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Potential Effects of Olive and Mango Leaves on Alloxan Induced Diabetes Complications in Rats

Yousif Elhassaneen, Amal Nasef, and Neama Abdel Rhman

Dept. of Nutrition and Food Sciences, Faculty of Home Economics , Menoufia University, Shibin El Kom, Egypt.

Abstract:

The present study aimed to investigate the potential effect of different concentrations, 2.5 and 5 % ,of olive and mango leaves powder (OLP & MLP) as well as their mixture on Alloxan-induced diabetes complications in rats. Forty-eight male albino rats, weighing 150±10 g, were used and divided into two main groups. The first group, 6 rats, was kept as a negative (-ve) control group fed on the basal diet, while the second one, 42 rats, was injected by alloxan to induce diabetes and divided into seven equal subgroups. The second group was still fed on the basal diet and kept as positive (+ve) control group and the rest six groups were fed on the basal diet containing 2.5 and 5% of olive and mango leaves powder as well as their mixture. Animals treatment with alloxan caused a significant increase ($p \leq 0.05$) in serum glucose concentration by the ratio of 156.22% compared to normal controls. Supplementation of the rats' diet with 2.5. and 5% of the selected plant parts including OLP, MLP and their mixture (Mix) leads to decrease this value by the rate of -20.68, -30.13, -37.68, -42.18, -47.21 and - 56.30%, respectively. The same action was recorded for liver (ALT, AST and ALP) and kidney (urea, uric acid and creatinine) in diabetic rats have been induced by different rates as a result the supplementation with the studied plant parts. All of these effects could be principally attributed to the strong antioxidant activities of these plant parts as the result of their high bioactive compounds content. These findings provide a basis for the use of OLP and MLP to attenuate the complications caused by type-2 diabetes.

Key Words*: hyperglycemia, body weight, kidney functions, liver functions, hemoglobin.*

Introduction

Diabetes mellitus is a dreadful disease found in all parts of the world and is becoming a serious threat to mankind health. Diabetes mellitus is a group of metabolic diseases characterized by high blood sugar (glucose) levels that result from defects in insulin secretion, or action, or both (Kapil et al.,2014). It is a serious complications in today life. The lifestyle and day today circumstances are play major role in occurring this type of serious complications. In this review we get some idea regarding diabetes mellitus (Nishita et al., 2016). Diabetes mellitus is a global health problem and one of the major causes of morbidity and mortality. The incidence of the disease is high worldwide and varies between populations because of differences in genetic susceptibility and other modifiable risk factors. Diabetes mellitus is a metabolic disease, characterized by hyperglycemia (increased concentration of blood glucose) and disturbance of glucose metabolism, as a result of reduced secretion or insulin resistance or both (Quaseem et al., 2007).

Long-term complications of diabetes include retinopathy with potential loss of vision Diabetic Retinopathy is leading cause of blindness in people with between 20-74 years of age . Chronic hyperglycemia results in multiple end stage organ damage and failure including the Heart, kidneys, eyes, nerves, blood vessels. Diabetes associated with cardiovascular complications are believed to be responsible for the high morbidity and mortality observed in Diabetes. There is increased incidence of atherosclerotic cardio-vascular diseases and cerebrovascular diseases, Hypertension and abnormality of lipoprotein metabolism are often found in people with Diabetes. Diabetic Nephropathy leading to renal failure, peripheral neuropathy with risk of foot ulcers, amputation and Charcot joint and Autonomic neuropathy is causing gastro-intestinal, genitor urinary and cardiovascular symptoms and sexual dysfunction (Robert and Frank, 2004).

Olive (Olea europaea, L.) leaves are a byproduct of olive tree cultivation. Large amounts of leaves are collected during pruning, harvest and processing. Available throughout the year, this biomass can be used as a cheap source of high added-value phenolic compounds. Phenolic composition of olive leaves is influenced by several factors which has been shown by the different treatment and analytical techniques used. Such bioactive ingredients could be used in medicines, pharmaceuticals, cosmetics, to improve the shelf life of foods and to develop functional foods. Thus, valorization of olive leaves should be encouraged (Leila et al., 2015). Also, Patrícia et al., 2015 found that Polyphenols of olive leaves, especially oleuropein, have interesting effects on the human body such as antioxidant capability, antihypertensive, hypoglycemic, hypocholesterolemic, however, many of these effects have been tested in animals and it is necessary to perform studies with human beings to confirm the benefits attributed to polyphenols from olive leaves.

