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Biological Evaluation of Cupcake Treated with Hawthorn Leaves on Diabetic Rats

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ABSTRACT

The aim of this study was to produce cupcake by replacement of 10, 20% wheat flour (WF) with hawthorn leaves(Crataegus sp.) powder (HLP). The effect of this replacement on the chemical, organoleptic, stability during storage cupcake for 14 day was investigated. Biological assay was also conducted on diabetic male rats. The results indicated that there were no clear differences between (WF) and (HLP) especially in moisture content and crude protein. However, (HLP) had higher contentes of ash, crude fat and crude fiber. Also, (HLP) contained 2841 mg/100g of total phenolic compounds and antioxidant activity (DPPH) recorded 46.47%. On the other hand epicatechen was the most predominant component, (2022.3 mg/100g) followed by chlorogenic and salicylic (509 and 309.5 mg/100g), respectively. Also it can be concluded that cupcake contain 20% (HLP) caused an improvement in some organoleptic characteristics and also it help to prolong the shelf life of product. Concerning the biological assay results showed that the diets containing cupcake fortified with HLP improved liver functions, while increasing of replacing ratio to 20% had a relatively negative effect on kidney functions. On the other hand plasma insulin showed a clear improvement as affected by amaryl drug and feeding on20% HLP cupcake sample (15.01 and 15.90 U/L, respectively). Meanwhile fasting blood glucose recorded an improvement in group fed on 10% HLP cupcake sample (209.40 mg/dL) and amaryl drug group (228.14 mg/dL) compared with(+ve) diabetic group(329.40 mg/dL).

Keywords: Hawthorn, insulin, fasting blood glucose, liver and kidney functions.

INTRODUCTION

There were over 8.57% of Egyptian population suffering from diabetes in 2015 (IDF, 2015).

In Egypt, the total annual death cases caused by diabetes reached 7080 cases, while high blood glucose caused about 42910 cases per year. WHO projects stated that diabetes will be the 7th leading cause of death in 2030 (Mathers and Loncar, 2006).

So, there is a real need to look for new natural materials curing this dangerous disease. One of promising substances is Hawthorn (*Crataegus sp.*), it is widely found in the northern hemisphere. It has been used as a medicinal drug and food for hundreds of years both in Europe and China. Researchers suggest that extracts of hawthorn fruits and leaves have many health benefits including hypolipidaemic, anti-atherosclerotic, hypotensive, cardioprotective and blood vessel relaxing activities. Also, fruit extracts have some antioxidant and radical scavenging activities (Pengzhan and Baoru 2012).The same authors reported that phenolic compounds, procyanidins (PCs), flavonols and C-glycosyl flavones are considered among the major bioactive compounds in hawthorn. Moreover, hawthorn fruit is rich in vitamin C, triterpenoids, fruit acids, sugar alcohols and some other components with beneficial effects on the human health.

Alaghawani and Naser (2013) investigated the therapeutic effect of hawthorn ethanolic extract in streptozotocine-induced diabetic rats and they concluded that *Crataegus laevigata* has clear hypoglycemic effect but further experiments should be carried out and active phytochemicals must be identified.

Shih, *et al.* (2013) examined the effect and molecular mechanism of *Crataegus pinnatifida Bge. var. major N.E. Br.* (hawthorn) by quantifying the expression of hepatic gluconeogenesis and lipogenesis on diabetes and dyslipidemia in high-fat-fed C57BL/6J mice. The results suggested that hawthorn extract decreased glucose production and triacylglycerol synthesis by inducing AMPK-phosphorylation and hawthorn is a possible source of antidiabetic and antihyperlipidemic factors.

Accordingly , this work was conducted to evaluate biologically the utilization of hawthorn leaves as a therapeutic material to remedy streptozotocine-induced diabetic rats. Also, this plant was examined as a food preservative.

MATERIALS AND METHODS

Materials

Hawthorn leaves *(Crataegus sp.*) was obtained from local market in Mansoura city, Egypt**.**

Wheat flour (72%), margarine, egg, sugar, salt, skim milk, vanillin and baking powder were obtained local market in Mansoura city, Egypt**.**

Streptozotocine (STZ) was obtained from Sigma Company, Cairo Egypt. Amaryl drug is oral hypoglycemic drug producing by Saofi-Avents Egypt.

