

THE POSSIBILITY OF USING OLIVE AND FIG LEAVES TO REDUCE GLUCOSE BLOOD IN INFECTED RATS

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ABSTRACT

The aim of the current research was to assess the antidiabetic possible of orally administered of olive and fig leaves in Alloxane induced diabetic rats.

The experimental recommended 56 male albino rats were randomly divided into two main groups. The first main group (8 rats) was considered as negative control group (healthy rats) fed on basal diet while the second main group (48 rats) were induced by a single intraperitoneal injection of alloxan (150 mg/kg body weight). The second main group consists of 6 subgroups each of (8 rats). One of these groups was chosen as a positive control. The rats in the positive control continued feeding on basal diet, however the other five groups has received olive leaves and fig leaves powder in their diet at levels of 3.5% , 7% and their mixture at 7% substitution respectively for 4 weeks . The results also declared that all diabetic groups which treated with olive leaves , fig leaves and their mixture resulted in significant decrease ($p < 0.05$) in the values of glucose, serum cholesterol, TG , LDL-c and VLDL-c but showed a significant increase ($p < 0.05$) in the values of serum HDL-c comparing with control positive group .The results also revealed that significant decrease ($p < 0.05$) in the values of AST and ALT in diabetic groups treated with 3.5% and 7% olive leaves and fig leaves powder and their mixture at 7% substitution. These results reported that all diabetic rat groups ingested olive and fig leaves in the diet declared significant decrease ($P < 0.05$) in the values of creatinine comparing with the control positive group (PC), whereas for urea there are significant decrease ($P < 0.05$) in the values of urea in all diabetic groups ingested olive and fig leaves in the diet except for diabetic rats that received 3.5% olive leaf powder (OL1) group comparing with the control positive group (PC) .These results demonstrated that olive leaves and fig leaves has antihyperglycemic and hypolipidemic effect , because of the presence of antioxidants.

The study recommended that adding olive leaves and fig leaves to drinks to reduce glucose blood , cholesterol and improve liver and kidney functions wither alone or mixture (1:1).

Keywords: Olive leaves-fig leaves – rats – alloxane - diabetes mellitus

INTRODUCTION

Diabetes mellitus (DM) is a chronic metabolic disease with the highest rates of prevalence and mortality worldwide that is caused by an absolute or relative lack of insulin and or reduced insulin activity Kamtchouing *et al.* (2006) impaired glucose-induced insulin secretion with a decrease in pancreatic β cell mass will eventually lead to chronic hyperglycemia Sebbagh *et al.* (2009). It is a complex and multifarious group of disorders characterized by hyperglycemia that has reached epidemic proportions in the present century Noor *et al.* (2008).

Although the most common treatment is insulin and drugs with hypoglycemic effects, but their side effects such as increasing body fat storages, body wasting at the injection site, and hypoglycemic shock are

worth to mention; however, these drugs do not have many impact on long term debilitating morbidities. Regarding our daily increasing knowledge about the disease, it is really needed to seek for new medications with fewer side effects Shapiro and Gong (2002).

Herbal medication usage is of great importance in traditional medicine and such plants have been used for the treatment of many diseases for a long time, whereas there are not still enough scientific evidences about the effects of most of them Zargari (1993).

Many herbal medicines therapeutic available been recommended for the treatment of diabetes. Herbal drugs are prescribed widely because of their effectiveness, less side effects and relatively low cost Venkatesh *et al.* (2003).

Antihyperglycemic herbs increase insulin secretion, enhance glucose uptake by adipose or muscle tissues and inhibit glucose absorption from intestine and glucose production from liver Hongxiang *et al.* (2009).

Olive tree (*Olea europaea* L.) leaves have been widely used in traditional remedies in European and Mediterranean countries. They have been used in the human diet as extracts, herbal teas, and powder and contain several potentially bioactive compounds that may have antioxidant, antihypertensive, antiatherogenic, anti-inflammatory, hypoglycemic, and hypocholesterolemic properties El and Karakaya (2009)

Furthermore, the olive leaf contains triterpenes (oleanolic and maslinic acid), flavonoids (luteolin, apigenine, rutin), and chalcones (olivin, olivindiglucoside). It has been traditionally used in hypertonia, arteriosclerosis, rheumatism, gout, diabetes mellitus, and fever Fleming (2000).

