Impact of Strawberry (*Fragaria x* ananassa) Leaves Powder on Induced Diabetic Rats

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Abstract

In the present study the chemical composition and identification total phenolic content (TPC) and healthy and nutritional benefit of strawberry (*Fragaria x* ananassa) leaves powder was carried out to determine the important polyphenolic composition, potential of the strawberry leaves for potential biological applications. Diabetic rats were fed on strawberry leaves powder at percent(0.50%, 1% and 1.50%). Blood glucose, lipid profile of rats, liver and kidney functions were determined in blood serum. Histopathalogical studies on liver, pancreas and kidney sections were carried out. The elevated levels of blood glucose (221.11g/dl), TG (140.98), TC (144.88), LDL-C (70.765), (mg/dl) and the lowest level of HDL-C (39.915 mg/dl) were noted in group 2 animals(G2positive control) at six weeks also three weeks compare with rats groups fed on strawberry leaves powder at the differences percentage . Results showed that strawberry leaves powder were found to lower the serum cholesterol, triglyceride, LDL-C, but were found to increase the HDL-C as compared to the corresponding diabetic group (positive control). The histopathological examination of liver, pancreas and kidney were more or less normalized in the groups that were fed strawberry leaves powder rats compared to the positive control group. Thus, the study demonstrates that strawberry leaves powder possesses a diabetic effect on serum lipid profile, liver, pancreas and kidney functions. Results are revealed an improve in liver, pancreas and kidney functions of rats fed on strawberry leaves powder. From the foregoing results in the current work, it could be recommended to using of strawberry leaves powder or extract at a ratio 0,5% 1.0% and 1.50% of differences fields such as manufacturing or nutrition specific diabetic to get the highest healthy and nutritional benefits of this leaves .

Keywords: leaves powder, diabetic rats, blood profiles lipid, liver and kidney enzymes liver, pancreas and kidney tissue,

Introduction :

To days a great tendency in use of plant extracts or powders in nutrition to get of the awareness of human and nutrition healthy . The importance of plants extracts has been attributed to their effective physiological and pharmacological substances, natural antioxidants and trace mineral contents with vitamin presence.

Currently, there are over 150 million diabetics worldwide and this number is likely to increase with increase in sedentary lifestyle, consumption of an energy-rich diet, and obesity (Yajnik, 2001).

Phenolic compounds are secondary metabolites in plants which play an important role in human health and nutrition. Moreover, some of them present in natural products have higher antioxidant activities than those of synthetic antioxidants (Ji *et al.,* (2009) and Jayashri *et al.,* (2017).

Strawberry leaves as a source of bioactive compounds with potentially beneficial biological effects have been largely overlooked. **Mudnic *et al.* (2009)** examined direct, dose-dependent effects of wild strawberry (*Fragaria vesca, L.*) leaves aqueous extract, in two experimental models and animal species.

Mazzio and Soliman (2009) reported that strawberry leaf is has anti-cancer effect and can be one of the alternative medicines. **Modun *et al.* (2007)** suggested that strawberry leaves (*Fragariae herba folium*) are valuable source of bioactive phytochemicals with potentially beneficial effects on cardiovascular system.

Mudnic *et al.,* (2009) researched that vasodilators potential of the wild strawberry leaves aqueous extract was compared with vasodilators activity of aqueous extract of hawthorn (*Crataegus oxycantha* L.) leaves with flowers, which can be regarded as a reference plant extract with a marked vasodilators activity.

Leaves of strawberry, raspberry and blackberry evaluated the antioxidant activity of fruits and by their oxygen radical absorbance capacity (ORAC); extracts of phenolics from leaves exhibited significantly ($p<0.05$) higher ORAC values than those from the corresponding berries **Wang and Lin [2000].**

Many human diseases are caused or negatively affected by free radicals. The natural defense of the human organism againts free radicals is not always sufficient

mainly due to the significant exposition to free radicals from external sources in the modern world. The dietary intake of antioxidants

plays an important role in the protection of the human organism againts free radicals. Many clinical and epidemiological studies show a connection between the antioxidant activity of the substances present in the diet and the prevention from such diseases as cardiovascular diseases or carcinogenesis (**Hughes, 2000; Kris-Etherton *et al*., 2002; Lindsay and Astley, 2002).** Methods

Materials

Strawberry leaves ***(Fragaria x* ananassa*)*** were collected before noon at sunny at the beginning of wild strawberry's flowering stage and were dried at (40°C). Alloxan monohydrate and kits (total cholesterol, , triaglycerol and total high density lipoprotein cholesterol (HDL-C), total protein (ALT, AST, creatinine and urea were purchased form Sigma-Aldrich (MO,IL USA) .Reagents and chemicals used were of the highest purity.