Thirty male Albino strain rats (90 ± 10g) were obtained from National Organization Drug Control and Research (NODCAR), Giza, Egypt. Adult animals.

Methods

Preparation of hawthorn leaves powder

Hawthorn leaves were milled and packaged in polyethylene bags until using and analysis were carried out.

Preparation of cupcake

Cupcake samples were containing 10, 20% of hawthorn leaves powder. Cupcake was prepared according to the method described by Lakshminarayan *et al.* (2006). The dough transferred to aluminum cup and baked at 190C° for 20 min. in an electric oven. After cooling, the cakes packaged in polyethylene bags and stored at room temperature for fourteen days.

Organoleptic evaluation

Cupcake samples were organoleptically evaluated by a panel of ten panelists for appearance, color, softness, odor and ability value as the method described by Blends and Rungnaphar (2011).

Gross chemical analysis

Moisture, crude fiber, crude protein, crude fat, and ash were determined according to the method of A.O.A.C. (2000).Total carbohydrates content was calculated by difference.

HPLC analysis of phenolic compound

Phenolic compounds for analyzed hawthorn leaves powder was at Bio-technology Lab., Plant Pathology Institute, Agricultural Research Center, Giza, Egypt. Analysis was performed with a high pressure liquid chromatography HPLC "HP1050" equipped with a 4.6 mm x 150 mm ODS C18 column with UV detector and the injection volume was 5µl. Isocratic mobile phase was 40 methanol: 60 distilled water. The wave length in the UV detector was 230 nm; total run time for the separation was approximately 15 min at a flow rate of 0.60 ml/min according to the proposed method of Waskmundzka *et al.* (2007).

Determination of total phenolic compounds

Total phenolic compounds were determined according to the proposed method of Waskmundzka *et al.* (2007).

Determination of antioxidant activity (DPPH):

The antioxidant activity of hawthorn leaves powder was assessed by its ability to scavenging 2, 2-diphenyl-1-picrylhydrazyl stable free radicals (DPPH). The DPPH assay was performed as described by Miler and Rice-Evans (1997).

Extraction of cupcake fat

The cupcake samples fats were extracted from cake samples using the cold extraction method with petroleum ether.

Peroxide value

Peroxide value was determined in each fat sample according to the method described in A.O.A.C. (2000).

Thiobarbituric acid (TBA)

The test was performed according to the methods previously stated by some authors Ottolenghi, (1959) ; Kikuzaki and Nakatani, (1993), with small modifications. The TBA value was expressed as mg malondialdhyde/kg sample using the following equation: TBA = 7.8 × OD, where: OD is the absorbance at 540 nm.

Biological assay

Animals and experiential design

All animals were kept under standardized conditions (12h light/ dark cycle, 22°C) and were provided free access to standard diet (Table1) and water (NRC, 1995). Rats were subjected to streptozotocine dissolved in cold 0.01M citrate buffer, streptozotocine was intraperitoneally given at dose 65mg|kg body weight to induce diabetes. After injection, rats supplied with 5% glucose solution for 48 hrs. (Broca *et al*. 1999). Animals showing fasting blood glucose more than 300mg/dl were selected and used as diabetic rats.

Table 1. Composition of the standard diet

Ingredients	g/kg diet
Casein	200
Corn starch	497
Sucrose	100
Vitamin mixture	020
Mineral mixture	100
Corn oil	050
Cellulose	030
Methionine	003

This experiment was designated to study the therapeutic effect of hawthorn leaves on plasma glucose and insulin in streptozotocine-induced diabetic rats.

In this experiment, thirty male rats were divided into six groups (n=5) as the following:

Group 1: (- Control) received distilled water (2.5ml\kg).

Group 2: (+ Control) Diabetic rats control.

Group 3: Diabetic rats received Amaryl drug (daily dose was 0.36mg|kg body weight) by dissolving in distilled water (Paget and Barnes, 1964).

Group 4: Diabetic rats received control cupcake.

Group5: Diabetic rats received cupcake with 10% hawthorn powder.

Group6: Diabetic rats received cupcake with 20% hawthorn powder.

At the end of four weeks, the animals were deprived of food overnight and sacrificed by decapitation. Blood was collected in two different tubes, one with anticoagulant (potassium oxalate and sodium fluoride) for plasma and another without anticoagulant for serum separation. Plasma and serum were separated by centrifugation.