Olive leaf extracts are traditionally used to lower blood pressure and reduce the sugar in diabetes. These are just some of the many uses of olive leaf extracts as a supplement Fathia *et al.* (2012)

Olive leaf tea and chewing olive leaves are folk remedies for the treatment of diabetes. The bioactivity of olive tree byproduct extracts appears to be attributable to antioxidant and phenolic components such as oleuropein, hydroxytyrosol, oleuropein aglycone, and tyrosol Visioli *et al.* (2002). As an antiviral and an antimicrobial agent, it holds a lot of promise in the field of nutraceuticals as a natural and effective way to boost the immune system in infections. Olive leaf and diabetes is now something that has been looked into through many different studies .

The leaf *Ficus carica* decoction is taken as a remedy for diabetes and calcifications in the kidneys and liver Morton (1987). Several studies in animal models with diabetes have shown hypoglycemic effects, although human trials are lacking Akbulut *et al.* (2009). The fruit and leaf of *Ficus carica* are traditionally used to cure throat diseases, and as stimulant, laxative, emollient, antitussive, resolvent, emmenagogue Guarrera (2003).

Fig has been traditionally used for its medicinal benefits as metabolic, cardiovascular, respiratory, antispasmodic and anti-inflammatory remedy Gond and Khadabadi (2008). The chloroform extract obtained from a decoction of leaves has been shown to reduce blood cholesterol levels in streptozocin-induced diabetic rats Canal *et al.* (2002).

Ficus carica contain a high amount of sugar, pectins, flavonoids and vitamins. Leaves contain phenolic compounds such as flavonoids, a-tocopherol and 3-O-caffeoylquinic acid, with antioxidant capacity and superoxide radical scavenging activity. They contain also organic acids, such as oxalic, citric, malic, quinic, shikimic and fumaric acids. Leaves contain also steroids, triterpenoids and coumarins. The flavonoids contained in the Fig leaf aqueous extract may contribute to the hypolipidemic action, as it has been demonstrated that some flavonoids, such as naringenin, inhibit HMGCoA reductase and ACAT activities in high cholesterol-fed rats. The aqueous extracts obtained from *F. carica* leaves could significantly decrease secretion of cholesterol from the liver cell in both stimulated and basal condition which is resemble to the diabetic animals Fatemi *et al.* (2007).

The present research was aimed to investigate antidiabetic activities of fig and olive leaves in alloxan induced diabetic rats.

MATERIALS AND METHODS

Materials

Olive leaves

Olive leaves (*Olea europaea* L.) leaves were collected from farm in Belkas, Abou Madi, Dakahlia, Egypt .

Fig leaves

Fig leaves (*Ficus carica* L.) were obtained from a farm in kafr El-Sheikh , Egypt

Chemicals and Kits

Vitamins, minerals, cellulose ,bile salts , choline chloride, diagnostic kits and alloxane were purchased from El-Gomhoria Co., Sherief Street , Cairo, Egypt.

Methods

Preparation of olive and fig Leaves powder

Plants leaves were dried at 25°C \pm 2 under shade, then powdered with mechanical grinder. Both powder was mixed with rats food under treatment Baluchnejadmojarad and Roghani (2003).

Induction of experimental diabetes

Diabetes were induced in the rats by a single intraperitoneal injection of alloxan (150 mg /kg body weight). Since alloxan is capable of producing hypoglycaemia as a result of massive pancreatic insulin release, rats were treated with 20% glucose solution (15–20 ml) intraperitoneally after 6 h. The rats were then kept for the next 24 h. on 5% glucose solution bottles in their cages to prevent hypoglycaemia Stanely *et al.*(2004). After 5 days when the condition of diabetes were stabilized, rats with blood glucose range of 200 - 300 mg/dl were selected for the study.

