Egyptian J. of Nutrition Vol. XXXVII No. 1 (2022)

The therapeutic and preventive effect of sumac seeds (Rhus coriaria) on some fertility hormones in diabetic female rats

Asmaa M.I.El Gamel[1] and Esraa A. Awaad[2]

[1]Fellow (Lecturer) of Nutrition and Food Science, Ahmed Maher Teaching Hospital, Egypt
[2]Lecture of Nutrition and Food Science, Faculty of Specific Education, Zagazig University, Egypt

Abstract

Sumac's scientific name is*Rhuscoriaria.* In the Arab world, sumac is a widely used spice. Although it is used as a powder, it is a fruit in its original condition. This study was carried out investigate the effect of using sumac seeds on some fertility hormones in female diabetic rats. Forty-five female rats (*Sprague Dawley Strain*) 140±10g have been used for 6 weeks.They were divided into three major groups. Group 1 (5 rats) was kept as negative control group. The second major group (20 rats) was injected with freshly prepared recrystallized Alloxan in saline at a dose level of 150 mg/ kg body weight and kept as therapeutic groups and then it was divided into four groups. The third major group (20 rats) was divided into four groups and kept as protective groups that were injected near the end of the experiment with freshly prepared Alloxan in saline at a dose level of 150 mg/ kg body weight. Chemical, biological, biochemical and histological tests were carried out. The results of this study showed that sumac powder contains a high amount of fiber and carbohydrates and contains a moderate amount of fat and protein. They also recorded a high amount of total phenols and total flavonoids.

Total cholesterol, triglycerids, LDL-c (Low Density Lipoprotein Cholesterol) and VLDL-c (Very-low-density lipoproteinCholesterol) decreased significantly and there was a marked significant increase in HDL-c (High Density Lipoprotein Cholesterol) in all therapeutic andprotective groups that were supported by different percentages of sumac powder compared with thepositive control group (therapeutic and protective). Additionally, they showed significant decrease in kidney function and liver enzymes in all therapeutic and protective groups that were supported by different percentages of sumac powder compared with the positive control group (therapeutic and protective). There was also a marked improvement in the female hormones (Estrogen,Folicle Stimulating Hormone and Lutenizing Hormone)being studied andGlucose serum. For examination of pancreas Histopathologically there was a remarkable improvement in all therapeutic and protective groups that were supported by different percentages of sumac powder compared with the positive control group (therapeutic and protective). This study therefore recommends that sumac powder could be used to improve blood sugar and a fertility hormone in female diabetic rats due to contains bioactive compounds.

Key words: sumac seeds (*Rhus coriaria*)- Diabetic- Fertility hormone- Estrogen- Folicle Stimulating Hormone - Lutenizing Hormone- Glucose serum

Introduction

Diabetes mellitus is an endocrine system metabolic illness that is rapidly becoming a major issue ***(Ali-Shtayeh et al., 2012).***It is expected to affect six hundred and forty million people by 2040 **(*International Diabetes Federation, 2016).***

Sumac (*Rhuscoriaria*) is a popular spice in the Mediterranean and Arabic worlds. Sumac is known for its antimicrobial and antioxidant properties***(Alia kbarluet al., 2013 ; Ali-Shtayeh et al., 2013 & Kossah et al., 2013)*****,** as well as its hypoglycemic ***(Golzadeh et al., 2012 & Anwer et al., 2013),*** and hypolipidemic properties ***(Madihi et al., 2013).***Presence of antioxidant components in sumac to improve “DM type 2” and its negative consequences for the reproductive system **(*Anwer et al., 2013).***Medicinal plants sumac have a number of effective ingredients with little side effects, and are used to treat a variety of health problems ***(Sunil & Kumar, 2010).***Sumac is a medicinal herb that is high in flavonoids and tannins. Polyphenols called flavonoids have anticancer, hypoglycemic, free radical scavenging, and antioxidant properties. ***(González et al., 2011)*** Sumac contains a variety of chemical components, including phenolic acids, volatiles, fatty acids, and minerals, all of which were antihemototoxic and antioxidant in diabetic rats. During hyperglycemia, bioactive rich extracts showed antioxidant and anticoagulant properties, also they may help to alleviate or avoid subsequent problems including vascular occlusion, nephropathy, and liver damage ***(Dalar et al.,2018).*** The rats' insulin sensitivity increased considerably after being given sumac, according to the findings. Furthermore, sumac therapy greatly reduced the development of insulin resistance. This demonstrated sumac's therapeutic and management effectiveness in the treatment and control of insulin resistance ***(Anweri et al., 2013).***Oxidative stress& a rise in “reactive oxygen species” production in. “mitochondria” cause

several the sexual organ problems seen in diabetic rats. As a result of, several natural & artificial antioxidants have been recommended to prevent oxidative stress-induced hormonal imbalance in the reproductive system and infertility ***(Kianifard et al., 2011).*** These studies demonstrate that sumac not only helps to regulate glycemia but also helps to prevent problems like infertility ***(Ahangarpour et al., 2014).***Estrogen is a sex hormone that is involved in the development and control of the female reproductive system, as well as secondary sex characteristics ***(Mechoulam et al.,2005).***

Estrogen and progesterone, among other steroid hormones, are considered to play a role in the carcinogenesis of ovarian tumors ***(El-Sharqawi et al.,2018)***. Many herbs and spices have been proven to have antioxidant properties in food, with phenolics being the active ingredient. The antioxidant, anti-inflammatory, antimutagenic, anticarcinogenic, and anti-tumor properties of phenolic compounds produced from herbs and spices contribute to their chemopreventive potential ***(Saini et al.,2013).***

Antioxidants found in medicinal plants can boost female hormones as well as protect the female reproductive system against harmful, teratogenic consequences ***(Shabanian et al.,2016)*** One of the phenolic chemicals, quercetin, has significant antioxidant properties and improves fertility indices ***(Al-kadi et al.,2020).*** Resveratrol, a kind of natural phenol, reduces oxidative damage, inflammation, and hormonal changes in female rats ***(Ismail&Yousry,2018).*** Resveratrol has been shown to have a protective antioxidant impact on female reproductive organs. It also helps to prevent fertility loss ***(Ortega &Duleba.,2015).*** Medicinal herbs and their secondary metabolites can scavenge free radicals and regulate the release of ovarian hormones due to their antioxidant capabilities ***(Al-kadhi et al.,2020).***

This study was conducted to evaluate the potential advantage that can be obtained by using sumac seed powder as a therapeutic or preventive effect on the fertility hormones of diabetic females.

Materials and Methods

Materials:

Dried samples Sumac (*Rhusc oriaria*) was obtained from Haraz druggist (Cairo, Egypt).