Chemical composition of strawberry leaves powder

Moisture, crude protein, fat, total dietary fibre and ash contents of strawberry leaves powder were determined by the standard procedures described in the AOAC (2010). Total carbohydrates were calculated by difference according to the following equation:

Total carbohydrates =100 - (Moisture% + crude protein% + crude fat% + ash% + total crude dietary fibre %).

Determination of Phenolic Compounds Using HPLC

Identification of phenolic compounds using HPLC using by phenolic acids of the Strawberry leaves ***(Fragaria x* ananassa*)*** were identified according to the method described by **Mattila*et al*. (2000).** HPLC (Hewllet Packard series 1050, USA) equipped with auto sampling, injector, solvent degasser, UV detector set at 330 nm and quarter HP pump (series 1050) was used. Column (C18 hypersil BDS) with particle size 5 lm was used. The separation was carried out with methanol and acetonitrile as a mobile phase at flow rate of 1 mL/min. The column temperature was performed at room temperature (25°C) throughout the experiment. Identification and quantification were carried out based on calibrations of the standards prepared from phenolic acids dissolved in a mobile phase. Retention time and peak area were used for calculation of phenolic acid compounds by the data analysis of Hewllet Packard Software.

Biological experiment

Experimental animals

The work was carried out in Food Science Department, Faculty of Agriculture, Zagazig University, Egypt. Healthy male albino rats weighting 118-125 g, were obtained from the National Research Center ,Dokki, Giza, Egypt, and used in this investigation. The rats were housed in stainless steel cages with screen bottom in a controlled environment with 12 hr., light and 12 hr., dark cycles.

All groups were fed on the basal diet for one weeks as adaptation period. The basal diet consisted of 15% casein, 5% cellulose, 10% fat and 65% corn starch. Salt and vitamin mixtures were added at a ratio of 4% and 1%, respectively according to AOAC (2010).Water was given *ad libitum*. The animals were divided into 5 groups, 6 rats each. After the adaptation period (7 days), one group continued feeding on the basal diet and served as negative control (G1). (Other four groups were fed on basal diet and diabetic animals). Group (2) was fed on basal diet and served as a positive control (G 2). All groups rats except control (negative and positive control) received strawberries leaves powder, where the three other group were allowed to fed on strawberry leaves powder. The three group were fed on 0.50% strawberry leaves powder (G 3). The four group was fed on 1.0% strawberry leaves powder (G 4) and The five group was fed on 1.50% strawberry leaves powder (G 5). All groups were feeding for 42 days.

Induction of diabetes

Diabetes was induced in male wister albino rats by intraperitoneal injection of single dose alloxan monohydrate (150mg/kg bw), (**Jelodar *et al.,* 2010).** The animals were allowed to drink 5% glucose solution to overcome the drug (**Balasubramaian *et al.,* 2004**). Fasting blood glucose levels were measured after 2 days. After three days of alloxan induction the rats were screened for diabetes and animals having glycosuria with blood glucose level of 200-310 mg/dL were taken for the study. Blood samples were collected from the tip of tail at the defined time patterns (**Aslan *et al.,* 2007a,b**). The blood samples have been collected after 3 and 6weeks feeding and analysed by enzymatic kit method (**Young, 2001**)

Sample collection

At the three and six weeks (end) of the experimental periods, the animals were fasted overnight and sacrificed by cervical decapitation. .