Biological Studies:

Experimental animals

56 male albino rats (Sprague Dawley strain) weighing about 165 gm were obtained from (Food Technology Research Institute, Agriculture Research Center, Giza) .All rats were fed on basal diet for one week, after one week period , the rats were divided into two main groups. The first main

group (n=8 rats) was fed only on the basal diet as a control negative group (NC). The basal diet consists of protein (10%), corn oil (10%), choline chloride (0.2%), cellulose (5%), vitamin mixture (1%), (Reeves *et al.*, 1993) salt mixture (4%) (Hegested *et al.*, 1941) and corn starch (up to 100%). The second main group 48 rats were injected with (150 mg /kg body weight) of alloxan to induce hyperglycemia, rats divided into 6 subgroups each group was submitted to a specific treatment as follows.:

Group 1: normal rats which fed on basal diet (NC) negative control group.

Group 2: diabetic rats that serve as positive control fed on basal diet (PC) positive control group.

Group 3: diabetic rats that received 3.5% olive leaf powder (OL1) group.

Group 4: diabetic rats that received 7% olive leaf powder (OL2) group.

Group 5: diabetic rats that received 3.5% fig leaf powder (FL1) group.

Group 6: diabetic rats that received 7% fig leaf powder (FL2) group.

Group 7: diabetic rats that received 7% mixture of olive leaves and fig leaves powder (1:1) (OLFL) group.

Blood sampling:

At the end of experimental period (4 weeks) rats were fasted overnight before sacrificing. Blood was collected and centrifuged (3000rpm), serum was separated for analysis. Serum was carefully aspirated, transferred into clean cuvet tubes and stored frozen at -20°C for analysis. Body weight gain % was calculated by following formula:

$$\text{BWG\%} = \frac{\text{Final weight} - \text{Initial weight}}{\text{Initial weight}} \times 100$$

Biochemical analysis :

For each group analyses included the following:

Total cholesterol (TC) was determined according to Allen (1974). The determination of serum triglycerides (TG) was done according to (Fassati and Prencipe, 1982), while high density lipoprotein-cholesterol (HDL-c) was determined according to Lopez (1977), whereas low density lipoprotein-cholesterol (LDL-c) were determined according to Friedewald *et al.*, (1972).

$$\text{LDL-c} = \text{TC} - [\text{HDL-c} + (\text{TG}/5)]$$
$$\text{VLDL-c} = \text{TG}/5$$

Determination of GOT (AST) and GPT (ALT) were determined according to Reitman and Frankel (1957). Urea was determined according to Pattn and Crouch, (1977), the determination of creatinin was determined according to Henry, (1974) and determination of glucose oxidase was carried out according to Tietz (1976).

Statistical Analysis :

Statistical analysis were performed by using computer of statistical package for social science (SPSS version 13.0). The results are presented as means \pm SD. One way analysis of variance (ANOVA) was used to test the differences between groups SPSS (1999).

RESULTS AND DISCUSSION

Effect of olive and fig leaves on body weight gain percent (BWG%) of the experimental rat groups.

Data in Figure (1) declared that the highest body weight gain was observed for negative control group (NC), whereas the lowest body weight gain was observed for positive control group (PC). However, the diabetic rats treated with (3.5% and 7% olive leaves powder, 3.5%, 7% fig leaves powder and the mixture of them at 7%) demonstrated higher values of body weight gain as compared to positive control group (PC) whereas, it demonstrated lower values of body weight gain as compared to negative control group NC.

Several olive leaf constituents have been reported to exert beneficial effects against obesity both in vitro and in vivo. Oleuropein, hydroxytyrosol, luteolin, apigenin, rutin and caffeic acid were found to decrease the accumulation of intracellular lipid. Hao and Shen (2010) and Drira *et al.* (2011). In this regard, oleuropein and rutin which were found in olive leaf decreased body weight gain. Hsu *et al.* (2009). In this concern, Kim *et al.* (2010) reported that oleuropein supplementation significantly reduced body weight gain and plasma lipid levels in high-fat diet (HFD)-fed mice for 10 weeks.

On the other hand, these results are in harmonization with Perez *et al.* (1996) who declared that *Ficus carica* leaves extract induced significant hypoglycemic effect, body weight loss prevented in treated diabetic rats.