Casein, vitamins, minerals, cellulose, choline chloride and Alloxan (HYDRATE) extra pure were purchased from El-Gomhoreya Company, Cairo, Egypt.

Oil and starch were purchased from local market, Cairo, Egypt.

Forty five female albino rats (*Sprague Dawley Strain*) 140±10g were obtained from Food Technology Res. Institute, Giza.

Methods:

Chemical analysis

Chemical analysis of Sumac powder including protein, lipids, moisture and ash were conducted in Food Technology Res. Institute according to the method described by the ***A.O.A.C., (2005).***Carbohydrate value was calculated according to ***FAO (1982)*** by follows:

Carbohydrates (%) = 100 – (protein % + ash % + fat % + fiber % +moisture %).

Total phenolic and total flavonoid content ofsumac powder were determined according to method described by ***Saeed et al., (2012)*** and ***John et al., (2014),*** respectively

Biological Experiment

Basal diet

Diet was given in a non-scattering feed cups to minimize food loss. Water was provided to the rats by means of glass tube projecting

through the cage wire. Basal diet was prepared from fine ingredients (100 g) according to ***Reeves et al., (1993).***

Experimental design

Forty-five rats were housed in well-aerated cages under hygienic condition and fed on basal diet for one week for adaptation. After this week, rats were divided into nine groups including both therapeutic and protective groups (five rats each).

Group 1 was kept as negative control group which fed on basal diet and tap water for 6 weeks.

The other forty rats were divided into two main groups (20 rats for each main group).

The secand main group (20 rats) was injected with freshly prepared recrystallized Alloxan in saline at a dose level of 150 mg/ kg body weight ***(Lazarow&Palay, 1954).*** Immediately after injection animals were received 5% glucose solution overnight to overcome drug-induced hypoglycemia ***(Wohaieb& Godin, 1987&Kakkar, et al., 1998).*** After five days fast blood glucose (FBG) was analyzed using a specific kit (AlGomhoryia Company for Trading Drugs, Chemicals and Medical Instruments, Cairo, Egypt) by a drop of blood was obtained from the tail vein and subjected to a strip of haemogluco test. All rats with FBG >126 mg/dl were considered to be diabetics,kept as therapeutic groups and then it was divided into four groups as follows:

Group 2 was considered as control positive **(therapeutic)** and was fed on basal diet.

Group 3 (therapeutic) was fed on basal diet + 2.5% Sumac powder replacing equivalent amount from the basal diet.

Group 4(therapeutic) was fed on basal diet + 5% Sumac powder replacing equivalent amount from the basal diet.

Group 5(therapeutic) was fed on basal diet + 7.5% Sumac powder replacing equivalent amount from the basal diet.

The third main group (20 rats) was divided into four groups as follows**:**

Group 6was considered as control positive **(protective)** and was fed on basal diet.

Group 7(protective) was fed on basal diet + 2.5% Sumac powder replacing equivalent amount from the basal diet.

Group 8(protective) was fed on basal diet + 5% Sumac powder replacing equivalent amount from the basal diet.

Group 9(protective) was fed on basal diet + 7.5% Sumac powder replacing equivalent amount from the basal diet.

Groups 6, 7, 8 and 9 were injectednear the end of the experiment with freshly prepared Alloxan in saline at a dose level of 150 mg/ kg body weight and kept for five days after injection. During feeding period, the initial and final body weights of rats were recorded and changes in body weight and feed efficiency were calculated. Thebody weight gain and food efficiency ratio % (FER) were calculated according by ***Chapman et al., (1959)as following:***

$$(\mathrm{BWG}) = \frac{\text{Final Weight\_ Initial Weight}}{\text{Initial Weight}}$$

$$(\mathrm{FER}) = \frac{\text{Daily body Weight gain(g)}}{\text{Food intake (g/d)}} * 100$$

At the end of experiment, blood samples were collected for biochemical analyses

Biochemical analyses

Serum samples were used for determination of glucose according to ***Kaplan, (1984).***Estrogen was determined according to ***Owens& Ashby (2002)*** whileluteinizing and follicle stimulating hormones were determined by the method of ***Uotila et al., (1981).*** Serum total cholesterol(TC) and triglycerides(TG)were according to ***Schettler&Nussel, (1975),*** high density lipoprotein cholesterol (HDL-c) ***(Lope Virella et al., 1977),*** low density lipoprotein cholesterol (LDL-c) and very low density lipoprotein cholesterol (VLDL-c)were

according to ***Fried wald et al., (1972),***aspartate amino transferase (AST) and alanine amino transferase (ALT) ***(Reitman & Frankel, 1957),*** serum alkaline phosphates (ALP) ***(Belfield & Goldberg, 1971),*** serum uric acid ***(Fossati et al., 1980)*****,** urea ***(Marsch et al., 1965),***Creatinine ***(Bartels &Bohmer, 1971).***

Histopathological Examination

Pancreas was separated from each rat and examined histopathologicalyaccording to***Bancroft et al., (2012).***

Statistical analysis

Results are expressed as mean ± SD.Data were statistically analyzed using one – way analysis of variance ˝ANOVA˝ according to ***Armitage&Berry,(1987).***Computer software system SPSS (version 15).

Results and Discussion

Chemical composition ofsumac powder

Sumac powder was analyzed for chemical composition on the dryweight basis per 100g(moisture, protein, carbohydrates,fat, crude fiber and ash).The obtained results in Table 1showed that the crude protein,total carbohydrates, fat content, crude fiber ,ashandmoisture were 5.66 , 39.746 , 17.183 , 27.50 , 2.261 and7.650% on dry weight, respectively.The present results are disagreed with ***Ozcan & Haciseferogullari,(2004)*** who concluded that Sumac powder contains 2.6 percent protein content, 7.4 percent fat, 14.6 percent fiber content, and 1.8 percent ash.Also our data are disagreed with ***Raodah et al.,(2014)*** who concluded that chemical composition of Sumac (Moisture (%)2.43, Crude oil (%)18.74 , Crude protein (%)4.69 , Crude fiber (%)ND , Carbohydrate (%)71.21 , Ash (%)2.93) .In another study by ***Ozcan & Haciseferogullari, 2004*** **&** ***Kizil & Turk, (2010)*** confirmed that chemical composition of Sumac

was13.65, 4.93, 16.88, 5.09, 59.45, and 19.61 g/100g for moisture, protein, fat, ash, carbohydrate, and fiber, respectively.

Total phenols and total flavonoids compounds ofsumac powder

The results in Table 2showed that sumac content of total phenolic recorded 46.69 mg/g while total flavonoid recorded219.4364 mg/g.These results were non agreement with ***Bashash et al.,(2014)***whorevealed that sumac powder had a phenolic content of 2.172–2.263 GAE/100 g.