Body weights of the rats were measured three times a week during four weeks. Daily changes in body weights as percentages were recorded. The percentage of daily changes in body weights was calculated according to the following formula:

Change in body weights (%)=100 ×(Final weight-Initial weight) / Initial weight.

Food Efficiency Ratio (FER) was calculated at the end of experiment as following: FER= Body weight gain (g) / Food intake (g).

Biochemical Analysis:

Fasting blood glucose was estimated by an enzymatic colorimetric method according to Siest *et al.* (1981).

Plasma insulin level was assayed by Enzymatic Linked Immune Sorbent Assay (ELISA) Kit as described by Nakagawa *et al.* (1973).

Bilirubin, Plasma alanine and aspartate aminotransferase enzymes activities (ALT and AST) were also determined according to the method of Reitman and Frankel (1957).

Plasma total protein and creatinine were determined by an enzymatic method according to Henry (1964).

Plasma uric acid was estimated by an enzymatic method according to Trinder (1969).

Statistical analysis

Results obtained from this experiment were analyzed using analysis of variance (one way ANOVA),

while comparisons were made using Least Significant Difference test (LSD) at $P<0.05$ level of significance using SPSS (2008) version 17 program for windows.

RESULTS AND DISCUSSION

Chemical composition of hawthorn leaves powder and wheat flour

Results illustrated in Table (2) show proximate chemical composition of wheat flour and hawthorn leaves powder. Obtained results indicate that there were no clear differences between wheat flour and hawthorn leaves powder especially in moisture content and crude protein. However, wheat flour contained more quantities of moisture, crude fat and total carbohydrates where they recorded 11.00, 10.00 and 75.3%, respectively.

Table 2. Chemical composition of hawthorn leaves powder and wheat flour

Parameter	WF	HLP
Moisture (%)	11.0±0.05	8.3± 0.08
Crud protein (%)	10.0± 0.03	7.2± 0.09
Ash (%)	0.7±0. 1	9.0± 0.04
Crude fat (%)	2.0±0.09	4.8± 0.01
Crud fiber (%)	1.0± 0.04	5.0± 0.10
Carbohydrate (%)	75.3±0.10	65.7± 0.12

WF = Wheat flour HLP= hawthorn leaves powder

On the other side, hawthorn leaves powder had higher content of crude fat and crude fiber were 4.8 and 5.00% , respectively. It could be clearly noticed that this plant leaves contained a high amounts of ash 9.00%.

Phenolic compounds of hawthorn leaves powder

Total phenolic compounds content was determine in hawthorn leaves powder and it recorded 2841 mg/100g. Also, antioxidant activity of hawthorn leaves powder was assessed by its ability to scavenging 2, 2-diphenyl-1-picrylhydrazyl stable free radicals (DPPH) and recorded 46.47%. Results illustrated in Figure (1) show phenolic compounds content (mg/100g) in hawthorn leaves powder, it clearly could be seen that epicatechen was the most predominant component, (2022.3 mg/100g), followed by chlorogenic and salicylic (509 and 309.5 mg/100g, respectively). These results are in agreement with those Bernatoniene *et al.,* (2008), who found that (-)-epicatechin and (+)-catechin showed the highest radical scavenging activity among the detected phenolic compounds. Clear synergistic effects were observed among different phenolic compounds.

So, it could be stated that hawthorn leaves powder had a quantity of phenolic compound, it had antioxidant activity which could be useful in biosystems or food preservation.

Sensory evaluation of processed cupcake treated with hawthorn leaves powder

Tabulated results in Table (3) show organoleptic properties of cupcake samples made from wheat flour and hawthorn leaves powder. It could be seen that there were no clear differences between the three treatments in softness and ability value. But the high percentage of hawthorn leaves powder (20%) caused an improvement in some characteristics such as appearance, color and odor in comparison with control treatment.

