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Potential effect of some fruit leaves to reduce weight in obese experimental animals

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Abstract

This study was carried out to evaluate the effect of different levels of mulberry(*Morus alba*) ,fig(*Ficus carica*),olive *(Olea europaea*) leaves as a source of anti-oxidant and phenolic compounds on body weight gain (BWG), food intake, feed efficiency ratio, lipid profile, kidney and liver function on obese rats. Fourty male albino rats(Sprague dawley strain) weighting 170±3 were divided into two main groups; the first group (5rats) fed basal diet used as negative control group.The second group (35 rats) obese rats were divided into 7 sub-groups (5per each); group (1) was fed on high fat diet(positive control group +ve), group 2,3) were fed on high fat diet containing 2.5% and 5 %, dried mulberry leaves respectively. group 4, 5 were fed on high fat diet containing 2.5% and 5 %, dried fig leaves respectively group 6, 7 were fed on high fat diet containing 2.5% and 5 %, dried olive leaves respectively.The result revealed that,All treated groups showed a significant decreace. BWG, FER, FI, T.G, cholesterol, LDLc, VLDLc, liver enzymes (ALT, AST and ALP), uric acid, urea and creatinine. However, all treated groups showed a significant increased HDLc as compared with positive control group.it could be concluded that consumption of olive leaves 5% has a best significant treatment effect to improve lipid profile, kidney, liver function in obese rats

Keywords: mulberry, fig and olive, leaves,lipid profile, liver, kidney function, Obesity.rats.

1-INTRODUCTION

Obesity has become the first non-infectious inflammatory disease in the history of mankind. It is defined as an excessive or abnormal accumulation of adipose tissue that may impair health **(WHO, 2006).**

Obesity as part of metabolic syndrome is a major lifestyle disorder throughout the world. Current drug treatments for obesity produce small and usually unsustainable decreases in body weight with the risk of major adverse effects. Surgery has been the only treatment producing successful long-term weight loss **(Brown *et al., 2015)***.

Obesity is associated with chronic diseases such as fatty liver, type 2 diabetes, cardiovascular disease, and severe metabolic syndrome. Among these complications related to obesity, non-alcoholic fatty liver disease (NAFLD) leads to increase morbidity and mortality in obese condition. Obesity causes impairment of metabolic regulation including oxidative stress and the lipogenes is pathway, which lead to an excessive accumulation of triglycerides (TG) in hepatic tissues. NAFLD is a common chronic liver disease that includes fibrosis, steatosis, hepatocellular ballooning, and inflammation (**Hey-Mogensen *et al.*, 2012)**

Chang *et al.* (2016) reported that the orally administering MLE (mullerry leaf extract) significantly reduced body weight gain and lipid accumulation in the liver and serum/hepatic triglyceride and total cholesterol levels compared with those in the HFD group. Therefore, the mulberry leaf may be used as a dietary supplement in patients with certain diseases with obesity involvement

The botanical features of (*Ficus carica L*)revealed its wide variety of chemical constituents, its use in traditional medicine as remedies for many health problems, and its biological activities. The plant has been used traditionally to treat various ailments such as gastric problems, inflammation, and cancer. Phytochemical studies on the leaves and fruits of the plant have shown that they are rich in phenolics, organic acids, and volatile compounds **(Mawa *et al*., 2013).**

Boudhrioua *et al.*, (2009) reported that the olive tree (*Olea europaea* L.) is a plant characteristic of the Mediterranean region that is cultivated in various countries of the world due to the great interest in the production of olives and their oil, which is rich in essential fatty acids. The leaves of the olive tree are an important by-product generated by pruning of trees that have significant amount of phenolic and fatty acids important to health Therefore, the present study was performed to examine the effect of mulberry,fig,olive leaves on lipid profile , kidney function and liver function for obese rats.