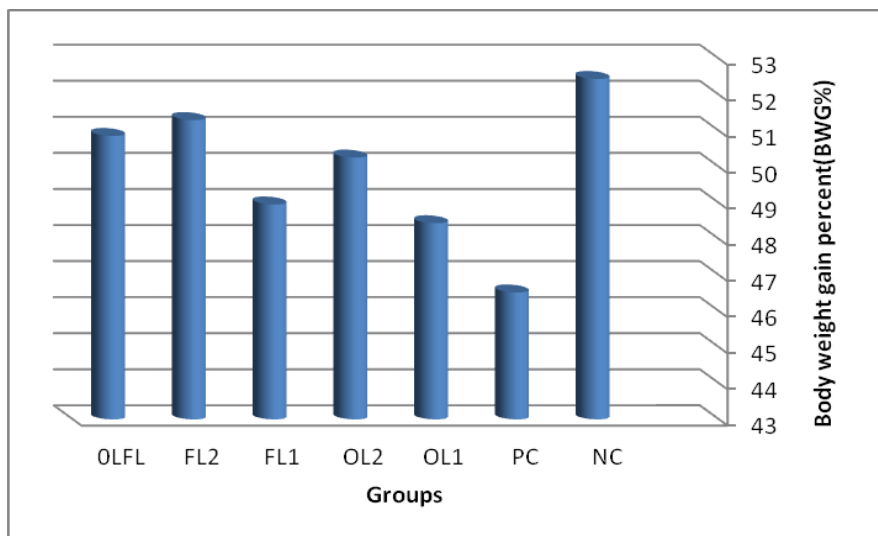


Figure (1): Effect of olive and fig leaves on body weight gain percent (BWG%) of the experimental rat groups.

NC: negative control group, PC: positive control group (diabetic rats), OL1: diabetic rats treated with 3.5% olive leaves, OL2: diabetic rats treated with 7% olive leaves, FL1: diabetic rats treated with 3.5% fig leaves, FL2: diabetic rats treated with 7% fig leaves, OLFL: diabetic rats treated with mixture of 7% olive and fig leaves (1:1)

Effect of olive and fig leaves on serum lipid profile of the experimental rat groups.

Effect of olive and fig leaves on serum cholesterol , TG, LDL-c, VLDL-c, and HDL-c in diabetic rats are presented in table (1). These results declared that, rats in the positive control group (PC) fed on basal diet have higher cholesterol, TG, LDL-c and VLDL-c levels while, have the lower HDL level comparing to rats in the negative control group(NC) .

These results also showed that diabetic rats fed on basal diet supplemented with different levels of olive and fig leaves gave a significant decrease in cholesterol, TG, LDL-c VLDL-c and an increase in HDL-c comparing to positive control group which fed only on the B.D.

Moreover, it has been showed that increased levels of serum glucose in diabetic rats can increase triglyceride,LDL, VLDL and indirectly decreases HDL Yanardag *et al.* (2002).

Previous studies suggests that the hypolipidemic effect of olive leaves in diabetic rats is mainly due to mainly attributed to the polyphenols, oleuropin and hydroxytyrosol in the olive by-products Jemai *et al.* (2008) and Somova *et al.* (2003).In this concern hydroxytyrosol lowered blood cholesterol and lipid concentrations in cholesterol-fed rats at doses ranging from 2.5 to 5 mg/kg, while in streptozotocin-induced diabetic rats, OLE (100–500 mg/kg) decreased serum concentrations lipids.

It has been reported by Comeyli and Miri Moghadam (2008) that the hypoglycemic effect of aqueous extract of olive leaves in diabetic rats, blood cholesterol and triglyceride also decreased and HDL cholesterol increased, which is in agreement with our results.

On the other hand, *Ficus carica* leaves extract contain flavonoids , such as naringenin and hesperidin, could lower cholesterol levels significantly in both the plasma and liver Borradaile *et al.*,(2003) and Lee *et al.*, (2003).