The effect of different levels of sumac powder on feed intake(FI), feed efficiency ratio (FER) and body weight gain (BWG) in both therapeutic and protective groups of diabetic female rats

Tabulated data in Table3 showed that therapeutic positive group(2) rats have significant decrease in FI,FER and BWG compared with normal control rats.In contrast, rats feeding on supplemented diet with sumac powder(2.5, 5, 7.5%) had significantly increased of FI, FER and BWG when compared with therapeutic positive group(2) rats.On the other hand, protective groups which feeding on supplemented diet with sumac powder (2.5, 5, 7.5%) and protective positive group(6) rats had no significant in FI, FER & BWG when compared with negative control group.These findings support the findings of ***Kosar et al., (2006),*** who found that sumac has a high concentration of tannins that are hydrolysable, vulnerable to cleavage by hydrolysis, and have a short molecular size.

Because of their tiny size, they are easier to digest and absorb, and they provide several health advantages. Also ***Kossahet al., (2009)*** indicated that Sumac species can be regarded possible sources of dietary fiber, which can aid in the treatment of gastro-intestinal problems.

The effect of different levels of sumac powder on Serum lipid profile and glucose (mg/dl) in both therapeutic and protective groups ofdiabetic female rats

The results of the analysis of serum lipid profile and glucose in rats have been shown in table 4. Total cholesterol showed a significant medium decrease in therapeutic group (4 & 5) while triglyceridsdecrease significantly in groups (3, 4 & 5)compared with therapeutic positive ($G2_{)}$.Best results were G5. Regarding to total cholesterol and triglycerids showed a significant light decrease in Protective group (G7, G8 & G9) when compared with the protective positive group and the best results were of G9. This result is in agreement with ***Alsamri et al., (2021)*** who reported thatSumac powder was used to increase sweating and lower cholesterol levels also ***Capcarova et al., (2012) &Golzadeh et al., (2012)*** who reported that sumac has been shown to reduce blood cholesterol levels. HDL-c results showed a significant increase in therapeutic group (4 & 5) compared with the therapeutic positive control. Regarding to HDL-c results showed a significant increase in Protective group (G7, G8 & G9) when compared with the protective positive group and the best results were of G9. Similar results were obtained by ***Anwar et al., (2018) & Akbari-Fakhrabadi et al., (2018)*** who reported that, Supplementation with Powder of sumac at a dosage of 1 g/day for 6 weeks revealed substantial increases in HDL-c in individuals with hyperlipidemia.

LDL-c serum showed a significant decrease in therapeutic group (G4 & G5) while VLDL-c decreasessignificantly in groups (3,4 & 5)when compared with the therapeutic positive G2. Concerning LDL-C and VLDL serum showed a significant decrease in Protective group (G7, G8 & G9) when compared with the protective positive G6. Similar results were obtained by ***Sabzghabaee et al., (2014)*** who reported that, Powdered Fruit Sumac powder (500 mg, three times daily) intake for four weeks resulted in substantial reductions in total cholesterol, LDL-C, and triglyceride levels.

These findings are supported by ***Mansoub, (2011)*** who claims that sumac's hypocholesterolemic properties are due to its polyphenolic components. Polyphonols have been proven to reduce cholesterol levels.

Glucose serum showed a significant decrease in therapeutic group (G3, 4 & 5) when compared with the therapeutic"positive group" and the best results were of G5. Concerning Glucose serum showed a significant decrease in Protective group (G7, G8 & G9) when compared with the protective positive group and the best results were of G9. Similar results were obtained by ***Anweri et al.,(2013)*** who reported that sumac has shown to be an effective treatment for hyperglycemia and hyperlipidemia, as well as a possible treatment for diabetes prevention and control.

The effect of different levels of sumac powder on serum liver enzymes and kidney function in both therapeutic and protective groups of rats

The results of the analysis of liver enzymes and kidney function of rats in this study have been shown in table 5. Liver enzymes (ALT & AST) showed a significant decrease in therapeuticrats (G3, G4&G5) comparing with the therapeutic positive rats ($G2_{)}$. While as ALP results showed a significant increase in therapeutic group (G3, G4 & G5) when compared with the therapeutic positive control group.

Best results wereG5. Regarding to liver enzymes (ALT & AST) showed a significant decrease in Protective group (G7, G8 & G9) when compared with the protective positive group. While as ALP results showed a significant increase in protective group (G7, G8 & G9) compared with Protective control positive group. These results is in agreement with ***Attaby et al., (2013) & Madihi et al., (2013)*** who reported that Sumac substantially reduced the levels of AST and ALT in the serum. Kidney function (creatinine, urea and uric acid) results

showed asignificant decrease in therapeuticrats (G3, G4 & G5) compared with the therapeutic“G2” positive. The best results were of group(5).

Regarding to Kidney function (creatinine, urea and uric acid) results showed asignificant decrease in protective group (G7, G8 & G9) when compared with the protective positive group and the best results were of G5. Similar results were obtained by ***Dogan&Celik., (2016)*** who reported that, in diabetic rats, there was a significant increase in AST, ALT, ALP, creatinine, and urea. The activities of AST, ALT, ALP, creatinine, and urea were considerably reduced after the treatment with sumac.

The effect of different levels of sumac powder on Serum Estrogen, Folicle Stimulating Hormone (FSH) and Lutenizing Hormone (LH) in both therapeutic and protective groups of rats

The results of the analysis of Female Hormones in rats have been shown in table 6. Serum Estrogen results showed a significant increase in therapeutic group (G3, 4 & 5) when compared with therapeutic positive control. Best results were (G5). Regarding to Serum Estrogen results showed a significant increase in Protective group (G7, G8 & G9) when compared with the protective positive group and the best results were of G9.

These results is in agreement with ***Liu et al.,(2017)&Özatik et al., (2016)*** who reported that resveratrol and a natural phenol that regulates the reproductive system by altering estrogen levels, also acts as a phytoestrogen.

Folicle Stimulating Hormone and Lutenizing Hormone results showed a significant light increase in therapeuticrats (G3, G4& G5) when comparing with the therapeutic positive rats. The best results were rats in G5. Regarding to Folicle Stimulating Hormone and Lutenizing Hormone results showed a significant light increase in Protective group (G7, G8 & G9) when compared with the protective

positive group and the best results were of G9. These results are in agreement with ***Shabanian et al., (2016)*** who reported that the plants' chemicals can control female hormones via influencing the glands that release these hormones, in addition to preserving reproductive organs through antioxidant actions.