2. Materials and Methods

2.1. Materials

- Casein, all vitamins, all minerals, cellulose, choline chloride and methionine, were obtained from El-gomhoria Company, Cairo, Egypt.
- Tallow which used in obesity induction, was obtained from local market of Shebin EL-kom, Menoufia, Egypt.
- The kits were supplied by Bio Diagnostics Company Cairo, Egypt.
- *Ficus carica L., Morus alba L and Olea europaea L.* were obtained from *Agricultural Research Center,2019 crop.*
- A total number of 40 albino rats (Sprague dawley strain) were purchased from Bio-diagnostic Co., Giza, Egypt. The average weight was (170g±3)g each

2.2. Methods

2.2.1. Induction of obesity:

This study was carried out on thirty-five albino rats (Sprague dawley albino strain). rats weighing 170±3 g body weight Basal diet (AIN-93M) was prepared according to **AIN (1993**) which provide about 9.5% of its energy from fat (40 g corn oil/kg diet). In order to induce obesity, High Fat Diet (HFD) was used in which at least45% of its energy comes from fat as reported by **Young and Kim (2016).** Basal diet was modified to contain 40 g corn oil + 200 g ghee/kg diet and the amount of add saturated fat was substituted from the amount of corn starch.

2.2.2. Preparation of mulberry ,fig ,olive leaves:

The mulberry, fig and olive leaves were air dried then milled using electric grinding machine to make powder.

2.2.3. Experimental design and animal groups

The experimental was done in the Faculty of Home Economics, Menoufia University, Shebin El-kom. Fourty white male albino rats, (Sprague dawley strain)weighting 170±3 g. were used in the study. The animals were obtained from Medical Insects Research Institute, Dokki, Cairo, Egypt. All rats were fed on basal diet which prepared according to **Reeves *et al.*, (1993)** for 7 consecutive days. After this adaptation period, rats are divided into two main groups; the first group (5rats) fed basal diet used as control negative group. The second group (35 rats) obese rats were divided into 7 groups (5per each) group (1), fed on high fat diet, served as positive control group, group ,(2,3) group of obese rats fed on dried mulberry leaves as a powder by 2.5%,5% respectively of basal diet (4, 5) group of obese rats fed on dried fig leaves as a powder by 2.5%,5% respectively of basal diet. Group, (6, 7) are obese rats fed on dried olive leaves as a powder by 2.5%,5% respectively of basal diet. During the experimental period, the body weight and food intake were estimated weekly and the general behavior of rats was observed. The experiment period was 28 days, at the end of the experimental period, each rat weight of separately then, rats are slaughtered and blood samples collected. Blood samples were centrifuged at 3000 rpm for ten minute to separate blood serum, which was then kept in deep freezer (-20°C) till using.

2.2.4. Biological evaluation:

Biological evaluation of the different tested leaves powder was carried by determination of food intake (FI), weight of rats in the (initial, mid and final of the experiment), body weight gain % (BWG %) and organs weight / body weight% according to **Chapman *et al.*, (1959)** using the following equations:

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

$$\text{Organ weight / body weight \%} = \frac{\text{Organ weight}}{\text{Final weight}} \times 100$$

$$\text{FER} = \frac{\text{Grams gain in body weight}}{\text{Grams food consumed}}$$

2.2.5. Biochemical analysis:

Serum total cholesterol, triglyceride (TG) and high density lipoprotein (HDLc) were determined by using methods of **Allain *et al.* (1974), Fossati and prencipe (1982) and Lopez-Virella (1977),** respectively.

Low density lipoprotein cholesterol (LDL_C) and very low density lipoprotein cholesterol ($VLDL_C$) were calculated according **to Lee and Nieman (2019)** as follows: VLDLv= TG/5 and LDLc= TC – (HDLc + VLDLc).

Alanine amino transferase (ALT), aspartate amino transferase (AST) and alkaline phosphatase (ALP) were determined according to **Tietz (1976) Henery(1974) and Haussament (1977)** respectively.

Uric acid, urea and creatinine were determined in serum according to **Fossati and Prencipe (1982), Malhotra (2003) and Chary and Sharma (2004)** respectively.

2.2.7. Statistical analysis:

Data were statistically analyzed using statistical analysis system **(Armitage and Berry, 1987)**. One way analysis of variance (ANOVA) was used to test the variations among groups and post hoc test (Duncan's Test) was used to compare group means.