Mango (*Mangifera indica*) belong to genus Mangifera and family Anacardiaceae. Mangoes (*Mangifera indica*) consist of about 30 species of tropical fruiting trees. It is cultivated on an area of approximately 3.7 million in the worldwide and it is on the second position as a tropical crop, in terms of production second to bananas. According to Ayurveda and different herbal books and journals mango tree has many medicinal properties in different parts of the tree. Mango possesses anti-diabetic, antioxidant, anti-viral, anti-inflammatory properties. Various effects like antibacterial, anti-fungal, anthelmintic, anti- parasitic, anticancer, anti-HIV, anti-bone resorption, antispasmodic, antipyretic, antidiarrheal, immunomodulation, hypolipidemic, antimicrobial, hepatoprotective, gastro protective have (Subhasis et al., 2019). Therefore, the present study aimed to investigate the potential effect of different concentrations 2.5 and 5 % of olive and mango leaves powder as well as their mixture on Alloxan-induced diabetes complications in rats.

Material and Methods

Materials

Olive and mango leaves were obtained from the local markets in 2018 from Sharqia Governorate.

Experimental animals

A total of 48 adult normal male albino rats Sprague Dawley strain weighing 150±10 g were obtained from Vaccine and Immunity Organization, Ministry of Health, Helwan Farm, Cairo, Egypt.

The chemical kits

Chemical kits were obtained from Al-Gomhoria Company for Drug, Chemicals and Medicals, Instruments, Cairo, Egypt.

Methods

Preparations of olive and mango leaves powders

Olive and mango leaves were washed and dried in a hot air oven (Horizontal Forced Air Drier, Proctor and Schwartz Inc., Philadelphia, PA) at 75 0C until arriving by the moisture in the final product to about 8% In an hour. The dried leaves were ground into a fine powder in high mixer speed (Moulinex Egypt, ElAraby Co., Benha, Egypt). The material that passed through an 80 mesh sieve was retained for packing in polyethylene pages and storing at 4 0C until use.

Induction of diabetes

Diabetes was induced in forty-two normal healthy rats by injection intraperitoneal operationally with freshly prepared alloxan monohydrate in saline at a dose level of 150 mg/ kg body weight (Lazarow & Palay, 1954). Immediately after injection animals were received 5% glucose solution over night to overcome drug induced hypoglycemia (Wohaieb and Godin, 1987and 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 tail vein and subjected to a strip of haemogluco test. All rats with FBG >126 mg/dl were considered to be diabetics and included in the study.

Experimental design

All biological experiments performed complied with the rulings of the Institute of Laboratory Animal Resources, Commission on life Sciences, National Research Council (NRC, 1996). Rats (n=48 rats) were housed individually in wire cages in a room maintained at 25 ± 2 0C and kept under normal healthy conditions. All rats were fed on basal diet for one-week before starting the experiment for acclimatization. After one week period, the rats were divided into two main groups, the first group (Group 1, 6 rats) still fed on basal/standard diet (SD) and the other main group (42 rats) was used for diabetes induction and classified into seven sub groups as follow: group (2) ; fed on standard diet only as a positive control (rats with diabetes); group (3) ; fed on SD containing 2.5 % (w/w) OLP; group (4) ; fed on SD containing 5 % (w/w) OLP, group (5) ; fed on SD containing 2.5 % (w/w) MLP, group (6) ; fed on SD containing 5.0 % (w/w) MLP, group (7) ; fed on SD containing 2.5% (w/w) mix (mixture of OLP and MLP by equal parts) and group (8) fed on SD containing 5 % (w/w) mix . During the experimental period, the body weight and food intake were estimated weekly and the general behavior of rats was observed at the end of experiment period, 28 days.

Blood sampling

At the end of experiment period, 28 days, blood samples were collected after 12 hours fasting using the abdominal aorta and rats were scarified under ether anesthetized. Blood samples were received into glass centrifuge tubes, containing oxalate solution (1.34 %) as anticoagulant. After centrifugation at 3000 rpm for 10 min., plasma was withdrawn and used for the analysis. The erythrocyte residue was washed with three successive portions of sodium chloride solution (0.9 %) and then hemolyzed with deionized water for 30 min. Haemolysate was then centrifuged at 3000 rpm for 30 min. and the supernatant fractions was transferred to a clean test tube and analyzed (Stroev and Makarova, 1989). Liver organ was removed and used for determination.