Histopathological Examinations

Examination of pancreas Histopathologically

Microscopically, examination of Pancreas of rats from negative rats (G1) revealed normal pancreatic acini and normal islets of Langerhan's (Figure. 1). On contrary, pancreas of rats from therapeuticPositiveControl (G2) exhibited vacuolations of cells of islets of Langerhan's, inflammatory cells infiltration around the pancreatic duct (Fig. 2), necrosis of cells of islets of Langerhan's and cystic dilatation of pancreatic duct. However, pancreas of rats from with 2.5% Sumac powder therapeutic (G3) showed vacuolations of some cells of islets of Langerhan's (Fig. 3) and vacuolations epithelial cells lining pancreatic acini. Furthermore, pancreas of rats from with 5% Sumac powder therapeuti (G4) described slight vacuolationssome epithelial cells lining some pancreatic acini (Fig. 4) and necrosis of some cells of islets of Langerhan's . Meanwhile, sections from with 7.5% Sumac powder therapeutic (G5) revealed either slight vacuolations some epithelial cells lining some pancreatic acini (Fig. 5) or moderate vacuolations some epithelial cells lining some pancreatic acin. On the other hand, pancreas of rats from protectiveControlPositive (G6) showed vacuolation of cells of islets of Langerhan's (Fig .6) and epithelial cells lining pancreatic acini as well as necrosis of cells of islets of Langerhan's. Meanwhile, some examined sections from with 2.5% Sumac powder protective (G7)showed no histopathological alterations (Fig. 7), whereas, other sections revealed vacuolation of some cells of islets of Langerhan's. Furthermore, pancreas of rats from with 5% & 7.5% Sumac powder protective (G8) and (G9) exhibited no histopathologicalalterations (Fig. 8&9).Our results agree with ***Arya et al.,(2014)*** that cleared that

quercetin treated reduced hyperglycemia by increasing insulin levels. Furthermore, histological examinations of the pancreas of diabetic rats given quercetin indicated a substantial reduction in structural deterioration.Also ***Tag et al., (2015)*** said that on histological analysis of the pancreatic, demonstrated antioxidative, the therapeutic effect.

Conclusion

This study shows that sumac powdercontains nutritional and medicinal propertieswhich led to an improvement in glucose levels and fertility hormone in female diabetic rats. In addition to improving blood cholesterol levels, liver enzymes and kidney function.

Recommendations

The study recommends thatSumac powder is frequently added to salads or served with minced meat to impart a lemony flavor, grilled meat to protect against the dangers of nitrogenous compounds to give taste and benefit from health benefits. Also it can use to improved fertility hormone in female diabetic rats.

Table (1): Chemical composition ofSumac Powder

Content (%) / Samples	Moisture	Protein	Fat	Ash	Fiber	Total Carbohydrates	Total
Sumac Powder	7.650	5.66	17.183	2.261	27.50	39.746	100

Table (2): Active component total (phenols &flavonoids) of Sumac Powder

Content / Samples	Total phenols (mg/g)	Total Flavonoids (mg/g)
Sumac Powder	46.69	219.4364

Table (3): Effect of different levels sumac powder on feed intake(FI),feed efficiency ratio(FER) and body weight gain(BWG) in both therapeutic and protective groups ofdiabetic female rats

Parameters / Groups		FI (g/day) (Mean±S.D)	FER (%) (Mean±S.D)	BWG (g) (Mean±S.D)
(G_1) Control (-ve)		16 ^{a} ± 0..61	7.91^{ab} ± 2.24	0.37^{ab} ± 0.12
Therapeutic groups	Group (2)	13.9 ^{b} ± 1.14	5.35 ^{b} ± 3.90	0.11 ^{b} ± 0.29
	Group (3)	16 ^{a} ± 0.61	11.76 ^{a} ± 1.69	0.54 ^{a} ± 0.09
	Group (4)	15.2^{ab} ± 1.20	7.24^{ab} ± 3.61	0.33^{ab} ± 0.17
	Group (5)	15.9 ^{a} ± 0.96	9.90^{ab} ± 1.37	0.46 ^{a} ± 0.08
Protective groups	Group (6)	15.2 ^{ab} ± 0.76	7.96^{ab} ± 2.40	0.35 ^{ab}± 0.11
	Group (7)	15.4^{ab} ± 1.19	7.06^{ab} ± 3.48	0.32^{ab} ± 0.17
	Group (8)	15.4^{ab} ± 0..89	7.36^{ab} ± 1.95	0.33^{ab} ± 0.10
	Group (9)	15.2^{ab} ± 0.57	6.66^{ab} ± 2.63	0.29^{ab} ± 0.12
LSD		1.17	3.49	0.20

Values are expressed as means ± SD.

Values at the same column with different letters are significant at P<0.05.

Table (4): Effect of different levels sumac powder onSerum lipid and glucose (mg/dl) in both therapeutic and protective groups ofdiabetic female rats

Groups \ Parameters		Total cholesterol (mg/dl) (Mean±S.D)	Triglycerids (mg/dl) (Mean±S.D)	HDL-C (mg/dl) (Mean±S.D)	LDL-C (mg/dl) (Mean±S.D)	VLDL-C (mg/dl) (Mean±S.D)	Glucose (mg/dl) (Mean±S.D)
(G_1) Control (-ve)		148.4 ^{c} ± 22.10	84.90 ^{e} ± 5.71	51.31 ^{a} ± 1.15	80.11 ^{b} ± 23.59	16.98^{e} ± 1.14	102.81 ^{c} ± 17.98
Therapeutic groups	Group (2)	282.6 ^{a} ± 28.94	232.43 ^{a} ± 31.64	43.95 ^{cde} ± 1.63	192.16 ^{a} ± 22.81	46.49 ^{a} ± 6.33	390.33 ^{a} ± 85.41
	Group (3)	286.54 ^{a} ± 20.37	164.5 ^{b} ± 7.69	43.29 ^{de} ± 2.21	210.34 ^{a}± 23.73	32.9 ^{b} ± 1.54	254.33 ^{b}± 29.73
	Group (4)	256.49 ^{a} ± 31.42	137.3^{bcd} ± 9.66	46^{bcd} ± 2.50	183.03 ^{a} ± 33.66	27.46^{bcd} ± 1.93	188^{bc} ± 19.52
	Group (5)	171^{bc} ± 27.31	103.37 ^{de} ± 7.99	48.43^{abc} ± 1.59	101.90 ^{b} ± 26.36	20.67 ^{de} ± 1.60	99.37 ^{c} ± 11.98
Protective groups	Group (6)	310.43 ^{a} ± 17.58	204.4^{a} ± 17.41	41.24 ^{e} ± 1.83	228.31 ^{a} ± 22.15	40.88 ^{a} ± 3.48	346.67 ^{a} ± 58.71
	Group (7)	287.99 ^{a} ± 16.12	169.57 ^{b} ± 17.17	45.80^{bcd} ± 2.26	208.28 ^{a} ± 13.16	33.91 ^{b}± 3.43	240.67 ^{b} ± 37.11
	Group (8)	249.83 ^{a} ± 11.91	143.83^{bc} ± 27.15	47.73^{abcd} ± 2.18	173.34 ^{a} ± 17.54	28.77^{bc} ± 5.43	188.33^{bc} ± 26.35
	Group (9)	197.3 ^{b} ± 27.44	108.5^{cde} ± 11.89	50.23^{ab} ± 0.94	125.37 ^{b} ± 24.53	21.7^{cde} ± 2.38	125.37 ^{c} ± 13.72
LSD		40.18	29.86	3.22	40.60	5.97	69.40

Values are expressed as means ± SD.