3. Result and Discussion

Table (1) showed the effect of different levels of mulberry,fig,olive leaves on food intake and Body weight gain and feed efficiency ratio

The results indicated that there was significant ($p \leq 0.05$) increase in FI and BWG of positive control group compared to negative control group. and significant ($p \leq 0.05$) decrease in FER of positive control group than negative control group. Obese rats fed on high fat diets and olive leaves 5% showed improving in body weight and feed intake compared to the positive control group. These results are agreement with

Shen *et al.*, (2014) reported that the OLE(*Olea europaea*) exerts beneficial effects against obesity by regulating the expression of genes involved in adipogenesis and thermogenesis in the visceral adipose tissue of HFD-fed mice

Stephen et al.,(2017)reported that, the ethyl acetate extract (250 and 500 mg/kg) of *F. carica* leaves showed significant effect ($p < 0.005$) in the levels of body weight and hepatic glycogen

peng et al .,(2011) indicated that male hamsters on high fat diet when fed with aqueous mulberry leaf extract had significantly lower body weight

Table (1): Body weight gain (g), food intake (g/day) and food efficiency ratio (FER) of negative control and obese rat groups

Groups \ Variables		Daily Food Intake (g)	Body Weight Gain (%)	Feed Efficiency Ratio (FER)
		mean±SD	**mean±SD**	**mean±SD**
(1)Control (-ve)		**14.72 e±1.21**	**8.31b±1.03**	**0.076a±0.01**
(2)Control (+ve)		**18.88 a±1.41**	**12.75a±1.10**	**0.035e±0. 04**
(3) Mulberry leaves	**(2.5%)**	**17.47 b±1.08**	**-15.59c±1.29**	**0.038e±0.02**
(4) Mulberry leaves	**(5%)**	**16.70 c±1.11**	**-17.49e±1.37**	**0.041d±0.01**
(5)Fig leaves	**(2.5%)**	**17.29 b±1.17**	**-16.31d±1.59**	**0.045d±0.04**
(6)Fig leaves	**(5%)**	**15.99d±0.45**	**-19.24f±1.85**	**0.053c±0.03**
(7)Olive leaves	**(2.5%)**	**16.34c±1.35**	**-15.26c±1.26**	**0.064b± 0.02**
(8)Olive leaves	**(5%)**	**15.05e±1.31**	**-16.11d±1.35**	**0.069b± 0.02**

-All values represented as mean±SD.

- Means with different superscript letters in the same column are significantly different at (p≤0.05).

Data of table (2) illustrate the effect of mulberry ,fig and olive leaves on lipid profile of obese rats. The mean values of serum T.C and T.G in positive control groups were (156.47±11.26 and 134.98±8.37 mg/dl), respectively, being significantly higher (p≤0.05) when compared to the corresponding values in negative control group which were (90.63±4.19 and 64.26±5.69 mg/dl, respectively. All treated obese groups showed significant decrease (p≤0.05) for TC when compared to positive control group.The lowest significant decrease (p≤0.05) was recorded for group 8 which fed on 5%olive leaves which was 110.65±1.62 and 90.98±2.17 mg/dl for TC and TG, respectively.

Similar results were obtained by ***Botsoglou et al.,* (2012)** who reported olive leaf to includes some medical compounds having hypocholesterolemic properties

***Covas et al.,*(2006)** showed that the olive leaf extract actively reduced the serum cholesterol and triglyceride levels. It was shown that the olive polyphenols can protect the LDL particles from oxidation.

***Fatemi et al.,* (2007)** reported the properties making the hydro-extracts of fig leaf a potentially safe intervention to modulate postprandial hyperlipidemia

Table (2) Serum Lipid profile in negative control and obese rat groups treated with some experimental natural leaves at the end of study

