and biologically active antioxidants. Hypoglycemic, hypolipidemic, anti-inflammatory, and anticancer activities for strawberry leaves powder, it was observed that SLP crackers had high effect on improving liver functions. These results according by (42) who showed that SLP improved liver tissue in rats. Also (43) said that SLP greatly decrease high levels of AST and ALT.

Table (3): Effect of feeding 15% crackers fortified with pea, tangerine peels, strawberry leaves powder and their mixture on liver functions experimental rats

Variables	Negative control	Groups				
		Positive control	(G3) 15% pea peels cracker	(G4) 15% tangerine peels crackers	(G5) 15% strawberry leaves crackers	(G6)15% mix of pea, tangerine peels and strawberry leaves crackers
ALT	33.89±6.97e	59.65±7.09 a	47.84±8.23 c	50.11±4.86 b	50.94±7.19 b	43.34±4.86 d
AST	34.80±5.87e	63.97±8.72 a	52.60±9.56 b	49.27±4.96 c	48.69±8.66 c	41.11±6.21 d
ALP	90.21±6.05e	171.59±9.76 a	156.11±8.45b	131.75±6.11 c	131.23±8.31 c	112.36±9.28 d

ALT- Alanine transaminase. AST- *Aspartate Aminotransferase. ALP-* Alkaline Phosphatase.*Values are means ± standard deviations of three replicate measurements. Means under the same column subscribed with different letters are significantly different (P≤0.05).*

The data in table (4) showed the diabetic rats who fed on 15% crackers containing TPP, PPP, SLP and their mixture reduced the rise of creatinine, uric acid and urea. The group fed on fortified cracker mixture showed the best results followed by groups fed on 15% crackers with SLP then TPP. In addition, the low values were negative control group in renal function parameters compared to all crackers products. There is no significant between groups fed on 15% crackers with tangerine peels or strawberry leaves.

These results agree with (44) who said that elevated renal function is a marker of renal dysfunction in diabetes compared to the control. (45) pointed out that all diabetic mice had significantly higher creatinine and urea values compared to the normal group. The improvement of renal function of diabetic rats that feeding on TPP related to antioxidant properties that protect cells from oxidative stress (46).

Diabetic rats receiving SLP showed significantly lower levels ($P \leq 0.05$) of creatinine, urea and uric acid compared with positive controls. Similarly, (47) confirmed that SLP decreased urea and creatinine level. Our studies have shown that the juice extracted from PPP is rich in proteins, minerals, and natural antioxidants that can decrease oxidative stress, improve immune system function, and increase glutathione levels in the kidney (48).

Table (4): Effect of feeding 15% crackers fortified with pea, tangerine peels, strawberry leaves powder and their mixture on kidney functions experimental rats

Variables	Groups					
	Negative control	Positive control	(G3) 15% pea peels cracker	(G4) 15% tangerine peels crackers	(G5) 15% strawberry leaves crackers	(G6)15% mix of pea, tangerine peels and strawberry leaves crackers
Creatinine	0.55±0.002e	1.20±0.23 a	0.99±0.07 b	0.86±0.11 c	0.83±0.006c	0.64±0.17 d
Urea	18.77±1.42e	35.81±2.52a	30.37±1.42b	27.72±2.63c	25.87±0.97c	21.75±1.84 d
Uric acid	2.99±0.85 e	6.03±1.62 a	5.11±0.45 b	4.22±1.07 c	4.26±0.76 c	3.58±0.58 d

Values are means ± standard deviations of three replicate measurements. Means under the same column subscribed with different letters are significantly different (P≤0.05).

The data provided in table (5) showed the lipid profile were affecting by feeding diabetic rats on 15% crackers substitution with tangerine peels or pea peels or strawberry leaves and their mixture. It proven that positive group was increased in total cholesterol, triglycerides, VLDL and LDL as compared all groups. Also, the other groups of rats fed on 15% crackers TPP, PPP, SLP and their mixture were lowing of blood lipid profile and LDL specially which fortified by mixture group followed by the groups fed on crackers TPP and crackers SLP which appeared no significant change between each other and the last effect was detected in the pea peels.

These results are in accordance with (49) who reported that fiber intake had significant effects like reducing triglycerides and blood glucose. TPP reduce lipids and contain a lot of phenolics and flavonoids, which have anti-oxidant properties (50).The efficiency of TPP in reducing serum triglycerides, serum total cholesterol, total liver fat, and liver cholesterol can be identified through various epidemiological investigations. Flavonoids reduced cholesterol and triglycerides in serum, phenolic and flavonoid compounds of mandarin exhibited lipid-lowering activities (51).