Values at the same column with different letters are significant at P<0.05.

Table (5): Effect of different levels sumac powder onSerum liver enzymes and kidney functions in both therapeutic and protective groups ofdiabetic female rats

Groups \ Parameters		ALT (U/L) (Mean±S.D)	AST (U/L) (Mean±S.D)	ALP (U/L) (Mean±S.D)	Creatinine (mg/dl) (Mean±S.D)	Urea (mg/dl) (Mean±S.D)	Uric acid (mg/dl) (Mean±S.D)
(G_1) Control (-ve)		65.17 e ± 5.36	105.59 ^{d} ± 18.22	184.67 ^{a} ± 34.31	0.67 ^{d} ± 0.09	33.63 ^{d} ± 7.62	4.48 ^{f} ± 0.52
Therapeutic groups	Group (2)	260.44 a ± 51.15	248.25 ^{a} ± 22.88	90.93 ^{c} ± 12.40	1.42 ^{a} ± 0.14	95.74 ^{a} ± 8.85	13.65 ^{a} ± 1.83
	Group (3)	174.27 b ± 6.42	212.6 ^{b} ± 19.43	133.83^{bc} ± 6.20	1.12 ^{b} ± 0.12	79.43 ^{b} ± 3.36	9.34 ^{c} ± 0.44
	Group (4)	131.77bcd ± 15.35	149.1 ^{cd} ± 24.43	126.3^{bc} ± 5.35	0.95^{bcd} ± 0.08	68.47^{bc} ± 3.57	7.45 ^{cd} ± 0.83
	Group (5)	95.12 de ± 6.13	114.03^{d} ± 25.03	156.8^{ab} ± 37.55	0.75 ^{cd} ± 0.06	43.08 ^{d} ± 5.25	5.34^{ef} ± 0.55
Protective groups	Group (6)	268.33 a ± 37.59	206.43 ^{b} ± 19.90	94.92^{c} ± 5.78	1.45 ^{a} ± 0.32	93.98 ^{a} ± 6.67	11.19 ^{b} ± 1.28
	Group (7)	156.07bc ± 8.28	174.37^{bc} ± 12.07	125.4^{bc} ± 5.37	1.05^{bc} ± 0.07	75.20^{bc} ± 2.88	8.87 ^{c} ± 0.70
	Group (8)	114.17cde ± 12.70	132.8 ^{d} ± 14.35	121.33^{bc} ± 13.26	0.87^{bcd} ± 0.12	62.94 ^{c} ± 4.90	6.74 ^{de} ± 0.73
	Group (9)	72.04e ± 7.64	109.57 ^{d} ± 12.84	137.6^{bc} ± 21.31	0.67 ^{d} ± 0.10	38.9 ^{d} ± 12.17	4.81^{ef} ± 0.65
LSD		39.04	33.19	33.83	0.24	11.62	1.60

Values are expressed as means ± SD.

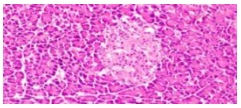
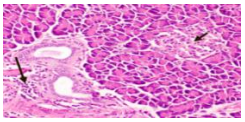
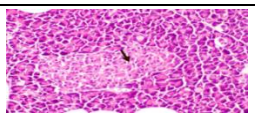
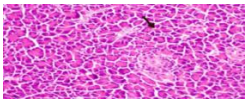
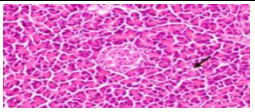
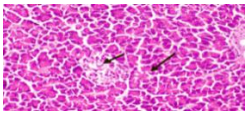
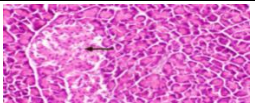
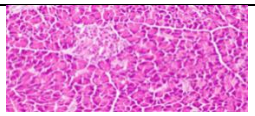
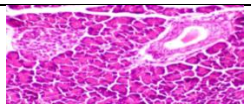
Values at the same column with different letters are significant at P<0.05.

Table (6): Effect of different levels sumac powder onSerum Estrogen, Folicle Stimulating Hormone (FSH) and Lutenizing Hormone (LH) in both therapeutic and protective groups ofdiabetic female rats

Groups \ Parameters		Estrogen (Pg/ml) (Mean±S.D)	FSH (mlu/ml) (Mean±S.D)	LH (mlu/ml) (Mean±S.D)
(G_1) Control (-ve)		464.85 ^{a} ± 82.31	6.77 ^{a} ± 0.86	38.18 ^{a} ± 3.22
Therapeutic groups	Group (2)	17.75 ^{d} ± 5.38	0.08 ^{e} ± 0.01	0.44 ^{e} ± 0.04
	Group (3)	46.86 ^{cd} ± 10.61	0.23 ^{e} ± 0.11	1.38 ^{c} ± 0.66
	Group (4)	119.19 ^{c} ± 26.60	1.68 ^{d} ± 0.30	9.77 ^{d} ± 2.26
	Group (5)	273.13 ^{b} ± 41.88	4.82 ^{b} ± 0.53	27.87 ^{b} ± 3.18
Protective groups	Group (6)	23.45 ^{d} ± 7.53	0.09 ^{e} ± 0.01	0.52 ^{e} ± 0.04
	Group (7)	63.18 ^{cd} ± 9.80	0.16 ^{e} ± 0.02	0.95 ^{e} ± 0.11
	Group (8)	86.52 ^{cd} ± 4.73	1.41 ^{d} ± 0.61	8.26 ^{d}± 3.48
	Group (9)	271.8^{b} ± 45.37	3.35 ^{c} ± 0.50	18.65 ^{c} ± 3.41
LSD		61.61	0.75	0.20

Values are expressed as means ± SD.