Body weight gains (BWG), feed intake (FI), and feed efficiency ratio (FER)
Nutritional evaluation of the different diets were carried out by determination of body weight gain % (BWG), food efficiency ratio (FER) according to Chapman et al., (1959) using the following formulas: BWG = Final weight – Initial weight

$$\text{B.W.G. \%} = \frac{(\text{Final weight - Initial weight}) \times 100}{\text{Initial weight}}$$

$$\text{F.E.R.} = \frac{\text{Grams gain in body weight}}{\text{Grams food consumed}}$$

Biochemical analysis

Blood glucose: Enzymatic determination of plasma glucose was carried out calorimetrically according to the method of Tinder (1969).

HB, HTC, PLT, RBC and WBC: The concentration of hemoglobin (HB), hematocrit (HTC), Platelets (PLT), red blood cell count (RBCs) and white blood cell count (WBCs) were estimated according to the method described by Dacie & Lewis (1998).

Liver functions: Determination of plasma alanine aminotransferase (ALT), plasma aspartate aminotransferase (AST), plasma alkaline phosphatase (ALP) were carried out according to the method of Hafkenscheid (1979), Clinica Chimica Acta (1980) and Moss 1982), respectively.

Kidney functions: Plasma urea and plasma creatinine were determined by enzymatic method according to Henry (1974) and Patton and Crouch (1977).

Statistical analysis

The data were analyzed using a completely randomized factorial design (SAS, 1988) when a significant main effect was detected; the means were separated with the Student-Newman-Keuls Test. Differences between treatments of ($P \leq 0.05$) were considered significant using SPSS Program. Biological results were analyzed by One Way ANOVA.

Results and Discussion

Data presented in Table (1) show the mean value of body weight gain (BWG), feed intake (FI) and feed efficiency ratio (FER) of diabetic rats on OLP, MLP and their mixtures. It is clear to notice that the mean value of body weight gain (BWG) g of positive control group was lower than negative control group, being 3.55±0.003 and 11.05±0.002, respectively. All diabetic rats fed on various diets showed significant increases in mean values as compared to positive control group except for MLP 2.5%. The values were 4.65±0.004, 9.17±0.006, 9.77±0.001, 9.97±0.005, 10.17±0.004 and10.90±0.006 for OLP

2.5%, OLP 5%, MLP 2.5%, MLP 5% , mixtures 2.5 and 5% mixture, respectively. Rats fed on groups (1, 4, 5, 6, 7 and 8) showed non-significant differences between them. Rats of groups (2 and 3) showed non-significant differences between them. Group (8), rats fed mixture of the tested plant parts, showed the highest increase of body weight gain as compared to negative control group.

Also, data in Table (1) illustrated that the mean value of (FI) of positive control group was significantly lower than negative control group, being 10.57±0.03and15.97±0.08, respectively, significant ($p \leq 0.05$). All diabetic rats fed on various diets showed significant ($p \leq 0.05$) increase in mean values as compared to positive control group. The values were 12.20±0.06, 12.62±0.02, 13.52±0.02, 14.25±0.04 ,14.72±0.06 and 15.10±0.05 for OLP 2.5%, OLP 5%, MLP 2.5%, MLP 5% , 2.5% mixture and 5% mixture, respectively. diabetic rats fed on basal diet + 5% mixture Olive Leaf, Mango leaves as Powder. Rats fed on groups (7 and 8) showed non-significant differences between them. Groups 7 and 8 showed the highest increase of FI as compared to negative control group.