The findings of our study are also in accordance with Park *et al.* (2002) who showed that fig leaves (*Ficus carica*) leaves extract contain tannins had hypolipidemic effects when tannic acid supplemented rat feed for three weeks. They noted that tannic acid lowered both plasma lipid concentrations (cholesterol and triglyceride).In this concern Rassouli *et al.* (2010) could demonstrate that the effect of three extracts of *Ficus Carica* leaves on the total cholesterol levels in serum and liver were investigated in experimentally-induced hyperlipidemic rats. The rats were treated daily by intraperitoneal administration of an aqueous methanolic extract and its aqueous fractions, for eight days. All the extracts of *Ficus Carica* leaves resulted in a decrease of serum and liver cholesterol levels. In this regards ,Dominguez *et al.* (1996) reported that *Ficus Carica* leaves significantly lowered plasma TG in rats with insulin dependent diabetes .

Table (1): Effect of olive and fig leaves on serum lipid profile of the experimental rat groups.

Groups	cholesterol (mg/dl)	TG (mg/dl)	HDL-c (mg/dl)	LDL-c (mg/dl)	VLDL-c (mg/dl)
NC	90.12 ± 5.73f	50.42± 6.27e	52.25± 7.09a	27.79 ± 11.53e	10.08± 1.25e
PC	240.50 ± 6.63a	79.58± 3.92a	34.5± 3.42c	190.08± 9.52a	15.92± 0.78a
OL1	210.18 ± 3.28b	68.46± 3.50b	39.84± 2.21bc	156.65± 1.83b	13.69± 0.70b
OL2	188.77± 4.26c	57.92±6.01cd	44.40± 9.74b	132.79± 10.71c	11.58±1.20cd
FL1	208.60± 7.48b	61.58± 5.50c	43.50± 4.69b	152.78± 4.63b	12.32± 1.10c
FL2	174.21± 4.10e	55.70± 3.41d	47.00± 5.95 ab	116.07± 8.85d	11.14±0.68cd
OLFL	181.47± 5.29d	58.17±4.64cd	44.66± 4.45b	125.18± 8.55c	11.63± 0.67c
LSD	6.274	5.194	6.72	9.31	1.086

NC:negative control group ,PC :positive control group(diabetic rats) ,OL1: diabetic rats treated with 3.5% olive leaves, OL2: diabetic rats treated with 7% olive leaves,FL1: diabetic rats treated with 3.5% fig leaves, FL2: diabetic rats treated with 7% fig leaves, OLFL : diabetic rats treated with mixture of 7% olive and fig leaves (1:1)
 Different letters on same column represent statistically significant ($P<0.05$) difference between means, Values are means + SD for 8 rats.

Effect of olive and fig leaves on blood glucose of the experimental rat Groups

Data in figure (2) declared that there were significant decrease ($p<0.05$) in serum glucose between positive control group (PC) (234.75± 5.73 mg/dl) and diabetic rat groups which treated with olive and fig leaves (OL1, OL2 , FL1,FL2,OLFL) (211.5± 7.33, 195.15± 6.36, 185.30 ± 8.27 ,152.00±9.44 159.68±8.45 mg/dl respectively).In this respect there are significant differences between OL1 group(diabetic rats treated with 3.5% olive leaves) and all groups in serum glucose concentration while there were no significant differences between FL2 group (diabetic rats treated with 7% fig leaves powder) and OLFL group(diabetic rats treated with mixture of 7% olive and fig leaves (1:1)). The best result was at FL2 group (diabetic rats treated with 7% fig leaves powder).

The findings of our study are in accordance with Stanely *et al.*,(2004) who declared that alloxan induces diabetes by damaging the insulin secreting cells of the pancreas leading to hyperglycemia.However, increased levels of serum glucose in diabetic rats can increase triglyceride,LDL, VLDL and indirectly decreases HDL. Yanardag *et al.* (2002).

In this respect Jamei *et al.* (2009) evaluated the effects of some other extracts of olive leaves on alloxan-induced diabetic rats, they concluded that serum glucose and cholesterol levels significantly decreased and this effect is due to antioxidant properties of olive leaves . The results also indicate a prolonged action in reduction of blood glucose by olive leaves and the mode of action of the active compounds of olive leaves is probably mediated through enhance secretion of insulin from the β -cells of Langerhans or through extrapancreatic mechanism. The present study clearly indicated a significant antidiabetic activity with the olive leaves and supports the traditional usage for the control of diabetes Abu-zaiton and Abu-Albasal (2012).