Also, all groups that treated with SLP were decreased significantly ($P \leq 0.05$) in lipid profile level compared to the positive control. Also, results showed a significant increase ($P \leq 0.05$) in HDL of the treated groups with SLP. This research in agreement with (52). The hypolipidemic effect probably because of polyphenols and antioxidant present in SLP.

Also, the obtained results about the reduction effect of pea peels were matched with the results of (53) who reported that the plant exhibited antidiabetic, antioxidant, and anti-hypercholesterolemia properties to contain protein, fiber, flavonoids, glycosides, carotenoids, tannins, tocopherols and alkaloids.

Table (5): Effect of feeding 15% crackers fortified with pea, tangerine peels, strawberry leaves powder and their mixture on lipid profile experimental rats

Variables	Groups					
	Negative control	Positive control	(G3) 15% pea peels cracker	(G4) 15% tangerine peels crackers	(G5) 15% strawberry leaves crackers	(G6)15% mix of pea, tangerine peels and strawberry leaves crackers
T.C	100.84±2.72e	267.29±4.73a	220.71±3.44 b	170.98±3.81 c	173.75±2.92 c	140.16±4.28 d
T.G	84.13±1.99e	194.77±3.82 a	152.82±2.69b	128.20±2.06c	132.013±4.18c	100.40±3.67 d
HDL	47.093±2.17a	35.22±2.04d	39.34±3.75 c	40.47±2.64c	41.27±1.88c	43.99±2.37 b
LDL	36.92±1.34e	193.12±3.85 e	150.81±3.94b	104.87±1.59c	106.08±5.77 c	76.09±1.48 d
VLDL	16.83±2.59e	38.95±1.06 a	30.56±1.11b	25.64±2.31 c	26.40±1.07 c	20.08±0.98 d

T.C- Total cholesterol. T.G- triglyceride.LDL-c- low-density lipoprotein cholesterol. HDL-c - high-density lipoprotein cholesterol .VLDL- Very Low-density lipoprotein cholesterol.Values are means ± standard deviations of three replicate measurements . Means under the same column subscribed with different letters are significantly different (P≤0.05).

The information provided in table (6) showed the effect of PPP, TPP, SLP and their mixture on biological evaluation (BWG, FI, FER) of diabetic rats. (FI) was reduced in positive group compared to negative control group, while treated groups with 15% fortified crackers especially mixture group which was nearly to negative group and the other three groups recorded no significant differences between each other. Diabetes disease caused significant decrease (P≤ 0.05) in BWG and FER for the positive group compared to the negative group, while treated groups with 15% fortified crackers were significantly increased in BWG compared to positive group, especially in fortified crackers mixture group. Also, no significant differences in FER and BWG of treated groups between pea peels, strawberry leaves, tangerine peels and the mixture group. Similar observation was made by(54).Gastrointestinal disturbances probably lead to reduced food intake. Treatment with strawberry leaf powder showed improvement in FI, BWG and RWG of diabetic rats. These results are consistent with the findings of (55). While I do not agree with (56) who found that SLP had not effect of feed intake.

The high effect of TPP led to its main components being volatile oils such as d-limonene and flavonoid components such as hesperidin, naringin, nobiletin, tangeretin and so on. In addition, there are also polysaccharides, alkaloids and other components that have been found to improve metabolic and vascular dysfunction and improve the weight of rats (57&58).

Table (6): Effect of feeding 15% crackers fortified with pea, tangerine peels, strawberry leaves powder and their mixture on body weight, feed intake and feed efficiency ratio experimental rats

Variables	Groups					
	Negative control	Positive control	(G3) 15% pea peels cracker	(G4) 15% tangerine peels crackers	(G5) 15% strawberry leaves crackers	(G6)15% mix of pea, tangerine peels and strawberry leaves crackers
FI	12.76±0.02 a	10.05±0.16 d	11.17±0.03 c	11.39±0.22 c	11.33±0.17 c	11.51±0.04 b
BWG	47.15±1.21 a	26.37±1.78 d	31.22±0.28 c	33.51±0.09 b	32.18±0.04 c	34.62±0.34 b
FER	0.088±0.003a	0.062±0.00d	0.067±0.002c	0.070±0.002b	0.068±0.001c	0.072±0.003 b

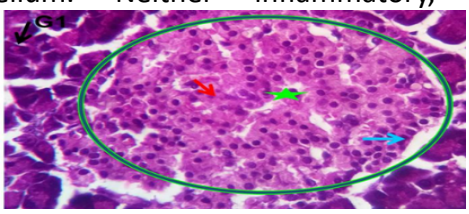
FI- Feed Intake. BWG- Body Weight Gain. FIR- Feed Efficiency Ratio.Values are means ± standard deviations of three replicate measurements.Means under the same column subscribed with different letters are significantly different (P≤0.05).