Table (1): Effects of olive, mango leaves and their mixtures as powder on body weight gain (BWG), feed intake (FI) and feed efficiency ratio (FER) (Mean ± SD) of diabetic rats

Groups	BWG (g/28day)	FI (g/day)	FER (g/day)
Group 1(negative control)	11.05±0.002a	15.97±0.08a	1.32±0.003a
Group 2(positive control)	3.55±0.003b	10.75±0.03d	0.61±0.001c
Group 3 (2.5 % Mango leaves)	4.65±0.004b	12.20±0.06cd	0.60±0.001c
Group 4 (5 % Mango leaves)	9.17±0.006a	12.62±0.02c	1.01±0.01b
Group 5 (2.5 % olive leaves)	9.77±0.001a	13.52±0.02bc	1.12±0.01ab
Group 6 (5 % olive leaves)	9.97±0.005a	14.25±0.04b	1.17±0.002ab
Group 7(2.5% Mixture)	10.17±0.004a	14.72±0.06ab	1.25±0.001ab
Group 8 (5 % Mixture)	10.90±0.006a	15.10±0.05ab	1.27±0.002ab

Values are expressed as mean ± SD. Values in the same column have the different superscript letters are significantly differed at $p \leq 0.05$.

On the other hand, the mean value of FER for positive control group was lower than negative control group, being (0.61±0.001 and 1.32±0.003) respectively, showing significant difference between them. All diabetic rats fed on various diets showed significant increases in mean values as compared to positive control group. Except for MLP 2.5% The values were 0.60±0.001, 1.01±0.01, 1.12± 0.01 , 1.17 ± 0.002,1.25 ±0.001

and1.27±0.002, respectively. Rats of groups 2 and 3 showed non-significant differences between them. Rats of groups 5, 6, 7 and 8 showed non-significant differences between them. Numerically the best FER was recorded for group 8 (5% mixture) as compared to negative control group. These results agree with Gamal et al., (2019) who studied the effect of olive leaf, mango leaves and their mixtures Powder on body weight of diabetic rats. The treated groups showed significant increase in body weight gain (P≤0.05), food intake (P≤0.05) and FER (P≤0.05) when compared with positive control group. Also, Abd El-Moneim et al., (2018) reported that the treated groups with OLP, MLP showed significant increase in BWG, FI, and FER.

Data obtained in Tables (2) show the effect of OLP, MLP and their mixtures on glucose level of diabetic rats. Treatment of animals with alloxan caused a significant increased (p≤0.05) in plasma glucose concentration by the ratio of 156.22% compared to normal controls. Supplementation of the rat diets with 2.5. and 5% of the selected plant parts including OLP, MLP and their mixture leads to decrease this value by the rate of -20.68, -30.13, -37.68, -42.18, -47.21 and - 56.30%, respectively.

Table (2): Effect of OLP, MLP and their mixtures on Blood glucose (Mean ± SD) of diabetic rats

Groups	Glucose (mg/dl)
Group 1 (negative control)	86.8±0.40f
Group 2(positive control)	222.4±1.10a
Group 3 (2.5 % Mango leaves)	176.4±0.30b
Group 4 (5 % Mango leaves)	155.4±0.20c
Group 5 (2.5 % olive leaves)	138.6±0.10d
Group 6 (5% olive leaves)	128.6±0.20de
Group 7 (2.5% Mixture)	117.4±0.10e
Group 8 (5% Mixture)	97.2±0.30f

Values are expressed as mean ± SD. Values in the same column have the different superscript letters are significantly different at p≤0.05.

The best treatment was recorded for group 8 (5% mixtures) as compared to negative control group. These results agree with Ahmed and Mariam, (2012) who suggested that olive leaf extract may be helpful in inhibiting hyperglycemia and oxidative stress caused by diabetes, and that it may be able to help diminish the complications of diabetes. Finally, clearly indicated a significant antidiabetic activity with the olive leaf decoction and supports the traditional usage to control of diabetes.

Data obtained in Table (3) show the effect of OLP, MLP and its mixture on kidney functions (on plasma urea, creatinine, and uric acid) of diabetic rats. As shown the mean value of urea of positive control group was higher than negative control group, being 77.6±2.99 and 26.6±1.80mg/dl, respectively, indicating significant difference between them. All diabetic rats fed on different diets revealed significant decreases in mean values as compared to positive control group. The values were 68.4±3.12, 64.8±1.85, 54.2±2.15, 44.6±2.24, 37.0±1.87 and 33.2±1.71 for OLP 2.50%, OLP 5 %, MLP 2.5%, MLP 5% and their mixtures (2.5 and 5%), respectively. The best treatment was recorded for groups 7 and 8 (2.5 and 5 % mixture) as compared to positive control group. The same action was observed for uric acid and creatinine. These results agree with Marianna et al., (2019) who suggests low cadmium exposure causes cell injury, possibly through inducing ROS production and treatment with OLE antagonizes the adverse effects of cadmium and decreases cadmium induced ROS generation in renal cells.