Variables / Groups		TC mg/ dl	TG mg/dl	HDLc mg/dl	VLDLc mg/dl	LDLc mg/dl
(1) Control (-ve)		**90.63f±4.19**	**64.26f±5.69**	**44.91a±3.71**	**12.85e±1.23**	**32.78f±1.35**
(2)Control (+ve)		**156.47a±11.26**	**134.98a±8.37**	**23.34g±1.31**	**26.99a±1.38**	**106.14a±4.43**
(3) Mulberry leaves	**(2.5%)**	**146.23b±8.33**	**121.74b±5.47**	**29.01f±1.44**	**24.34b±1.22**	**92.88b±2.51**
(4) Mulberry leaves	**(5%)**	**131.51cd±5.29**	**106.83cd±4.23**	**34.32d±1.19**	**21.36c±2.08**	**75.83c±1.63**
(5)Fig leaves	**(2.5%)**	**133.82c±3.18**	**115.54c±3.19**	**31.37de±1.11**	**23.10b±1.11**	**79.35c±1.96**
(6)Fig leaves	**(5%)**	**115.49de±2.36**	**102.25cd±2.11**	**37.49c±2.37**	**20.45c±1.54**	**57.55e±1.75**
(7)Olive leaves	**(2.5%)**	**122.42d± 1.45**	**98.92d±2.57**	**35.33cd±2.33**	**19.78cd±1.73**	**67.51d±1.89**
(8)Olive leaves	**(5%)**	**110.65e±1.62**	**90.98e±2.17**	**40.15b±2.63**	**18.17d±1.15**	**52.33e±1.11**

- All values represented as mean±SD.
- Means with different superscript letters in the same column are significantly different at ($p \leq 0.05$)

At the same table, the results indicated that the mean value of HDL for positive control group was significantly ($p \leq 0.05$) lower than negative control group, which was 23.34±1.31 and 44.91±3.71 mg/dl, respectively. All treated obese rats which received different levels of mulberry; fig and olive leaves showed significant increases ($p \leq 0.05$) when compared to positive control group . The best result was recorded for group 8 which fed on 5% olive leaves

***Rahmanian et al.*, (2015)** reported that the olive leaves extract improved the levels of LDLc and HDLc. Olive leaf lowers blood pressure and blood glucose

***Joerin et al.*, (2014)**results demonstrate that preventive treatment with F. carica significantly improved the lipid profile and decreased adipogenic risk factors in HFD rats most likely mediated through an increase in HDL-C levels

Concerning VLDlc, the results indicated that the mean value of positive control group was significantly ($p \leq 0.05$) higher than negative control group, which were 26.99±1.38 and 12.85±1.23 mg/dl. The different levels of VLDL in groups of mulberry, fig and olive leaves were decreased significantly ($p \leq 0.05$) in serum when compared to positive control group. It could be noticed that the mean value of obese rats group fed on olive leaves 5 ml was lower than positive control group which was 18.15±0.00 and 26.99±1.38 mg/dl, respectively. So the best result was recorded for group (8)

In agreement with these finding ***Waterman and lockwood*** **(2007)** reported that the antioxidant capacity of Olive leaf contributes to many health benefits. The in vitro antioxidant action of Olive has been documented and linked to such benefits as chemoprotection, anti-inflammatory action and prevention of atherosclerotic plaque formation.

As for LDLc, the results showed that the mean value for positive control group was significantly higher than negative control group, which were 106.14±4.43 and 32.87±1.35 mg/dl, respectively. Rats which received different levels of mulberry,fig and olive leaves were decreased significantly ($p \leq 0.05$) in serum LDL level when compared to positive control group. It could be noticed that the mean value of group 8 was lower than positive control group which was 52.33±1.11 and 106.14±4.43 mg/dl, respectively.

Patil et al., **(2012)**reported that, the hypolipidemic and preventive effects of Ficus carica leaf extract (50 or 100 mg/kg for 6 weeks) were studied in hyperlipidemia in high fat diet-induced obese male rats. *Ficus carica* leaf extract significantly lowered TG and IL-6 levels and elevated HDL cholesterol ($p < 0.05$)

Xu et al., **(2017)** The leaf hydroethanolic extract of *Morus alba*, when administered for 12 weeks in animals receiving a HF diet at a dose of 200 mg/kg of body weight, was responsible for reducing serum lipids

EL,S.N. and Karakaya (2009) reported that the Olive oil, the olive fruit and its leaves contain the phenolic compound oleuropein, which is known to be responsible for most of the characteristic therapeutic effects. Therapeutic uses of the olive leaves date back centuries. As extracts, herbal teas and powders, they have long been used to treat various conditions such as internal infections, cardiovascular diseases and chronic and degenerative disorders

Table (3) showed the effect of mulberry, fig and olive leaves on ALT, AST and ALP of obese rats.