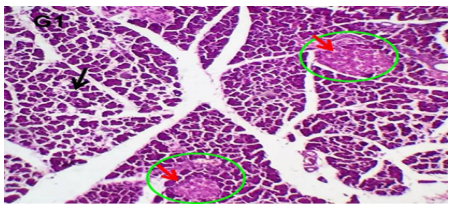
B. Histopathological Findings:

Pancreas

Examined serial sections from the pancreas of the negative group (G1) showed normality in

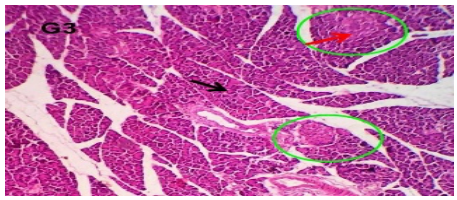
both the endocrine, exocrine limbs and secretory granules and healthy acinar epithelium. Neither inflammatory, nor necrotic or apoptotic changes could be detected. (Figs.1, 2 G1)

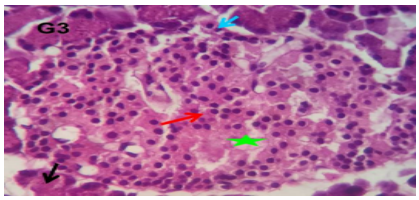


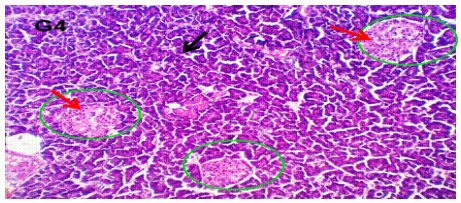


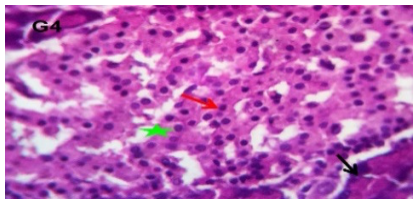
Photos.1, 2. Photomicrographs from pancreas of negative control group showing apparently normal exocrine acini (black arrows) and normal endocrine islets beta cells (green circles, red arrow) , alpha cells (light blue arrow) and intervening capillaries (green asterisk). H&E X 100, 400

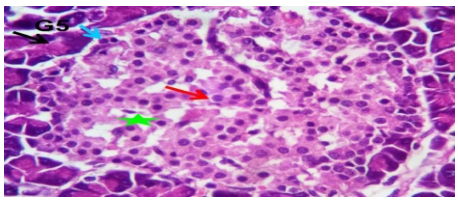
Nearly the same histo-morphologic characteristics were recorded in groups 3, 4, 5 and 6, however an active Islets beta cells modulatory changes with a more proliferative, occasionally trabecular change were recorded in these groups and could be attributed to an active bio -effective compound in the used food compounds as the islets appeared more cellular with increased beta cells population. Mild pancreatic ductal dilatation with peri-ductal fibrosis could be observed in group 5,6. (Fig, 3-10, G3, 4, 5, 6)

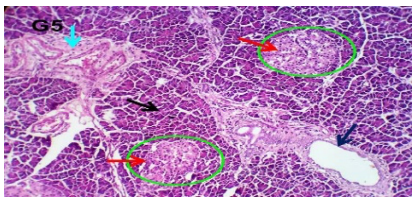


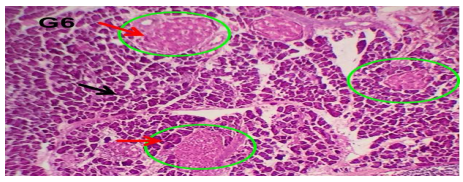












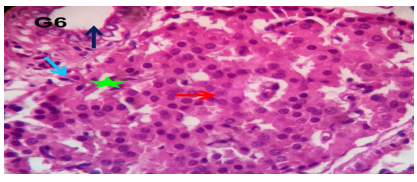
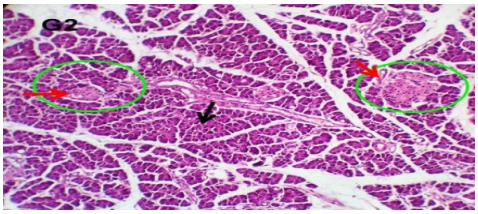


Photo. 3-10. photomicrographs from pancreas of groups 3, 4, 5,6 showing apparently normal exocrine acini (black arrows) and normal endocrine islets beta cells (green circles, red arrow), alpha cells (light blue arrow) and intervening capillaries (green asterisk) more proliferative, occasionally trabecular change are seen. Mild pancreatic ductal dilatation with peri-ductal fibrosis can be observed in group 5, 6(dark blue arrows). H&E X 100, 400.