Table (3): Effects of OLP, MLP and their mixtures on kidney functions (Mean ± SD) on plasma urea, creatinine, and uric acid of diabetic rats

Groups	Urea (mg/dl)	Uric acid (mg/dl)	Creatinine (mg/dl)
Group 1(negative control)	26.6±1.80f	2.60±0.254f	0.64±0.028e
Group 2(positive control)	77.6±2.99a	4.60±0.412a	1.01±0.138a
Group 3(2.5%mango leaves)	68.4±3.12b	4.30±0.192ab	0.93±0.040b
Group4 (5%mango leaves)	64.8±1.85b	4.12±0.192b	0.89±0.02bc
Group5 (2.5% olive leaves)	54.2±2.15c	3.64±0.240c	0.85±0.03bcd
Group6 (5% olive leaves)	44.6±2.24d	3.30±0.273d	0.83±0.03cd
Group7 (2.5%mixture)	37.0±1.87e	3.14±0.207de	0.78±0.03d
Group8 (5%mixture)	33.2±1.71e	2.88±0.132ef	0.69±0.05e

Values are expressed as mean ± SD. Values in the same column have the different superscript letters are significantly differed at p≤0.05.

Also, Mahmoud et al., (2013) suggests Mangifera, like other aldose reductase inhibitors, has promising therapeutic prospects for treatment of diabetic complications such as nephropathy and mango leaves help dissolve gall and kidney stones. Dry the mango leaves in the shade and grind it into fine powder. Mix the powder with water and rest it overnight. Drink this mixture daily to dissolve kidney stones.

Data obtained in Table (4) show the effect of OLP, MLP and thier mixtures on liver functions (AST, ALT and ALP) of diabetic rats. As shown the mean value of AST of

positive control group was higher than negative control group, being 235.4±18.99 and 31.4±4.66, respectively, showing significant difference between them. All hyperglycemic rats fed on OLP, MLP and their mixtures revealed significant decreases in mean values as compared to positive control group. The values were 202.8±18.06, 123.2±8.22, 104.6±8.46, 76.6±6.02, 60.6±3.20 and 48.4±3.50 for OLP 2.5%, OLP 5 %, MLP 2.5%, MLP 5% and their mixture (2.5 and 5%), respectively. Rats of groups 3, 4, 5 and 6 showed significant differences between them. Rats fed on groups 7 and 8 showed non-significant differences between them. Numerically group 7 and 8 (2.5 and 5% mixture) was the best treatment considering the AST activity showed significant differences, in comparison with negative control group. The same action was observed for ALT and ALP. These results agree with Hedya et al., (2020) who suggested that the effects of oleuropein-rich extract in hepatic cadmium toxicity in mice. They showed that Cd induced hepatic injury, inflammation, and apoptosis with depletion of antioxidants. Also, they validated the positive effects of oleuropein from olive leaf extract, at 16 mg/kg BW, which considerably reverses all Cd toxicity features. Subsequently, oleuropein could be considerably implicated in the pharmacotherapy of some hepatic cellular and molecular dysfunctions, such as cancer, by its significant regulation of apoptosis and inflammation.

Table (4): Effects of OLP, MLP and their mixture on liver functions (Mean ± SD) of diabetic rats

Groups	AST (U/L)	ALT (U/L)	ALP (U/L)
Group 1(negative control)	31.4±4.66g	27.2±5.67h	3.73±0.199f
Group 2(positive control)	235.4±18.99a	109.4±6.73a	6.44±0.19a
Group 3(2.5%mango leaves)	202.8±18.06b	94.2±4.76b	6.00±0.16b
Group4 (5%mango leaves)	123.2±8.22c	81.4±5.72c	5.76±0.17b
Group5 (2.5% olive leaves)	104.6±8.64d	69.4±7.16d	5.45±0.21c
Group6 (5% olive leaves)	76.6±6.02e	59.2±4.81e	5.24±0.21c
Group7 (2.5%mixture)	60.6±3.20f	48.4±4.97f	4.74±0.21d
Group8 (5%mixture)	48.4±3.50f	34.6±5.41g	4.36±0.22e

Values are expressed as mean ± SD. Values in the same column have the different superscript letters are significantly different at p≤0.05.