For ALT, the results indicated that the mean value of positive control group was significantly higher ($p \leq 0.05$) than that of negative control group, which was 110.96 ±5.38 and 63.24±2.52 U/L. The mean values of treated obese groups showed significant decrease ($p \leq 0.05$) when compared with positive control group. There are non-significant ($p \leq 0.05$) differences between control positive group and group 3. Numerically, the best mean value was recorded for group 8 (5% olive leaves) when compared to control positive group.

Similar results were obtained by **Domitrović et al.,(2012)** reporting that oleuropein administration has hepatoprotective and therapeutic effects on carbon tetrachloride-induced liver damage in mice.

Assy *et al.*, (2009) showed that the olive oil may be helpful in reducing the progression of non-alcoholic fatty liver disease (NAFLD), a pathological condition in which fatty infiltration in the liver exceeds 5%–10% of its weight.

As regard to AST, the data indicated that the mean value of positive control group was significantly higher (p≤0.05) than the mean value of negative control group, which was 251.27±8.63 and 132.11±5.18 UL, respectively. The mean values of treated obese groups indicated a significant decrease (P≤0.05), when compared with positive control group.

Elgebaly *et al.*, (2018) reported the protective effect of oleuropein- and hydroxytyrosol-rich extracts from olive leaves against BPA-induced lipid accumulation and liver injury in male rats and elucidate the molecular mechanism by which they regulate cellular inflammation.

Table (3) Serum some liver function in negative control and obese rat groups treated with experimental natural leaves at the end of study

Groups \ Variables		ALT (U/L)	AST (U/L)	ALP(U/L)
(1)Control (-ve)		**63.24e±2.52**	**132.11g±5.18**	**90.66f±2.39**
(2)Control (+ve)		**110.96a±5.38**	**251.27a±8.63**	**163.81a±5.12**
(3)Mulberry leaves	**(2.5%)**	**102.33a±3.33**	**222.15b±3.11**	**148.08b±3.42**
(4)Mulberry leaves	**(5%)**	**95.14bc±2.65**	**199.92c±2.28**	**139.31cd±3.11**
(5)Fig leaves	**(2.5%)**	**98.38b±2.81**	**195.45bc±2.37**	**144.44c±3.27**
(6)Fig leaves	**(5%)**	**87.72c±1.29**	**186.16d±2.56**	**132.18d±3.44**
(7)Olive leaves	**(2.5%)**	**80.66cd±1.42**	**165.08e±2.11**	**128.77de±3.54**
(8)Olive leaves	**(5%)**	**71.53d±1.75**	**151.21ef±2.92**	**99.15e±2.33**

- All values represented as mean±SD.
- Means with different superscript letters in the same column are significantly different at (p≤0.0)

Concerning to ALP, the data indicated that the mean value of positive control group was significantly higher (P≤0.05) than negative control rats, which was 163.81±5.12 and 90.66±2.39 U/L, respectively. It could be noticed that the mean values of treated obese groups showed significant decreases (p≤0.05) as compared to positive control group. The best result was recorded for group (8) which fed on 5% olive leaves diet when compared to control positive group.

Hamad (2015) showed that, olive leaf extract had very high phenol content and possess strong antioxidant activity and significant effect on liver damages induced by CCl4 administration, which resulted in improved serum ALT , AST and ALP activities and increased serum total antioxidant capacity in comparison with CCl4 treated group. So, the improving effect of olive may related to its antioxidant activity

MLE(mulberry leaves) has beneficial effects on obesity-related fatty liver disease by regulation of hepatic lipid metabolism, fibrosis, and antioxidant defense system. MLE supplementation might be a potential therapeutic approach for obesity-related disease including non-alcoholic fatty liver disease **(Ann *et al.*, 2015)**.