The samples were collected in tubes and were centrifuged at 3000 rpm for 20 min to obtain serum. The total cholesterol was analyzed according to Young (2001), triglyceride was analyzed according to **Stein (1987),** (HDL-C) was measured by enzymatic colorimetric method using Randox kits (**Gordon, 1977**) and the concentration of (LDL-C) cholesterol was calculated by (**Johnson *et al.*, 1997**) the following **equation**:

LDL -C= (T.C–HDL) – T.G/5

Aliver enzyme activates, alanine amino transferase (ALT), aspartate amino transferase (AST) and total protein were analyzed according to Young (2001). Kidney functions in serum creatinine and blood urea nitrogen were determined according to **Young (2001).**

Histopathological examination

Specimens from liver, kidney and pancreas from all groups were examined macroscopically then fixed in 10% neutral formalin and embedded in paraffin. Sections of five microns thickness were prepared, stained by haematoxylin and eosin as mentioned by **Suvarna S.K. *et.al.,* (2013)** and were examined microscopically.

Statistical analysis

The results concerning strawberry leaves powder were statistically tested by analysis of multi variance ANOVA and discriminative test. ANOVA functions and Roy test both with 0.05 significance level were used as Unitarian statistical procedures to assess significant differences among means (**Steel and orrie,1980**).

Results and discussion

Chemical composition of strawberry leaves powder

As shown in Table (1) chemical composition of **strawberry leaves powder** had high content of crude protein (15.12%) and high crude fiber,(14.50%) and lowest content of crude carbohydrates (49.93%) . These results agree with (**Zohra, 2015**). These results is agree with previous studies (**Ishihawa *et al.* (2002) and Al-Owaimer**

Table 1. Chemical composition of strawberry leaves powder

Sample	Moisture (%)	Protein (%)	Fat (%)	Total fiber (%)	Ash (%)	Carbohydrates (%)
Strawberry leaves drying	2.52	15.12	17.55	15.20	8.71	12.88

Identification of phenolic compounds

Table (2) shows the concentration of each phenolic compound in strawberry leaves powder there was a great variation among the identified components. It is suggested that there antioxidant activity is related to their cingulated rings and hydroxyl groups (**Mattila *et al*., 2000**). Phenolic compounds identified in strawberry leaves powder ranged from 8.00 to 1814.09 mg/100g that leaves were rich in various phenolic compounds. Phenolic compounds were identified in strawberry leaves powder namely catechin, Ellagic acid, Pyrogallol, Protocatechuic, Catechol acid, 3-OH- Tyrosol, Vanillic and P-OH-benzoic, and Ferulic acid. The obtained results are similar to those reported by **Arun *et al* ., (2015) and kong *et al*., (2012) and Olufunke *et al* ., (2016)**

Table (2).Identification of phenolic compounds in strawberry leaves powder as determined by HPLC

Test items	PPE (mg/100g)
Gallic acid	32.05
Pyrogallol	899.26
3-OH- Tyrosol	174.86
Protocatechuic	299.90
Catechin	1814.09
Catechol	226.15
P-OH- benzoic	104.36
Caffeine	44.42
Vanillic	151.68
P-cumaric	14.62
Ferulic	78.45
Iso-ferulic	52.89
Alpha-cumaric	8.00
Ellagic	1270.49
Coumarin	17.58
(3,4,5-methoxy cinnamic)	16.69
Cinnamic	25.98

Impact of feeding strawberry leaves powder on the levels of serum blood glucose :

From Table (3), it could be observed that the levels of blood glucose contents of rats fed diets containing different levels of strawberry leaves powder at different periods during the experiment. At the beginning of the experiment group fed on basal diet (-Ve group) and diabetic group (+Ve group) has a blood glucose 116.55 and 239.19 (g/dl), respectively. The data showed a significant decrease in blood

glucose level as a result of feeding rats 1.50% strawberry leaves powder (G5), then 1.0% strawberry leaves powder (G4) through 3 weeks and 6 weeks compared with the alloxan diabetic rats (G2). This effect may be due to the antioxidant of strawberry leaves powder. The results a agree with **Hassan and Ghoneim,(2013).** Strawberry leaf includes tannins, flavonoids, a small amount of ascorbic acid and essential oil. Flavonoids are antioxidant compounds neutralize harmful effects of

previously consumed substances in the body, especially in liver, adipose tissue and epithel tissue (**Kümeli, 2006; Anonymous, 2010, 2011a, b).**

Table 3: Impact of feeding strawberry leaves powder on the levels of serum blood glucose (g/dl)

Groups	Blood glucose (g/dl)	
	3 weeks	6 weeks
G1	129.57 B	90.16 BC
G2	184.83 A	221.11 A
G3	139.57 B	124.06 C
G4	125.78 B	113.38 BC
G5	119.64 B	101.19 BC
LSD	29.183	23.395