Also, Ines et al., (2020) suggests that the protective effect of the oleuropein- and hydroxytyrosol-rich olive leaf extracts on high-fat diet-induced lipid metabolism disturbance and liver injury in rats. Both extracts, mainly the hydroxytyrosol-rich extract,

were strongly effective in the protection against body weight gain by preventing the white adipose tissue overgrowth. In addition, these extracts were capable of protection against the lipid metabolism perturbation and the degenerative changes in the hepatic cells induced by the HFD (high-fat diet), not only by enhancing the antioxidant system activity in the cells but also by blocking the expression of the proteins involved in the inflammation and liver damage.

Data obtained in Tables (5) show the effect of OLP, MLP and their mixture on red blood cell, white blood cell, platelet and hemoglobin of diabetic rats. As shown the mean value of red blood cell of positive control group was lower than negative control group, being 3.08±0.58 and 7.74±0.48 respectively, showing significant difference between them. All diabetic rats fed on OLP, MLP and their mixtures revealed significant decreases in mean values as compared to positive control group. The values were 3.36±0.33, 3.86±0.47, 4.42±0.34, 4.80±0.46, 5.50±0.60, and 6.46±0.42 for OLP 2.5%, OLP 5 %, MLP 2.5%, MLP 5% and their mixture (2.5 and 5%), respectively. Numerically, group (8) (5% mixture) was the best treatment considering the red blood cell activity showed significant differences in comparison with negative control group. The same action was recorded for the hemoglobin and the opposite direction was recorded for W.B.CS and platelet. These results agree with (Natalia et al., 2018) who suggested that Olea europaea leaves was found to exhibit strong antioxidant activities based on numerous in vitro and in vivo assays. However, due to its richness in polyphenol and avonoid components, pre-treatment with EOLS (extract olive leaf) in DF-injected mice improved their hematological and biochemical parameters. Also, Ferdousi et al., (2019) suggest that olive leaf is rich in several polyphenols having potential health benefits. They conducted the current parallel-group randomized controlled trial to compare the effects of long-term consumption of olive leaf tea (OLT) and green tea (GT) (green tea) on hematological parameters in 31 female volunteers aged between 40 and 70 years of old. Also, they found that RBC count hemoglobin, and hematocrit were increased significantly in the OLT group than those of in the GT group at 6 and 12 weeks of intervention. Within-group comparison showed that hematocrit was significantly increased in the OLT group at 6 weeks of intervention, whereas RBC count and serum iron was significantly decreased in the GT group at 12 weeks of intervention.

Furthermore, Nwinuka et al., (2008) study the effects of crude aqueous extract of Mangifera indica (Mango) stem bark on body weight and hematological parameters in normal albino rats. Albino rats of both sexes weighing between 75 g and 125 g were used. At least 14 mL of the test aqueous extract of the plant was administered to each rat in the group for a period of 14 days. Observations showed that the extract of the medicinal plant have some effects on the hematopoietic system manifested by a positive increase in the levels of PCV (hematocrit), erythrocyte, leukocyte, platelet counts and lymphocytes,

while the hemoglobin (Hb) and neutrophil levels were decreased. The test plant also caused an increase in the weights of the rats. Therefore, it is not possible that its use can advance any adverse effects on hematological parameters.

Table (5): Effects of OLP, MLP and their mixture on red blood cell, white blood, Platelet and Hemoglobin (Mean ± SD) of diabetic rats