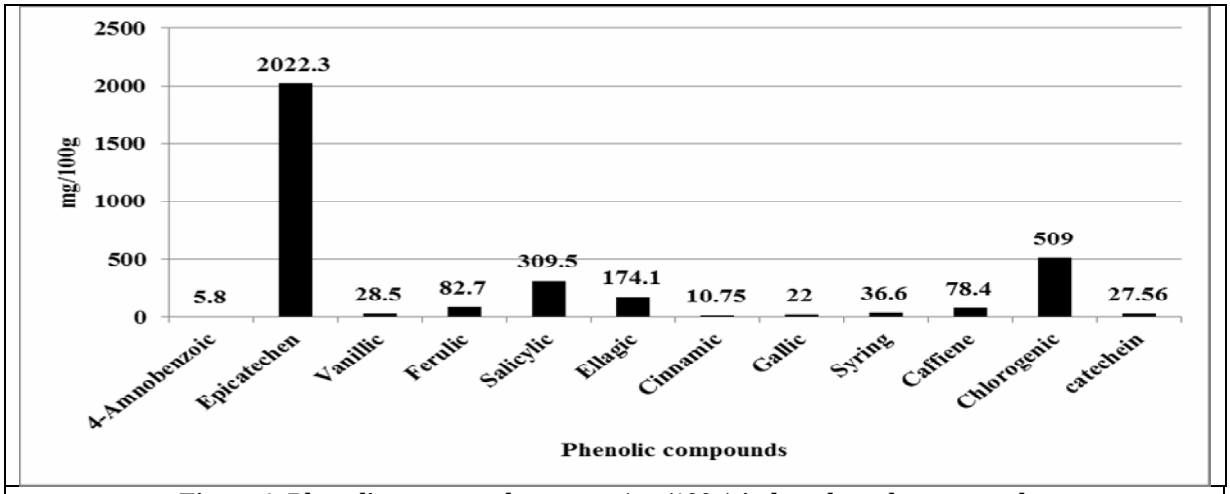

Figure 1. Phenolic compounds content (mg/100g) in hawthorn leaves powder

Table 3. Organoleptic properties of cupcake samples made from wheat flour and hawthorn leaves powder

Cupcake samples	Appearance 10	Color 15	Softness 15	Odor 15	Ability Value 10
100%WF (control)	9.0±0.5	14.1±0.2	12.3±0.2	14.5± 0.5	9.00±0.37
90%WF+10 % HLP	8.9±0.3	13.6±0.4	12.3±0.1	13.9± 0.3	8.73±0.32
80%WF+20 % HLP	9.1±0.5	14.0±0.5	12.3±0.2	14.2±0.4	8.97±0.35

WF: Wheat flour and HLP: Hawthorn leaves powder.

Chemical composition of treated cupcake during storage

Tables (4) show the gross chemical composition of all cupcake treatments at zero time and after 14 days of storage at room temperature. Results in Table (4) indicate that cupcake samples contained moisture about 30% with little variations which decreased to 21.0, 25, and 22.05% in the three samples after 14 days of storage. Crude protein of control sample had the same trend of moisture where that slightly decreased from 12.3 % to 8.99 %, also crud fat slightly increased from 16.33 ,14.33 and 13.00% to 17.37 , 15.43 and 15.00% in

control sample, 90%WF+10%HLP and 80% WF+20%HLP, respectively. While ash and crude fiber content increased from 2.5 and 2.34% to 4.1 and 2.93%, respectively. As for carbohydrates content, it clearly could be noticed that replacing of hawthorn leaves powder by 20% increased carbohydrates content from 37.57% in control sample to 39.75%. Storage of these cupcake samples at room temperature raised total carbohydrates of all samples where they were 45.7, 35.5 and 42.91% in control sample, 90%WF+10%HLP and 80%WF+20%HLP, respectively.

Table 4. Chemical composition of fortified cupcake made from wheat flour (72%extract) with hawthorn powder zero time and after 14 days of storage at room temperature

Cupcake samples	Time	Constituents					
		Moisture %	Crude protein %	Crude fat %	Ash %	Crude fiber %	*Carb. %
100% WF (control)	zero	29.0± 0.25	12.3±0.09	16.33±0.22	2.5±0.49	2.34±0.13	37.57
	14	21.0± 0.5	8.9±0.17	17.37+0.45	4.1+0.91	0.32+2.93	45.7
90%WF+10% HLP	zero	31.0± 0.20	11.3±0.09	14.33±0.2	6.10±1.40	6.50±0.23	30.77
	14	25.0± 0.20	9.18±0.35	15.43±0.23	7.31±1.00	7.55±0.11	35.53
80%WF+20% HLP	zero	30.0± 0.31	8.3±0.09	13.00±0.43	4.41±1.43	4.54±0.22	39.75
	14	22.05± 0.31	9.3±0.09	15.00±0.8	5.1±0.97	5.64±0.09	42.91

WF = Wheat flour HLP= hawthorn leaves powder *Carb=carbohydrate, , Each value is the mean + SE.