Values with different letters in the same column or row are significantly different ($P< 0.05$)

-Ve: Negative control group (normal) at the beginning +Ve: Positive control group at the beginning

G1: Negative control rats fed on basal diet. G2: Positive control diabetic rats

G3: diabetic group fed 0.5% strawberry leaves powder G4: diabetic group fed 1% strawberry leaves powder

G5: diabetic group fed on 1.5% strawberry leaves powder

Impact of strawberry leaves powder on the serum lipid profile of rats

As shown in Table (4), feeding the rats with strawberry leaves powder (1.50%) prevented the rise of mean serum TG, TC, and LDL-C concentrations after 3and 6 weeks compare to diabetic group fed on basal diet rats (G2) with significant differences. Results are indicated that the alterations of serum lipid profile in different groups of experimental animals. The elevated levels of TG (140.98), TC (144.88), LDL-C (70.765), (mg/dl) and HDL-C (39.915 mg/dl) were noted in group 2 animals(G2) at six weeks also three weeks . However, HDL-C levels showed (43.06 mg/dl) decline in diabetic groups over the control ones. **Sheriff, and Devaki (2012)** showed the increased hepatic secretion of LDL is due to high levels of free fatty acids and hyperglycemia during diabetes. Reduced activities of lipid metabolizing enzymes such as lipoprotein lipase (LPL) and lecithin cholesterol acyl tranferase (LCAT) are the feature of free radical mediated organ injuries.

The hypolipidemic mechanism of freeze strawberry powder may be due to its ability to decrease fat digestion and absorption in the gastrointestinal tract and suppress endogenous cholesterol biosynthesis. The high level of vitamin C, antioxidant phytochemicals and in part the soluble fiber content of strawberry (**Marques, *et al.,* (2010), and Sheriff S A (2014).** are responsible for the amelioration of serum and tissue lipids during alloxan induced diabetes in rats.

Table (4) : Serum lipids profile of rats fed on strawberry leaves powder

Feeding period (weeks)	Rats Groups	Triglycerides (mg/dl)	Total cholesterol (mg/dl)	HDL (mg/dl)	LDL (mg/dl)
Atthe beginning	-Ve	122.85 B	132.10 D	54.910 A	52.600E
	+Ve	151.24 A	149.16 A	46.720 B	72.195BC
3	G1	128.59 B	130.78 D	42.000 CD	63.06E
	G2	147.75 A	142.10 B	35.685 F	76.895BC
	G3	123.05 B	137.76 C	37.925 E	75.22 D
	G4	104.76 C	133.25 D	41.125 D	71.175 A
	G5	110.55 C	127.12 E	44.535 C	60.48 AB
L.S.D		9.0854	2.8729	1.0070	3.1126
6	G1	130.57 B	116.97 E	43.060 D	47.795 E
	G2	140.98 A	144.88 B	39.915 E	70.765 B
	G3	131.18 B	130.52 C	47.430 F	56.340 B
	G4	123.71 BC	126.29 D	48.465 C	53.083 C
	G5	118.43 C	114.71 E	51.615 B	39.415 F
L.S.D		8.7578	4.0430	0.9716	2.5339

Mean values in each column having different subscript (a, b, c, d) are significantly different at $p < 0.05$

Influence of strawberry leaves powder on liver functions :

Liver functions can be measured through the liver enzymes. These enzymes are groups of clinical biochemistry laboratory blood assays to give information about the state of liver. Hepatic liver involvement in some diseases can be of crucial importance. Table (5), shows that feeding rats on strawberry leaves powder at percent (1.50%) prevented the rise of mean serum alanine amino transaminase (ALT), and aspartate amino transaminase (AST) activities. The rate of decreased in the liver enzymatic activities were recorded 57.50, 52.50, for ALT and

52.00, 74.00(U/L) for AST with the rat fed 1% and 1.50% strawberry leaves powder respectively at six weeks . Serum total protein were 7.1500, (g/dl), 6.9300 (g/dl) after 6 weeks with the rat fed 1.0% strawberry leaves powder and 1.50% strawberry leaves powder respectively. These increased levels were due to the liver cell injuries induced by high fat diet. Strawberry leaves powder significantly decreased serum total protein and ALT, levels. The obtained results are similar to those reported by **Wang and Lin (2000),** leaves from strawberry (*Fragaria x* ananassa D.) plants were analyzed for total antioxidant capacity (oxygen radical absorbance capacity,) and total phenolic content.