Values at the same column with different letters are significant at P<0.05.

Groups \ Organ		Photomicrograph of pancreas	Discussion
(G_1) Control (-ve)			**Fig. 1:** Showis normal pancreatic acini and normal islets of Langerhan's (H & E X 400).
Therapeutic groups	Group (2)		**Fig. 2:** Showsvacuolations of cells of islets of Langerhan's (short arrow) and inflammatory cells infiltration around the pancreatic duct (long arrow) (H & E X 400).
	Group (3)		**Fig. 3:** Showsvacuolations of some cells of islets of Langerhan's (arrow) (H & E X 400).
	Group (4)		**Fig. (4):** Shows a slight vacuolations some epithelial cells lining some pancreatic acini (arrow) (H & E X 400).
	Group (5)		**Fig. 5:** Shows aslightvacuolations some epithelial cells lining some pancreatic acini (arrow) (H & E X 400).
Protective groups	Group (6)		**Fig. 6:** Showsvacuolation of cells of islets of Langerhan's (short arrow) and epithelial cells lining pancreatic acini (long arrow) (H & E X 400).
	Group (7)		**Fig. 7:** Showsvacuolation of some cells of islets of Langerhan's (arrow) (H & E X 400).
	Group (8)		**Fig. 8:** Shows no histopathological alterations (H & E X 400).
	Group (9)		**Fig. 9:** Shows no histopathological alterations (H & E X 400).

G1: Negative control group, **G2** Positive control (therapeutic), **G3:** 2.5% Sumac powder (therapeutic), **G4:** 5% Sumac powder (therapeutic), **G5:** 7.5% Sumac powder (therapeutic), **G6:** Positive control (protective), **G7:** 2.5% Sumac powder (protective), **G8:** 5% Sumac powder (protective)&G9: 7.5% Sumac powder (protective)

References

Ahangarpour, A., Oroojan, A. A., Heidari, H., Ehsan, G., &Nooshabadi, M. R. R. (2014).

Effects of hydro-alcoholic extract of Rhuscoriaria (Sumac) seeds on reproductive complications of nicotinamide-streptozotocin induced type-2 diabetes in male mice. The world journal of men's health, 32(3), 151-158.

Akbari-Fakhrabadi, M., Heshmati, J., Sepidarkish, M., &Shidfar, F. (2018).

Effect of sumac (RhusCoriaria) on blood lipids: a systematic review and meta-analysis. Complementary therapies in medicine, 40, 8-12.

Aliakbarlu, J., Mohammadi, S., &Khalili, S. (2014).

A study on antioxidant potency and antibacterial activity of water extracts of some spices widely consumed in I ranian diet. Journal of Food Biochemistry, 38(2), 159-166.

Ali-Shtayeh, M. S., Al-Assali, A. A., &Jamous, R. M. (2013).

Antimicrobial activity of Palestinian medicinal plants against acne-inducing bacteria.African Journal of Microbiology Research, 7(21), 2560-2573.

Ali-Shtayeh, M. S., Jamous, R. M., &Jamous, R. M. (2012).

Complementary and alternative medicine use amongst

Palestinian diabetic patients.Complementary Therapies in Clinical Practice, 18(1), 16-21.

Al-kadhi, N. A., Abass, K. S., & Abbas, Q. S. (2020).

Ovarian activity improvement and antioxidant effects of GundeliaMicrocephala extract in oxidative stress rats. EurAsian Journal of BioSciences, 14(1).

Alsamri, H., Athamneh, K., Pintus, G., Eid, A. H., &Iratni, R. (2021).

Pharmacological and antioxidant activities of Rhuscoriaria L.(Sumac). Antioxidants, 10(1), 73.

Anwar, M. A., Samaha, A. A., Baydoun, S., Iratni, R., &Eid, A. H. (2018).

Rhuscoriaria L.(Sumac) evokes endothelium-dependent vasorelaxation of rat aorta: involvement of the cAMP and cGMP pathways. Frontiers in pharmacology, 9, 688.

Anwer, T., Sharma, M., Khan, G., Iqbal, M., Ali, M. S., Alam, M. S., & Gupta, N. (2013).

Rhuscoriaria ameliorates insulin resistance in non-insulin-dependent diabetes mellitus (NIDDM) rats. Acta Pol Pharm, 70(5), 861-867.

Armitage,P&Berry,G (1987).

Statisitcal methods in medical research.Boston,MA: Blackwell Scientific.559p.

Arya, A., Al-Obaidi, M. M. J., Shahid, N., Noordin, M. I. B., Looi, C. Y., Wong, W. F., & Mustafa, M. R. (2014).

Synergistic effect of quercetin and quinic acid by alleviating structural degeneration in the liver, kidney and pancreas tissues of STZ-induced diabetic rats: a mechanistic study. Food and Chemical Toxicology,71, 183-196..

Association Official Analytical Chemist [AOAC]. (2005).

Official methods of analysis., 18th ED., AOAC international Gaithersburg, MD, USA.

Attaby, F.A.; El-Desouky, M.A.; Maha, H.; Mahmoud & Ahmed, Y.A. (2013).

Antihepatotoxic Effect of Some Natural Antioxidants against Liver Damage Induced By CCl4 in Rats, Journal of Applied Sciences Research, 9(3): 2042-2051.

Bancroft ,J.D.; Suvarna,K&Layton,C.(2012).

Bancroft's theory and practice of histological techniques. 7th ed. E book ISBN. 978-0-7020-5032–5039.

Bartels, H &Bohmer, M. (1971).

Creatinine standard and measurement of serum creatininewith picric acid. Clin.Chem. Acta.32:81.

Bashash, M., Zamindar, N., &Bolandi, M. (2014).

Evaluation of antioxidant activities of Iranian sumac (R. coriaria L.) fruit and spice extracts with different solvents. Journal of Food Measurement and Characterization, 8(3), 213-217.

Belfield, A & Goldberg, D.M. (1971).

Alkaline Phosphatase Colorimetric Method".J. of Enzyme. (12): 561.

Capcarova, M., Slamecka, J., Abbas, K., Kolesarova, A., Kalafova, A., Valent, M., &Massanyi, P. (2012).

Effects of dietary inclusion of Rhuscoriariaon internal milieu of rabbits.Journal of animal physiology and animal nutrition, 96(3), 459-465.

Chapman, D.G.; Castilla,R&Champell, J.A.(1959).

Evaluation of protein efficiency ratio ,Can.J.Biochem.Physiol.37:679-686.

Dalar, A., Dogan, A., Bengu, A. S., Mukemre, M., &Celik, I. (2018).

Screening in vivo antioxidant and haematological properties of sumac and acorn bioactive rich extracts.Industrial Crops and Products, 124, 20-27.