These changes in chemical composition did not refer to any effect of replacing wheat flour with hawthorn leaves powder, may be attributed to staling process and loss of moisture, the dry matter content will directly increase.

Changes of peroxide value and TBA of cupcake samples during storage

Table (5 and 6) summarized changes of peroxide and TBA value of cupcake samples during storage for 14 days at room temperature. These fat parameters treated only with oxidative rancidity and consequently effect of hawthorn leaves phenolic compounds on their changes.

Results illustrated in Table (5) indicated that there was a gradual increase in peroxide value of all cupcake samples during storage. In control sample peroxide value increased from 3.25 at zero time to 3.80, 4.19, 5.70 and 6.90 milliequevalant/Kg after 3, 6, 9 and 14 days of storage at room temperature, respectively. But addition of hawthorn leaves powder instead of wheat flour sharply reduced this increase and the peroxide value of these samples did not exceed 4.40 at the end of storage period. Peroxide value is well known as an indicator of primary oxidation products.

Table 5. Inhibitory effect of hawthorn powder on the primary oxidation of lipids extracted from fortified cupcake as measured by using peroxide value during storage

Cupcake samples	Zero	3	6	9	14
100% WF (control)	3.25±0.2	3.8±0.1	4.19±0.1	5.7±0.1	6.9±0.5
90%WF+10% HLP	3.24±0.2	3.4±0.08	3.5±0.09*	4.08±0.8*	4.4±0.1**
80%WF+20% HLP	3.25±0.2	3.1±0.2	3.45±0.2**	3.7±0.16**	4.00±0.09***

WF = Wheat flour HLP= hawthorn leaves powder Each value is the mean of samples+ SE.
Significant with control group *p< 0.05 ** P< 0.01*P< 0.001.**

Table 6. Inhibitory effect of hawthorn powder on the malondialdhyde formation of lipids extracted from fortified cupcake as measured by using TBA during storage

Cupcake samples	Zero	3	6	9	14
100% WF (control)	0.09±0.1	0.16±0.04	0.22±0.01	0.32±0.02	0.43±0.02
90%WF+10% HLP	0.09±0.1	0.19±0.1	0.20±0.01	0.23±0.01**	0.32±0.02**
80%WF+20% HLP	0.09±0.1	0.13±0.01*	0.18±0.4*	0.20±0.01***	0.26±0.01***

WF = Wheat flour HLP= hawthorn leaves powder Each value is the mean of samples+ SE.
Significant with control group *p< 0.05 ** P< 0.01*P< 0.001.**

While results in Table (6) show another indicator of secondary oxidation products or lipid peroxidation marker called malondialdehyde. The curves clearly indicated that increasing of hawthorn leaves powder ratio was followed by decreasing in TBA value. This value gradually increased during storage from 0.09 at zero time to 0.32 and 0.26 mg malondialdehyde/ Kg fat for 10 and 20% replacing ratio, respectively with highly significant differences. From these previous results, it could be said that the content of phenolic compounds in hawthorn leaves powder was sufficient to play its rule as natural antioxidant and help to prolong the shelf life of such products.

Biochemical evaluation of cupcake treated with hawthorn leaves powder

Weight gain and food efficiency ratio

Tabulated results (Table 7) showed effect of studied cupcake samples on weight gain and food efficiency ratio in male rats. The results indicated that weight gain of the diabetic group (+ve) control was significantly lower than (-ve) control (29.00 < 55.10 g). But when this group treated with amaryl drug, this value improved and increased to 41.05g. The groups which fed on cupcake with replacing ratios of hawthorn leaves powder showed positive effect, where weight gain reached 44.00 g in 80%WF + 20% HLP group and without any significant differences with amaryl drug group.