On the other hand, Pérez *et al.* (2000) carried out a study on rats for 3 weeks, a decoction of *F. Carica* leaves was administered to normal and

diabetic rats in lieu of potable water. The extract showed a clear hypoglycemic effect. In fact, the extract decreased the plasma glucose in diabetic rats, as well as the plasmatic levels of insulin in normal rats . It is concluded that the oral consumption of aromatic water leaves of *Ficus carica* decreased blood glucose level in normal and diabetic rats. In this respect, Rashidi and Nouredini (2011) declared that there are common factors in *F. carica* leaves, fruits and bark that are responsible for these phenomena, for example: quercetin and luteolin. Possible mechanism of this phenomena is via increasing effect of insulin on absorption by cells or antioxidant and protective effect of these compounds on B cells.

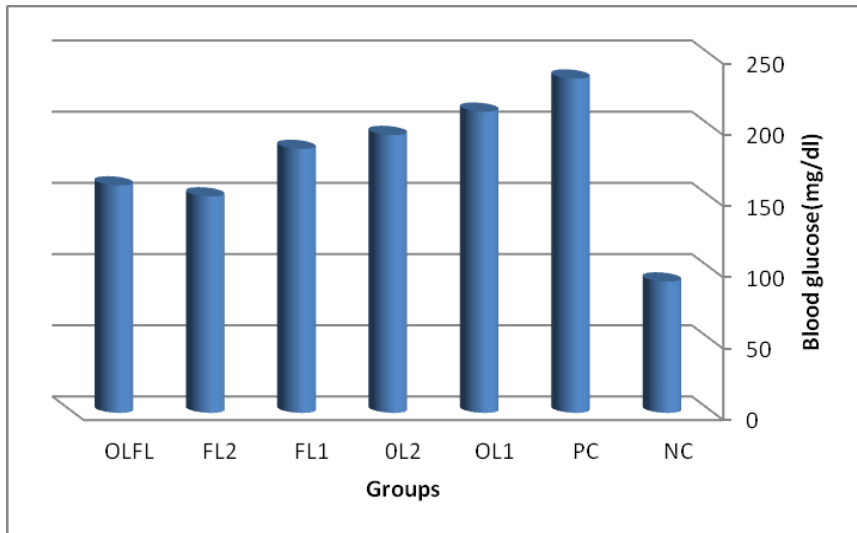


Figure (2): Effect of olive and fig leaves on blood glucose of the experimental rat groups

NC:negative control group ,**PC :**positive control group(diabetic rats) ,**OL1:** diabetic rats treated with 3.5% olive leaves, **OL2:** diabetic rats treated with 7% olive leaves,**FL1:** diabetic rats treated with 3.5% fig leaves, **FL2:** diabetic rats treated with 7% fig leaves, **OLFL :** diabetic rats treated with mixture of 7% olive and fig leaves (1:1)

Effect of olive and fig leaves on liver function of the experimental rat Groups

Results presented in figure (3) showed the effect of olive and fig leaves on liver enzymes AST , ALT. Results declared that rats in the positive control group(PC) showed high level of liver enzymes AST , ALT compared to rats in the negative control group(NC). These results also demonstrated that all diabetic rat groups ingested olive and fig leaves in the diet (OL1,OL2,FL1,FL2,OLFL) declared significant decrease ($P<0.05$) in the values of liver enzymes AST , ALT comparing with the control positive group (PC).

Olive leaves contain natural antioxidants such as polyphenols .Some beneficial effects of these compounds are inhibition of oxidative stress, prevention of amino transferase enzymes departure and treatment of liver

cells and liver toxicity Tiot *et al.* (2001). It means that olive leaves has beneficial effects on liver. In this respect, Estornell *et al.* (1994) declared that reduction in AST activity suggests decreased metabolic activity and cardioprotection in olive leaves extract supplemented rats.