Groups	R.B.CS (106/mm3)	W.B.CS (103/mm3)	Platelet (106/mm3)	Hemoglobin (g/dl)
Group 1(negative control)	7.74±0.84a	5.68±0.99f	212.0±5.70e	13.6±0.63a
Group 2(positive control)	3.08±0.58g	13.12±0.88a	248±10.36a	9.2±0.41f
Group 3 (2.5 % Mango leaves)	3.36±0.33fg	11.74±0.61b	244.0±2.9ab	9.6±0.50ef
Group 4 (5 % Mango leaves)	3.86±0.47ef	10.86±0.68b	242.0±3.2ab	10.2±0.6de
Group 5 (2.5 % olive leaves)	4.42±0.34ed	9.82±0.54c	240.0±4.4ab	10.9±0.3cd
Group 6 (5% olive leaves)	4.80±0.46d	8.18±0.66d	235.0±7.3bc	11.6±0.56bc
Group 7 (2.5% Mixture)	5.50±0.60c	7.20±0.44e	229.0±9.6cd	12.0±1.14b
Group 8 (5% Mixture)	6.46±0.42b	6.12±0.71f	222.0±6.67d	12.4±0.72b

Values are expressed as mean ± SD. Values in the same column have the different superscript letters are significantly differed at p≤0.05.

In conclusion, data of the present study has demonstrated the efficiency of the selected plant parts including OLP, MLP and their mixture to partially ameliorate hyperglycemia and its complications in diabetic rats. All of these treated effects could be attributed to the high contents of many bioactive compound categories found in the tested plant parts. These antioxidant activities affect the body weight, liver and kidney functions, and blood picture parameters in diabetic rats. These findings provide a basis for the use of the selected plant parts for the prevention and/or treatment of type-2 diabetes.

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التأثيرات المحتمله لاوراق الزيتون والمانجو علي مضاعفات مرض السكر المحدثه بالألوكسان في الفئران

يوسف عبدالعزيز الحسانين ، أمل ناصف زكى ، نعمة عادل عبد الرحمن
قسم التغذية وعلوم الأطعمة، كلية الاقتصاد المنزلي، جامعة المنوفية، شبين الكوم، مصر

الملخص العربى:
تهدف الدراسه الحاليه إلى معرفه التأثيرات المحتمله لتركيزات مختلفة 2.5 و 5٪ من مسحوق أوراق الزيتون والمانجو بالأضافه إلى خليطهما على مضاعفات مرض السكري التي يسببها الألوكسان في الفئران. تم استخدام ثمانية وأربعين من ذكور الفئران البيضاء ، وزنها 150 ± 10 جم ، وتم تقسيمها إلى مجموعتين رئيسيتين. المجموعة الأولى : 6 فئران ، تم وضعها كمجموعة ضابطة سلبية ، تغذت على النظام الغذائي الأساسي بينما المجموعة الثانية : 42 فأراً، تم حقنها بواسطة الألوكسان للحث على مرض السكري وتم تقسيمها إلى سبع مجموعات فرعية متساوية. المجموعة الثانية كانت لا تزال تتغذى على الغذاء الأساسى وتبقى مجموعة ضابطة موجبة . والباقي ست مجموعات تغذت على النظام الغذائي الأساسي الذي يحتوي على 2.5 و 5٪ من مسحوق أوراق الزيتون والمانجو وكذلك خليطهم. تسبب معالجه الحيوانات بالالوكسان في زيادة معنوية ($p\leq0.05$) في تركيز الجلوكوز في الدم بنسبة 156.22 ٪ مقارنة بالمجموعه الضابطه السالبه .بينما المكملات الغذائية للفئران مع 2.5. و 5٪ من مسحوق أوراق الزيتون والمانجو بالأضافه إلى خليطهما أدى إلى تقليل هذه النسبه بمعدل -20.68 و -30.13 و -37.68 و -42.18 و -47.21 و -56.30٪ على التوالي. تم تسجيل نفس الموقف بالنسبة لإنزيمات للكبد (ALT و AST و ALP) ووظائف الكلى (اليوريا وحمض البوليك والكرياتينين) في الفئران المصابة بداء السكري تم تحفيزها بمعدلات مختلفة نتيجة تكميل النظام الغذائي بأجزاء النباتات المذكوره. يمكن أن تُرجع كل هذه التأثيرات بشكل أساسي إلى الأنشطة المضادة للأكسدة القوية لهذه الأجزاء النباتية نتيجة لمحتواها العالي من المركبات النشطة بيولوجيًا. لاستخدام كلا من أوراق الزيتون والمانجو لعلاج المضاعفات الناجمة عن مرض السكري من النوع 2.

الكلمات المفتاحية: أرتفاع سكر الدم ، وزن الجسم ، وظائف الكلى ، وظائف الكبد، الهيموجلوبين