Table 7. Body weight gain and food efficiency ratio of male rats fed on cupcake treated with hawthorn leaves powder

Groups		Initial weight (g)	Final weight (g)	weight gain (g)	Daily food intake	Food efficiency ratio
G1	(–ve) Control	94.30±2.70	149.40±20.70	55.10±8.27	13.66±3.63	0.40±1.81
G2	(+ve) Control	94.00±3.49	122.25±15.30	29.00±5.32*	11.28±2.97	0.24±0.80
G3	Amaryl drug	94.75±2.90	135.80±18.20	41.05±7.20***	12.00±3.60	0.34±1.30**
G4	100% WF	95.80±2.70	131.70±21.70	35.99±7.31***	12.00±4.10	0.29±1.80*
G5	90%WF+10%HLP	95.20±3.50	132.70±19.70	37.50±6.01***	11.55±2.30	0.32±1.00**
G6	80%WF+20%HLP	94.75±3.09	136.70±11.70	44.00±4.82***	14.50±1.70	0.32± 0.002**

(–ve)=negative (+ve)=positive

:* P< 0.05, ** P< 0.01 and ***P< 0.001 mean that there were significant differences with control group.

The same trend was observed in food efficiency ratio, where it was 0.40 in (–ve) control group and 0.24 in + control group. While it recorded 0.32 in 80%WF (+ve) 20% HLP group without significant differences with amaryl drug group (0.34).

Liver functions

The effect of the treated cupcake samples on liver functions in male rats, which, ALT and AST enzymes activity were analyzed. Tabulated data in Table(7) show that as a result of diabetes, ALT and AST sharply increased from 11.60 and 28.40 U/L to 30.80 and 45.40 U/L, respectively. Administration of Amaryl drug slightly reduced these values to 26.20 and 29.40 U/L. But the 20% replacing ratio could significantly reduce these values to 21.10 and 26.60 U/L for ALT and AST, respectively. Bilirubin content ranged from 0.44 in 90%WF + 10% HLP group to 1.00 mg/dL in + control group. The previous results reported that although replacing of wheat flour with hawthorn leaves powder helped to improve of liver functions. In various in vivo studies, hawthorn leaves extract has been found normalized levels of antioxidant enzymes in the liver. (Shanthi *et al.,* 1996)

Table 8. Effect of feeding on treated cupcake on liver functions in male rats

Groups	ALT (U/L)	AST (U/L)	Bilirubin (mg/dL)
G1(–ve) Control	11.60 ±5.85	28.40±4.80	0.45±0.03
G2(+ve) Control	30.80±4.29	45.40±3.50	1.00±0.03
G3Amaryl drug	26.20±7.20	29.40±2.96*	0.55±0.09**
G4100% WF	29.90±5.00	41.20±7.30	0.62±0.05
G590%WF+10%HLP	28.40±7.40	39.00±3.93	0.44±0.06**
G680%WF+20%HLP	21.10±7.80**	26.60±7.20**	0.57±0.03*

(–ve)=negative (+ve)=positive

:* P< 0.05 and ** P< 0.01 mean that there were significant differences with control group.

Kidney functions:

Data in Table (9) showed that urea content increased from 12.20 to 30.70 g/dL in (–ve) and (+ve) control, respectively. Amaryl drug could slightly reduce this value to 24.20 and still represented double of the (–ve) control group. The fed groups with hawthorn leaves powder reduced urea value to be near of amaryl group (23.70 g/dL in 90%WF + 10% HLP group). Creatinine content recorded 0.80, 2.64, 1.68 and 1.7 g/dL in (–ve) control, (+ve) control, amaryl drug and 90%WF + 10% HLP group, respectively. Uric acid content showed the same change as affected by amaryl drug and hawthorn leaves powder. It was 2.80 and 2.54 mg/dL in (–ve) control and 90%WF + 10% HLP group, respectively. Increasing of replacing ratio to 20% had a relatively negative effect on kidney functions.

Table 9. Effect of feeding on treated cupcake on kidney functions in male rats

Groups	Urea (g/dL)	Creatinine (g/dL)	Uric acid (mg/dL)
G1 (–ve) Control	12.20±2.90	0.80±0.100	2.80±0.38
G2 (+ve) Control	30.70±3.20	2.64±0.15	4.14±0.58
G3 Amaryl drug	24.20±3.32*	1.86±0.43**	2.80±0.50**
G4 100% WF	26.10±3.60	2.20±0.17	3.10±0.50
G5 90%WF+10%HLP	23.70±2.6**	1.70±0.11**	2.54±0.60**
G6 80%WF+20%HLP	25.20±3.40	1.92±0.21	3.20±0.40

(–ve)=negative (+ve)=positive

:* P< 0.05 and ** P< 0.01 mean that there were significant differences with control group.