Doğan, A., &Çelik, İ. (2016).

Healing effects of sumac (Rhuscoriaria) in streptozotocin-induced diabetic rats.Pharmaceutical biology, 54(10), 2092-2102.

El-Sharqawi, S. L. ; Abdel-Al, W. E. ; Talaat, S. M. ; Sharaf, H. A. ; Haridi, A. A &Bakir, R. M.(2018).

Expression of Estrogen Receptors In Epithelial Ovarian Carcinoma. Journal of The Arab Society for Medical Research. 13(1):1687-4293.

FAO .(1982).

Food Composition Tables for the Near East, F.A.O., Food and Nutrition Paper, 26.

Fossati, P., Prencipe, L., &Berti, G. (1980).

Use of 3, 5-dichloro-2-hydroxybenzenesulfonic acid/4 aminophenazone chromogenic system in direct enzymic assay of uric acid in serum and urine.Clinical chemistry, 26(2), 227-231.

Fried wald, W. T.; Leve, R. I. & Fredrickson, D. S. (1972).

Estimation of the concentration of low-density lipoprotein separation by three different methods.Cli. Chem. 18: 499-502.

Golzadeh, M., Farhoomand, P., &Daneshyar, M. (2012).

Dietary Rhuscoriaria L. powder reduces the blood cholesterol, VLDL-c and glucose, but increases abdominal fat in broilers. South African Journal of Animal Science, 42(4), 398-405.

González, R., Ballester, I., López-Posadas, R., Suárez, M. D., Zarzuelo, A., Martínez-Augustin, O., & Medina, F. S. D. (2011).

Effects of flavonoids and other polyphenols on inflammation.Critical reviews in food science and nutrition, 51(4), 331-362.

International Diabetes Federation. (2016).

International Diabetes Federation.IDF Diabetes Atlas. Brussels: International Diabetes Federation.

Ismail, D. I., &Yousry, M. M. (2018).

The effectiveness of resveratrol in protection against histological alterations induced by hyperprolactinemia in reproductive organs of female albino rats.Egyptian Journal of Histology, 41(2), 123-139.

John, B. I.;Sulaiman, C. T.; George, S & Reddy, V. R. (2014).

Total phenolics and flavonoids in selected medicinal plants from Kerala.International Journal of Pharmacy and Pharmaceutical Sciences. 6(1): 406-408.

Kakkar, R.; Mantha, S.V.; Radhi, J & Prasad, K. (1998).

Increased oxidative stress in rat liver and pancreas during progression of streptozotocin – induced diabetes.Clinical Science.94: 623 - 32.

Kianifard, D., Sadrkhanlou, R. A., &Hasanzadeh, S. H. (2011, January).

The histological, histomorphometrical and histochemical changes of testicular tissue in the metformin treated and untreated streptozotocin-induced adult diabetic rats. VETERINARY RESEARCH FORUM.

Kizil, S., & Turk, M. (2010).

Microelement contents and fatty acid compositions of Rhuscoriaria L. and Pistaciaterebinthus L. fruits spread commonly in the south eastern Anatolia region of Turkey. Natural Product Research, 24(1), 92-98.

Kosar, M., Bozan, B., Temelli, F., & Baser, K. H. C. (2007).

Antioxidant activity and phenolic composition of sumac (Rhuscoriaria L.) extracts. Food chemistry, 103(3), 952-959.

Kossah ,R.; Nsabimana, C.; Zhang ,H & Chen ,W. (2013).

Evaluation of antimicrobial and Hyperuricemic Mice Journal of Pharmaceutical and Biomedical Sciences,3(12):1-6.

Kossah, R., Nsabimana, C., Zhao, J., Chen, H., Tian, F., Zhang, H., & Chen, W. (2009).

Comparative study on the chemical composition of Syrian sumac (Rhuscoriaria L.) and Chinese sumac (Rhustyphina L.) fruits. Pakistan Journal of Nutrition, 8(10), 1570-1574.

Lazarow, A., &Palay, B. (1954).

Experimental Diabetes and its relation to the Disease.Asymposium.Black wells scientific Publication, 14, 66-69.

Liu, Y., Wang, Y. L., He, S. W., Chen, M. H., Zhang, Z., Fu, X. P., ... & Wang, H. L. (2017).

Protective effects of resveratrol against mancozeb induced apoptosis damage in mouse oocytes. Oncotarget, 8(4), 6233.

Lopes-Virella, M. F., Stone, P., Ellis, S., & Colwell, J. A. (1977).

Cholesterol determination in high-density lipoproteins separated by three different methods.*Clinical chemistry*, 23(5), 882-884.

Madihi, Y., Merrikhi, A., Baradaran, A., Rafieian-Kopaei, M., Fard, S., Ansari Samani, R., &Mesripour, A. (2013).

Impact of Sumac on postprandial high-fat oxidative stress.Pakistan Journal of Medical Sciences, 29(S), 340-345.

Mansoub, N. H. (2011).

Effect of different levels of Sumac Powder (Rhuscoriaria L.) on performance, carcass and blood parameters of broiler chickens.Annals of Biological Research, 2(5), 647-652.

Marsh, W. H., Fingerhut, B., & Miller, H. (1965).

Automated and manual direct methods for the determination of blood urea.Clinical chemistry, 11(6), 624-627.

Mechoulam, R.; Brueggemeier, R.W &Denlinger, D.L. (2005).

Estrogens in insects".Cellular and Molecular Life Sciences. 40 (9): 942–944.

Ortega, I., &Duleba, A. J. (2015).

Ovarian actions of resveratrol.Annals of the New York Academy of Sciences, 1348(1), 86-96.

Owens, J. W., & Ashby, J. (2002).

Critical review and evaluation of the uterotrophic bioassay for the identification of possible estrogen agonists and antagonists: in support of the validation of the OECD uterotrophic protocols for the laboratory rodent. Critical reviews in toxicology, 32(6), 445-520.

ÖZATİK, F. Y., Kevser, E. R. O. L., & ÖZATİK, O. (2016).

Estrogen modulating effects of resveratrol in female rats.Marmara Medical Journal, 29(2), 95-101.

Özcan, M., &Haciseferogullari, H. (2004).

A condiment [sumac (Rhuscoriaria L.) fruits]: some physicochemical properties. Bulgarian Journal of Plant Physiology, 30(3-4), 74-84.

Raodah, M., Al-Ali, A. Z. H., &Faleeha, H. H. (2014).

The antioxidant and antimicrobial of Syrian sumac (Rhuscoriaria) fruit extracts. J Nat Sci Res, 4(11), 36-40.