On the other hand, Krishna *et al.* (2007) reported that *Ficus carica leaves* (F.C.L.) extract exhibited a significant protective effect by lowering the serum level of aspartate aminotransferase, alanine aminotransferase in rats with liver damage induced by CCL4.

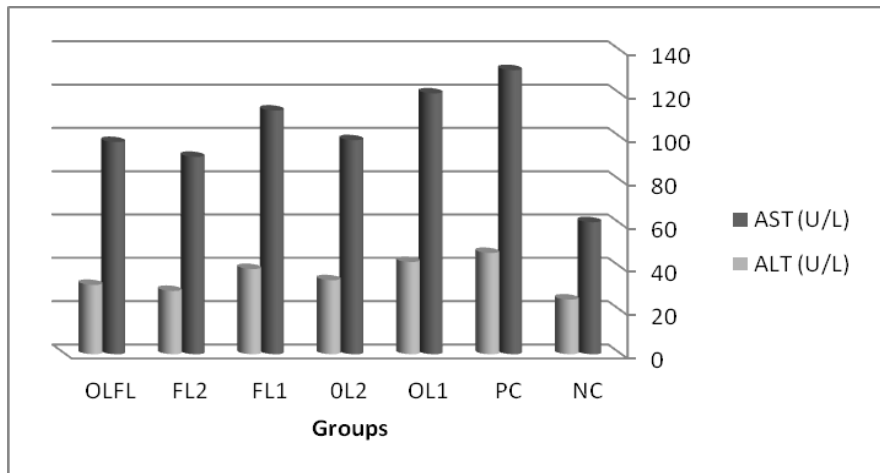


Figure (3): Effect of olive and fig leaves on liver functions of the experimental rat groups

NC:negative control group,PC :positive control group(diabetic rats) ,OL1: diabetic rats treated with 3.5% olive leaves, OL2: diabetic rats treated with 7% olive leaves,FL1: diabetic rats treated with 3.5% fig leaves. FL2: diabetic rats treated with 7% fig leaves, OLFL : diabetic rats treated with mixture of 7% olive and fig leaves (1:1) Different letters on same column represent statistically significant ($P<0.05$) difference between means, Values are means \pm SD for 8 rats.

Effect of olive and fig leaves on kidney function of the experimental rat groups

Data presented in figure (4) A,B declared the effect of olive and fig leaves on kidney functions urea and creatinine . Results showed that rats in the positive control group(PC) showed high level of kidney functions urea and creatinine compared to rats in the negative control group(NC). These results also reported that all diabetic rat groups ingested olive and fig leaves in the diet (OL1,OL2,FL1,FL2,OLFL) declared significant decrease ($P<0.05$) in the values of creatinine comparing with the control positive group (PC),whereas for urea there are significant decrease ($P<0.05$) in the values of urea in (OL2,FL1,FL2,OLFL groups) comparing with the control positive group (PC) while there are no significant differences between (OL1)group and the control positive group (PC). In this respect Eidi *et al.* (2009) found that OLE (100–500 mg/kg) which found in olive leaves decreased serum concentrations uric acid and creatinine on streptozotocin-induced diabetic rats.

On the other hand ,ELShobaki *et al.* (2010) declared that all diabetic rat groups which were supplemented with *Ficus Carica* leaves showed a significant decrease ($P<0.05$) in the level of uric acid, urea nitrogen and creatinine as compared to the positive control group.