Insulin and fasting blood glucose

Plasma insulin (U/L) and fasting blood glucose (mg/dL) results were summarized in Table (10). Plasma insulin activity showed a clear improvement as affected by amaryl drug and feeding on cupcake samples it was 16.6 U/L in (–ve) control group, then it reached 7.80 U/L in (+ve) control group. It ranged from 14.40 to 15.90 U/L in the other experimental rat groups.

Table 10. Effect of feeding on treated cupcake on insulin and fasting blood glucose in male rats

Groups	Plasma insulin (U/L)	Fasting blood glucose (mg/dL)
G1(–ve) Control	16.6 ±1.85	113.40±15.80
G2(+ve) Control	7.80±0.99	329.40±63.50
G3Amaryl drug	15.01±1.20**	228.14±35.70*
G4100% WF	14.40±1.80*	299.20±67.30
G590%WF+10%HLP	14.51±1.10*	209.40±42.96**
G680%WF+20%HLP	15.90±2.10**	269.60±47.20

(–ve)=negative (+ve)=positive

:* P< 0.05 and ** P< 0.01 mean that there were significant differences with control group.

Fasting blood glucose had the least value (113.40 mg/dL) in (–ve) control group and recorded the highest value (329.40 mg/dL) in (+ve) control. Meanwhile, it relatively decreased in group treated with Amaryl drug and 90%WF + 10% HLP groups with value of 228.14 and 209.40 mg/dL, respectively. These last results were promising to use hawthorn leaves powder to improve plasma insulin and fasting blood sugar of diabetic patients.

CONCLUSION

From these results, it could be stated that hawthorn plant could be considered a promising plant to extract its phytochemicals and carry out fractionation process to get the bioactive components. It could be used as a helpful agent in controlling blood sugar.

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التقييم البيولوجي للكب كيك المعامل بأوراق نبات الزعرور على فئران التجارب المصابة بمرض السكري

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الهدف من هذه الدراسة هو تقييم انتاج كب كيك وذلك باستبدال 10 و20%من الدقيق بمسحوق اوراق نبات الزعرور وتأثير هذا الاستبدال على الصفات الكيميائية و الحسيه و الثبات اثناء التخزين لمده 14 يوم و كذلك الخصائص البيولوجية لذكور الفئران المصابة بالسكر. وبينت النتائج انه لا توجد فروق واضحة بين دقيق القمح و مسحوق اوراق نبات الزعرور خاصه في محتوى الرطوبة و البروتين الخام بينما احتوى مسحوق اوراق نبات الزعرور على اعلى نسبه من الرماد و الدهن والالياف الخام وكذلك احتوى على 2841ملجم/100جم من الفينولات الكلية وسجل النشاط المضاد للأكسدة (DPPH) 46.47%. ومن ناحية اخرى كان الابيكاتشين هو المركب السائد حيث كانت نسبته 2022.3ملجم/100جم تلاه الكلوروجينك والسليسلك (509 و 309.5 ملجم/100جم) على التوالي. وكذلك يمكن تلخيص ان الكب كيك المحتوى على 20% من مسحوق اوراق نبات الزعرور سبب تحسن في بعض الصفات الحسية وايضا ساعد على اطاله فتره الثبات اثناء تخزين المنتج.اظهرت نتائج التقييم البيولوجي ان الوجبات المحتوية على مسحوق نبات الزعرور ساعدت على تحسين وظائف الكبد بينما زياده نسبه الاستبدال الى 20% ادت الى تأثير سلبي نسبيا على وظائف الكلى ومن ناحيه اخرى اوضحت نتائج الانسولين تحسنا واضحا نتيجة تأثير عقار الاميريل (Amaryl drug) و التغذية على الكب كيك المحتوى على 20% من مسحوق اوراق الزعرور (15.01 و 15.90 u/لتر) على التوالي بينما سجلت نتائج سكر الدم تحسنا في المجموعة التي تغذت على الكب كيك المحتوى على 10% من مسحوق اوراق الزعرور209.40ملجم/ديسيلتر و مجموعه عقار الاميريل (Amaryl drug) 229.14ملجم/ديسيلتر مقارنه بالمجموعة المصابة بالسكر (المجموعة الموجبة) 329.40ملجم/ديسيلتر.

الكلمات الدالة: نبات الزعرور – الأنسولين – جلوكوز الدم – وظائف الكبد والكلى.