Table (5) : Influence of strawberry leaves powder on serum total protein , alanine amino transferrase (ALT), and alanine amino transferrase (AST),contents of rats.

Feeding period (weeks)	Rats Groups	Total protein (g/dl)	ALT (U/L)	AST (U/L)
At the beginning	-Ve	6.8100BC	48.000D	59.500 A
	+Ve	7.6400 A	62.500 C	67.500 A
3	G1	6.5750 C	57.500 ABC	59.500 A
	G2	7.5850 AB	76.500 AB	71.500 A
	G3	6.4100 C	72.000 A	59.500 A
	G4	6.5700 C	67.500 AB	53.000 A
	G5	6.6450 C	62.500 CD	52.000 A
L.S.D		0.8193	15.041	27.479
6	G1	7.1100 ABC	62.000 AB	71.500 A
	G2	7.6700 A	77.000 A	79.500 A
	G3	7.3650 ABC	67.500 B	59.000 A
	G4	7.1500 ABC	57.500 C	52.500 A
	G5	6.9300 BC	52.500 C	47.500 A
L.S.D		0.7230	10.422	23.817

Mean values in each column having different subscript (a, b, c, d) are significantly different at $p < 0.05$

Influence of strawberry leaves powder on kidney functions

Feeding of the rats with strawberry leaves powder prevented the rise of mean serum creatinine and urea concentrations. The rate of prevention was increased with the increasing the concentrations in Table (6). The value of decreasing in the kidney function parameters were recorded 1.2600 , 1.1750 (mg/dl) for creatinine and 25.445 , 23.145 (mg/dl) for urea of 6 weeks with the rat fed on strawberry

leaves powder at percent 1% and 1.5% respectively. serum creatinine and led to a significant increase in antioxidant status in diabetic rats.

Alloxan toxicity also leads to abnormal accumulation triglycerides in liver and kidney Udayakumar, (2009). Strawberry leaves are used as appetizer, cholesterol and blood pressure lowering, gastrointestinal disorders, diuretic, stricture, get strong of sight and tooth, expel kidney stones and intestinal worms, anemia, hepatisis, strengthen nerve and immune system, intestinal and liver activity, diarrhoea suppressant, arthritis and speeding up metabolism in folk medicine (**Kümeli, 2006; Anonymous, 2010, 2011a, b).**

Table (6) : Effects of strawberry leaves powder serum creatinine, and urea contents of Rats.

Feeding period (weeks)	**Rats Groups**	**Creatinine** (mg/dl)	**Urea** (mg/dl)
At the beginning	-Ve	0.9450 D	27.710 ABC
	+Ve	1.3700 A	31.950 A
3	**G1**	0.9300 D	29.310 AB
	G2	1.4100 A	30.265 AB
	G3	1.3400 A	26.150 BC
	G4	1.2450 B	26.610 BC
	G5	1.0550 C	24.115 C
L.S.D		0.0931	
6	**G1**	0.9650 BC	26.395 BC
	G2	1.3800 A	34.855 A
	G3	1.3950 A	28.855 ABC
	G4	1.2600 A	25.445 BC
	G5	1.1750 AB	23.145 C
L.S.D		0.2262	7.0164

Mean values in each column having different subscript (a, b, c, d) are significantly different at $p < 0.05$

Histopathology :

The beneficial effects of feeding diabetic rats on strawberry leaves powder at percent(0.50%, 1%, and 1.50%), were confirmed by histopathological examination of the liver, pancreas and kidney are shown in photo.(1-15) respectively.

Antidiabetic agents that stimulate pancreatic insulin secretion, reduce hepatic glucose production, delay digestion and absorption of intestinal carbohydrates, or improve insulin action (**Pallavi**, ***et al.,*** **2017**).