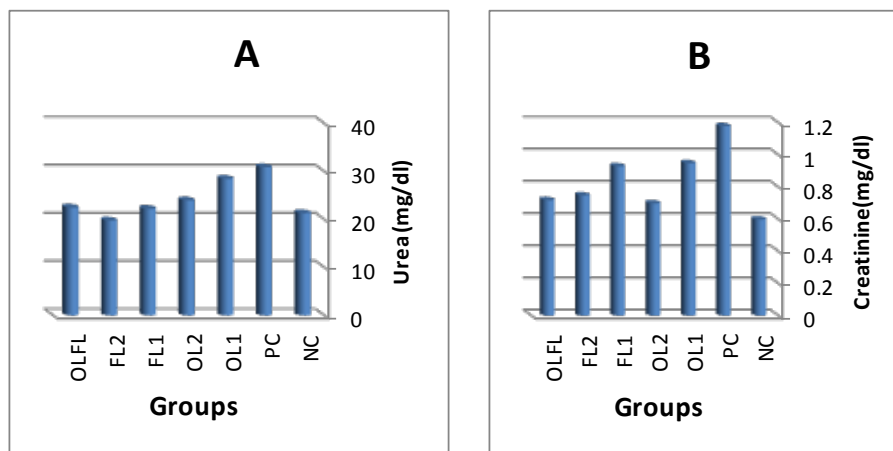


Figure (4): Effect of olive and fig leaves on kidney function of the experimental rat groups

NC:negative control group ,**PC :**positive control group(diabetic rats) ,**OL1:** diabetic rats treated with 3.5% olive leaves, **OL2:** diabetic rats treated with 7% olive leaves,**FL1:** diabetic rats treated with 3.5% fig leaves. **FL2:** diabetic rats treated with 7% fig leaves, **OLFL :** diabetic rats treated with mixture of 7% olive and fig leaves (1:1)
Different letters on same column represent statistically significant ($P<0.05$) difference between means, Values are means + SD for 8 rats.

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مدي إمكانية استخدام أوراق التين والزيتون في تخفيض سكر الدم في الفئران المصابة

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يهدف البحث الحالي إلي دراسة تأثير تركيزات مختلفة من أوراق الزيتون والتين على الفئران المصابة بمرض السكر ، ولهذا الغرض تم تطبيق الدراسة على ٥٦ فأر من ذكور الألبينو تم تقسيمهم إلي مجموعتين رئيسيتين ، المجموعة الرئيسية الأولى (٨ فئران) تم تغذيتهم علي الغذاء الأساسي فقط(مجموعة ضابطة غير مصابة) ، أما المجموعة الرئيسية الثانية (٤٨ فأر) فقد تم اصابتهم بالسكر عن طريق حقنهم بمادة الألوكسان ثم قسمت تلك المجموعة إلي ٦ مجموعات فرعية متساوية استمرت احدهما كمجموعة ضابطة مصابة أما الخمس مجموعات الباقية فقد أدخل مسحوق أوراق الزيتون والتين في غذائها بنسب ٣% ، ٧% ، استبدال على التوالي لمدة ٤ أسابيع وكذلك مخلوطهما بنسبة ٧% (١:١)

وقد أوضحت نتائج الدراسة أن الفئران المصابة بالسكر والتي تم إضافة أوراق الزيتون والتين في غذائها بنسب ٣% ، ٧% وكذلك مخلوطهما بنسبة ٧% قد حققت زيادة في الأوزان المكتسبة وكانت أعلى زيادة عند ٧% أوراق تين ، كما صاحبها انخفاض معنوي عند مستوي معنوية ٠,٠٥ ، في كل من مستوى الكولسترول الكلي ، الجليسيريدات الثلاثية ، كولسترول البروتينات الدهنية المنخفضة الكثافة (LDL-c) ، والبروتينات الدهنية المنخفضة جدا في الكثافة (VLDL-c) ، ووظائف الكبد (AST,ALT) ووظائف الكلى (الكرياتينين) أما بالنسبة لليوريا فقد أظهرت النتائج حدوث انخفاض معنوي في جميع مجموعات الفئران المصابة بالسكر والتي أدخل أوراق الزيتون والتين في غذائها فيما عدا مجموعة الفئران المصابة بالسكر والتي أدخل ورق الزيتون في غذائها بنسب ٣% ٠ كما أظهرت النتائج ارتفاع معنوي في كولسترول البروتينات الدهنية العالية الكثافة (HDL-c). ولقد أوضحت النتائج أيضاً انخفاض معنوي عند مستوى معنوية ٠,٠٥ ، في مستوى جلوكوز الدم ، وتوصي الدراسة بالاستفادة من أوراق التين والزيتون في عمل مشروبات لمرضى السكر سواء كل بمفرده أو بخلطهما بنسبة (١:١) .

الكلمات المفتاحية: أوراق الزيتون - أوراق التين - الألوكسان - مرض السكر .