Contrary to the abovementioned changes serial sections from pancreatic tissue of alloxan -induced diabetic rats (G2) revealed mild to moderate decrease in densities of the islet's cells with a corresponding degenerative and apoptotic changes in the β-cells. (Photos. 11, 12 G2)



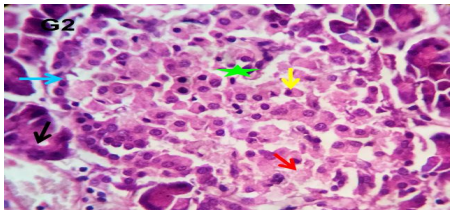


Photo.11-12. photomicrographs from pancreas of group 2 showing mild to moderate decrease in densities of the islet's cells(green circles) with a corresponding degenerative and apoptotic changes in the β- cells (red and yellow arrows) .H&E X 100 , 400.

4. Conclusion

Treatment rat diets with fortified crackers with pea, tangerine peels and strawberry leaves powder improved most of blood parameters in the (3,4,5,6) groups, suggesting the effectiveness of crackers containing of pea, tangerine peels and strawberry leaves powder are rich sources of fibers, phenols and anti-oxidant. Therefore, it is necessary to increase the use of medicinal herbs and pre- pruducts because of their medical and therapeutic benefits, especially SLP and TPP which produced by the lowest cost as defend against diseases this could reduce blood glucose, improve liver and kidney functions and reduce lipid in blood.

Conflict of Interest

The authors declare that there is no conflict of interest.

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نوع المقالة: بحوث اصلية
التغذية وعلوم الاطعمة

التأثير الخافض لسكر الدم للمقرمشات المدعمة بمسحوق قشور البازلاء واليوسفي وأوراق الفراولة على الفئران المصابة بالسكري الناتج عن مادة الألوكسان

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الملخص العربى:
صممت الدراسة الحالية لتقييم التأثير الخافض لسكر الدم للمقرمشات المدعمة بالبازلاء وقشور اليوسفى ومسحوق أوراق الفراولة على الفئران المصابة بالسكري المستحث بالألوكسان بنسبة 0.5%. تم تقسيم ستة وثلاثون من ذكور الفئران البيضاء إلى ست مجموعات (كل مجموعة تتكون من ستة فئران) على النحو التالى: المجموعة (1): تغذت على نظام غذائى أساسى كمجموعة تحكم سلبية. وتم حقن المجموعات الأخرى تحت الجلد بالألوكسان (150 مجم/كجم من وزن الجسم) لتحفيز مرض السكري. المجموعة (2): تغذت على النظام الغذائى الأساسى فقط كمجموعة تحكم إيجابية. المجموعة (3): تغذت على 15% مقرمشات مدعمه بـ 5% من مسحوق قشور البازلاء من الغذاء الأساسى المجموعة (4): تغذت على 15% مقرمشات مدعمه ب5% من مسحوق قشور اليوسفى من الغذاء الأساسى. المجموعة (5): تغذت على 15% مقرمشات مدعمه ب5% من مسحوق مقرمشات مدعمة بمسحوق أوراق الفراولة من الغذاء الأساسى. المجموعة (6): تغذت على 15% مقرمشات مدعمه بـ 5% من خليط مساحيق قشور البازلاء واليوسفى وأوراق الفراولة واستمرت التجربة لمدة 7 أسابيع. فى نهاية التجربة تم وزن الفئران كل فأر على حدة، وتم تشريح الفئران لجمع عينات الدم لإجراء الفحوصات المختلفة من تحديد الجلوكوز ومستوى الدهون ووظائف الكبد والكلى فى المصل وتم إجراء فحص هستوباثولوجي لأنسجة البنكرياس. النتائج التى تم الحصول عليها أشارت الى أن إثراء المقرمشات بنسبة 5% من مسحوق قشور البازلاء واليوسفى وأوراق الفراولة أدى إلى زيادة فى التقييم الحسى وتحسنًا فى مستوى الجلوكوز والدهون ووظائف الكبد والكلى. وتحسنت أنسجة البنكرياس مقارنة بالمجموعة (2). وبالتالى، أظهرت النتائج أن المقرمشات المدعمة ب 5% من مسحوق قشور البازلاء واليوسفى وأوراق الفراولة لها إمكانيات عالية لتعزيز القيمة الغذائية والحماية من مرض السكري.

الكلمات الكاشفة: مرض السكري، قشور البازلاء، قشور اليوسفى، مسحوق أوراق الفراولة، المقرمشات

الاستشهاد الي:
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