Examination of histopathology

Group1,(negative control)

In liver hepatic tissue rat was normal control where, sinusoids and kupffer cells were normal (Fig.1). Cells of endocrine pancreas had pyknotic and karyorrhexis of nuclei were normal(Fig.2)in pancreas**.** Fig 3, shows normal kidney hepatic tissue rat where, typical renal cortical tissue without any abnormality **.**

Group2 ,(positive control)

Liver tissue rat **(Fig. 4),** indicated that portal edema, proliferations of bile ductless and lymphocytic aggregations were seen in some portal area. Others areas revealed severe portal fibrosis infiltrated by lymphocytic inflammatory cells and proliferation of bile duct epithelium. The hepatocytes suffered from reversible regenerative attempts could be seen. **Fig. (5**), showed that cells of endocrine pancreatic portion suffered from accidental cell death islet of *Langerhans* and loss of secretary activity. Kidney (**Fig. 6**), was acute cell swelling and congestion blood vessels and necrosis of renal tubular epithelium represented by pyknotic nuclei together with congested glomerular tuft (arrow).

Group3 (diabetic group rats fed 0.5% strawberry leaves powder).

It is observed in **Fig. 7** that liver had some hepatic cells still exhibited microsteatosis or acute cell swelling and other had clusters from programmed cell death (apoptosis)**.** Figure (8) showed that pancreas lymphocytic in portal blood vessels and lowest in number cells (hylanized) *Langerhans***.** Endothyrosis. Focal nephrotic changes as vacuolated cytoplasm**(Fig. 8). Figure 9** indicated that lymphocytic infiltration and proliferation of bile duct epithelium. Hylanized vascular wall of hepatic arteriole and mild fibroblastic proliferation could be seen in portal areas.

Group4 (diabetic group rats fed 1.0% strawberry leaves powder).

Liver tissue in figure 10 was lymphocytic infiltration and proliferation of bile duct epithelium were reducing. and mild fibroblastic proliferation could be seen in liver portal areas and were lowest in **Fig.(7**). Pancreas was endocrine cells of islets showed intense degeneration and necrosis of endocrine pancreas (**Fig.11**) and high number cells *Langerhans* . Kidney tissue showed that the renal parenchyma appeared normal (Fig. 12).

Group 5 (diabetic group rats fed 1.5% strawberry leaves powder).

Liver had the hepatic histological structures within the normal except some congestion and lymphocytic aggregation **(Fig 13).** All pancreatic structures appeared normal and healthy picture. congestion normal and moderates of number *Langerhans***(Fig 14).** The renal tissues appeared within the normal morphological picture **(Fig 15).**

Examination of histopathology

Group1,(negative control)

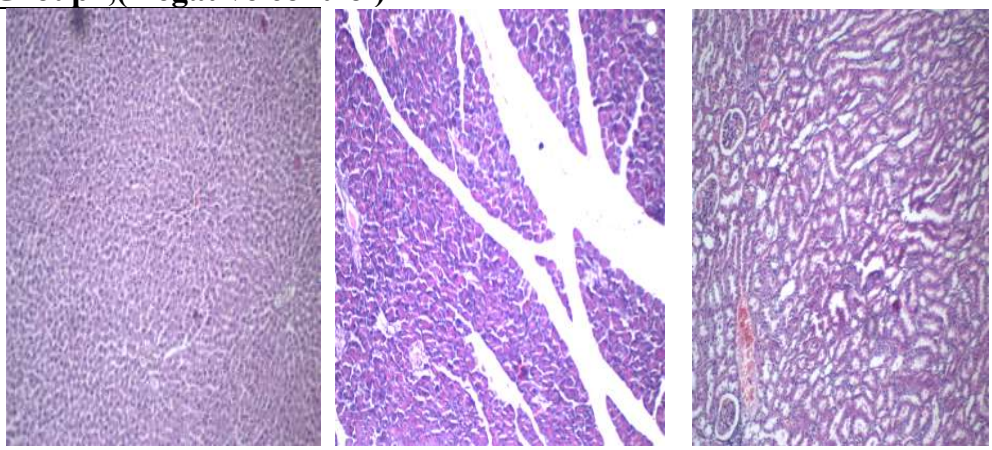

Figure 1: Liver of rat (negative control of group G1) H&E (X300).
Figure2: pancreas of rat (negative control of group G1) H&E (X300).
Figure3: Kidney of rat (negative control of group G1) H&E (X300).