Reeves, P. G.; Nielsen, F. H. &Fahmy, G. C. (1993).

AIN-93 purified diets for laboratory rodents: Final report of the American Institute of Nutrition ad hoc writing committee on the reformulation of the AIN-76A rodent diet. Journal of Nutrition,123(11):1939-1951.

Reitman, S & Frankel, S. (1957).

Determination of glutamate pyruvate transferase.Am. Journal of Clinical Pathology.28:56.

Sabzghabaee, A. M., Kelishadi, R., Golshiri, K., Ghannadi, A., &Badri, S. (2014).

Clinical effects of Rhuscoriaria fruits on dyslipidemia in adolescents: a triple-blinded randomized placebo-controlled trial. Medical Archives, 68(5), 308.

Saeed, N., Khan, M. R., &Shabbir, M. (2012).

Antioxidant activity, total phenolic and total flavonoid contents of whole plant extracts Torilisleptophylla L. BMC complementary and alternative medicine, 12(1), 1-12.

Saini, R., Garg, V., &Dangwal, K. (2013).

Effect of extraction solvents on polyphenolic composition and antioxidant, antiproliferative activities of Himalyan bayberry (Myricaesculenta).Food Science and Biotechnology, 22(4), 887-894.

Shabanian, S., Bahmani, M., &Asadi-Samani, M. (2016).

The medicinal plants effective on female hormones: A review of the native medicinal plants of Iran effective on estrogen, progesterone, and prolactin. Journal of Chemical and Pharmaceutical Sciences, 9(3), 1270-6.

Sunil, K., & Kumar, D. (2010).

Evaluation of antidiabetic activity of Euphorbia hirta Linn.instreptozotocininduced diabetic mice. Indian journal of natural products and resources, 1(2), 200-203.

Tag, H., Ali, A. L., Abdelwahab, M., & Nabil, Z. (2015).

Hypoglycemic, antihyperlipidemic and antioxidant effects of ginger and alpha-lipoic acid in experimentally diabetic rats.Catrina: The International Journal of Environmental Sciences, 12(1), 7-15.

Uotila, M.; Ruoslahti, E &Engvall, E. (1981).

Two-site sandwich enzyme immunoassay with monoclonal antibodies to human alpha-fetoprotein.Journal of immunological methods. 42(1), 11-15.

Wohaieb, S. A., & Godin, D. V. (1987).

Alterations in free radical tissue-defense mechanisms in streptozocin-induced diabetes in rat: effects of insulin treatment. Diabetes, 36(9), 1014-1018.

Kaplan, L. A. (1984).

Glucose.Clin Chem. The CV Mosby Co. st Louis. Toronto. Princeton.1032-1036.

Schettler, G. &Nussel,E. (1975).

Arb.Med.Soz.Med.Prav.Med.10:25.

التأثيرالعلاجي والوقائي لبذور السماق على بعض هرمونات الخصوبة في إناث الجرذان المصابة بداء السكري

أسماء محمد ابراهيم الجمل[١] و إسراء عبد الفتاح عواد[٢]

[١]زميل (مدرس) التغذية وعلوم الأطعمة ، مستشفى أحمد ماهر التعليمي ، مصر
[٢]مدرس التغذية وعلوم الأطعمة ، كلية التربية النوعية ، جامعة الزقازيق ، مصر

الملخص العربى

يعتبر السماق من التوابل شائعة الاستخدام في العالم العربي. على الرغم من استخدامه كمسحوق إلا أنه فى الحقيقة من الفاكهة. أجريت هذه الدراسة لمعرفة تأثير استخدام بذور السماق على بعض هرمونات الخصوبة فى إناث الجرذان المصابة بسكر الدم. تم استخدم ٤٥ من إناث الجرذان ذات وزن ١٤٠ ± ١٠جرام لمدة ستة أسابيع. قسمت الفئران إلى ثلاث مجموعات رئيسية. المجموعة الرئيسية الاولى (٥ جرذان) وتم استخدامها كمجموعة تحكم سلبية. المجموعة الرئيسية الثانية (٢٠ جرذاً) تم حقنها بمحلول الألوكسان المحضر طازجاً في محلول ملحي بمستوى جرعة ١٥٠ مجم / كجم من وزن الجسم واستخدمت كمجموعات علاجية ثم قسمت إلى أربع مجموعات. المجموعة الرئيسية الثالثة (٢٠ جرذاً) قسمت إلى أربع مجموعات واستخدمت كمجموعات وقائية وتم حقنها قرب نهاية التجربة بمحلول الألوكسان المحضر طازجاً في محلول ملحي بمستوى جرعة ١٥٠ مجم / كجم من وزن الجسم. أجريت الاختبارات الكيميائية والبيولوجية والهستوباثولوجية . أظهرت نتائج هذه الدراسة أن مسحوق السماق يحتوي على نسبة عالية من الألياف والكربوهيدرات وكمية معتدلة من الدهون والبروتينات. كما يحتوى السماق على كمية عالية من إجمالي الفينولات وإجمالي مركبات الفلافونويد. انخفض إجمالي الكوليسترول والدهون الثلاثية وLDL-c وVLDL-c بشكل ملحوظ وكانت هناك زيادة ملحوظة فيHDL-c في جميع المجموعات العلاجية والوقائية التي تم تدعيمها بنسب مختلفة من مسحوق السماق مقارنة بمجموعة التحكم الإيجابية (العلاجية والوقائية). بالإضافة إلى ذلك ، فقد اظهرت النتائج انخفاضًا معنويًا في وظائف الكلى وإنزيمات الكبد في جميع المجموعات العلاجية والوقائية التى تم تدعيمها بنسب مختلفة من مسحوق السماق مقارنة بمجموعة التحكم الإيجابية (العلاجية والوقائية). كما كان هناك تحسن ملحوظ في الهرمونات الأنثوية (Estrogen, FSH and LH)تحت الدرسة وفى مستوى سكر الدم. بالنسبة للفحص الهستوباثولوجى للبنكرياس كان هناك تحسن ملحوظ في جميع المجموعات العلاجية والوقائية التي تم تدعيمها بنسب مختلفة من مسحوق السماق مقارنة بمجموعة التحكم الإيجابية (العلاجية والوقائية). لذلك توصي الدراسة بإمكانية استخدام مسحوق السماق لتحسين نسبة السكر في الدم وهرمونات الخصوبة في إناث الفئران المصابة بداء السكري وذلك لما يحتويه السماق على مركبات نشطة بيولوجيًا.

الكلمات الدالة : بذور السماق - السكرى - هرمون الخصوبة - هرمون الاستروجين - الهرمون المنشط للجريب - الهرمون اللوتيني - سيرم الجلوكوز