Group2 ,(positive control)

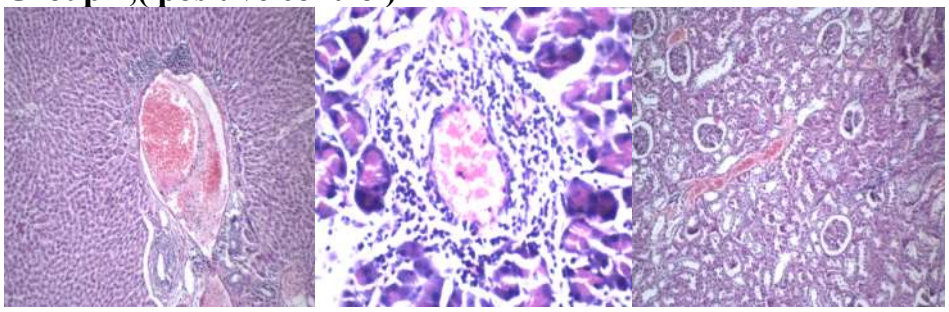

Figure4: Liver of diabetics rat (positive control of group G2) H&E (X300).
Figure5: Pancreas of diabetics rat (positive control of group G2) H&E**(X1200).**
Figure 6 :Kidney of diabetics rat (positive control of group G2) H&E (X300).

Group3 (diabetic group rats fed 0.5% strawberry leaves powder).

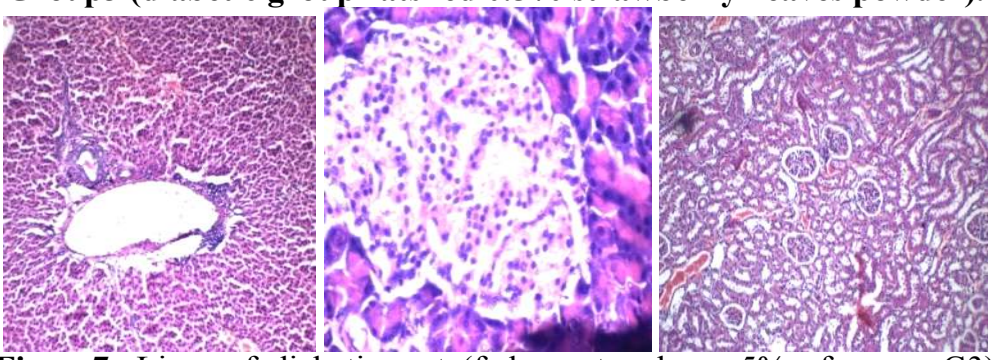

Figure7: Liver of diabetics rat (fed on strawbway.5% of group G3) H&E (X300).

Figure8: Pancreas of diabetics rat (fed on strawbway.5% of group G3) H&E (X1200).

Figure 9 :Kidney of diabetics rat (fed on strawbway.5% of group G3) H&E (X300).

Group4 (diabetic group rats fed 1.0% strawberry leaves powder).

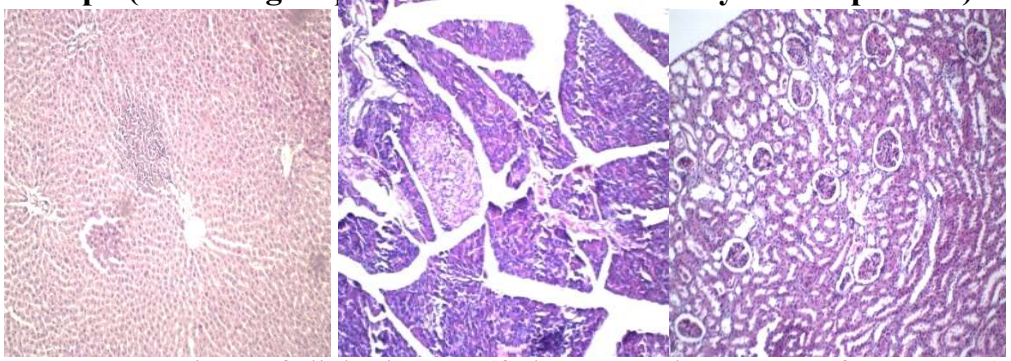

Figure10 : Liver of diabetics rat (fed on strawbway1% of group G4) H&E (X300).

Figure11: Pancreas of diabetics rat (fed on strawbway1% of group G4) H&E (X1200).

Figure 12 : Kidney of diabetics rat (fed on strawbway1% of group G4) H&E (X300).

Group5 (diabetic group rats fed on 1.5% strawberry leaves powder).

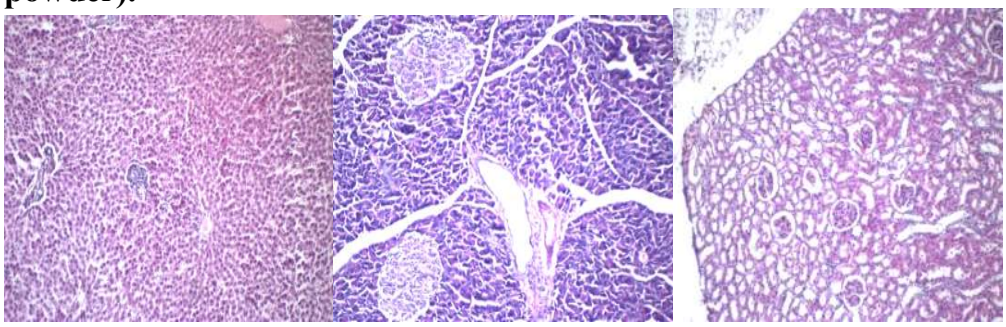

Figure13: Liver of diabetics rat (fed on strawbway1.5% of group G5) H&E(X300).

Figure14: Pancreas of diabetics rat (fed on strawbway1.5% of group G5) H&E(X300).

Figure 15 :Kidney of diabetics rat (fed on strawbway1.5% of group G5) H&E(X300).

Conclusion :

Present in the leaves are several phenolic compounds such as Catechein, Ellagic Pyrogallol acid and the others compounds with excellent antioxidant properties The effect strawberries leaves powder on diabetic rats, lipid profile of rats, liver and kidney enzymatic functions and hepatic sections. Feeding of strawberries leaves powder reduced activities of lipid blood. Strawberry leaves powder significantly decreased serum total protein and ALT, levels. The value of decreasing in the kidney function parameters. Feeding of strawberries leaves powder had healthy and nutritional beneficial, and improved lipid profile, liver function. The results of this study clearly suggest that strawberry leaves powder is effective in controlling hyperlipidemia during diabetes.

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تأثير أوراق الفراولة ا لبودر على فئران مرضى السكر

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الملخص العربي :

أجريت الدراسة الحالية لتقدير التركيب الكيماوي لأوراق الفراولة البودر وتقدير محتوى الأحماض الفينولية لمعرفة الفوائد الغذائية والصحية.

تم تغذية الفئران المصابة بالسكري على أوراق الفراولة البودر بنسب ٠,٥% و ١% و ١,٥% لمعرفة تأثيرها على جلوكوز الدم وسيرم الدم ووظائف الكبد والكلى وتم عمل قطاعات هستولوجية بالكبد والبنكرياس والكلى وأظهرت النتائج أعلى مستوى لجلوكوز الدم (٢٢١,١١) وتراي جلسريد(١٤٠,٩٨) والكولسترول الكلى (١٤٤,٨٨)والليبيدات منخفضة الكثافة (٧٠,٧٦) مليجرام / ديسلتر واقل مستوى لليبيدات مرتفعة كانت بمجموعة الفئران رقم (٢) المريضة بالسكر ولم تعالج وعلى العكس من ذلك بالمجاميع التي تمت تغذيتها على أوراق الفراولة البودر كانت اقل مستوى للجلوكوز الدم وتراي جلسريد والكولسترول الكلى والليبيدات منخفضة الكثافة بينما أعلى مستوى لليبيدات عالية الكثافة .أوضحت القطاعات الهستولوجية للكبد والبنكرياس والكلى اقل تغير وأنها الأقرب للصورة الطبيعية المجموعة ذات التغذية البودر خاصة بأعلى النسب لذلك توضح الدراسة أن أوراق الفراولة البودر لها تأثير على وظائف سيرم الدم وإنزيمات الكبد والكلى وقطاعاتهم لذلك توصى باستخدام أوراق الفراولة البودر أو مستخلصة بنسب ٠,٥% ١%و ١,٥%في مجالات الصناعة أو خاصة لمرض السكري للحصول على أعلى فائدة غذائية وصحية. ,