Table 4 results the effect of mulberry, fig and olive leaves on urea, uric acid and creatinine of obese rats.

For urea, it could be noticed that the mean value of urea (mg/dl) of control negative group was lower than control positive group, it was being 33.94±2.64 and 59.29±3.72 (mg/dl), respectively. All kidney disorder rats fed on various diets showed significant decrease ($p \leq 0.05$) in mean values as compared to control positive group .There were non-significant differences ($p \leq 0.05$) between control positive group and groups 3,5. Also there are non-significant differences ($p \leq 0.05$) between groups (4, 6 and 7). Numerically, the lowest mean value of serum urea (mg/dl) recorded for group 8 (5% olive leaves) when compared to control positive group.

HSM (2016) reported that, the olive leaf extracts increased levels of antioxidant enzymes and decreased levels of MDA, serum creatinine and urea in all treated groups

Table(4) Serum renal functions in negative control and obese rat groups treated with some experimental natural leaves at the end of study

Groups \ Variables		Urea mg/dl	Uric acid mg/dl	Creatinin mg/dl
(1)Control (-ve)		33.94e± 2.64	1.72e±0.11	0.53e±0.01
(2)Control (+ve)		59.29a± 3.72	3.78a±0.15	1.16a±0.11
(3) Mulberry leaves	(2.5%)	54.09a± 1.12	3.41a±0.43	1.09a±0. 15
(4) Mulberry leaves	(5%)	49.56b± 1.76	3.08b±0.27	0.95bc±0.91
(5)Fig leaves	(2.5%)	54.56a± 1.33	3.35a±1.38	0.99b±0.31
(6)Fig leaves	(5%)	47.92bc± 1.67	2.70bc±0.18	0.81cd±0.17
(7)Olive leaves	(2.5%)	49.88b± 1.89	2.56c±0.64	0.85c±0.43
(8)Olive leaves	(5%)	44.71c± 1.47	2.25d±0.14	0.72d±0. 23

- All values represented as mean±SD.
- Means with different superscript letters in the same column are significantly different at ($p \leq 0.05$).

For uric acid, it could be noticed that the mean value of uric acid (mg/dl) of control negative group was lower than control positive group, being 1.72±0.11 and 3.78±0.15 (mg/dl), respectively. All kidney disorder rats fed on various diets showed significant decrease ($p \leq 0.05$) in mean values as compared to control positive group. There are non-significant differences ($p \leq 0.05$) between positive group and groups (3,5). Also there are non-significant differences ($p \leq 0.05$) between groups (4, 6 and 7). The lowest mean value of serum uric acid (mg/dl) recorded for group 8 (5% of olive leave) when compared to control positive group.

Al-Attar *et al.,(*2017) showed that, the administration of (olive leaves extract) can prevent severe alterations of renal haematobiochemical markers and disruptions of its histological structure.

Butt *et al.,* (2008) indicated that the methanolic extract of *M. alba* at doses of 200, 400 and 80mg/kg mice BW exhibited antischistosomal activity in mice as showed by elevation in GSH level and reduction in both of nitrite/nitrate and MDA levels in the renal and testicular tissues of treated mice besides that plasma uric acid level is significantly reduced

For creatinine, the data revealed that the mean value of positive control group was higher than negative control group, which was 1.16±0.11 mg/dl and 0.53±0.01 mg/dl. It could be noticed that the best effect was detected in the group (8) which fed on 5% of olive leave, being 0.72 ± 0.23 (mg/dl).

Laaboudi *et al.,* (2016) confirmed that the administration of OLE decreased the levels of creatinine, urea and uric acid

Al-Janabi et al., (2013) showed that the use of olive leaves extract improved the levels of blood glucose, albumin, total protein and creatinine

Ghafoor *et al.,* (2015) showed *Ficus carica* leaf extract treated animals showed significant reduction in biochemical markers of kidney functions.

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التاثير القوي لبعض اوراق الفاكهة لخفض الوزن في حيوانات التجارب السمينة

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الملخص العربى :

أجريت هذة الدراسة لتقييم تأثير مستويات مختلفة من اوراق التوت والتين والزيتون علي الفئران المصابة بالسمنةلغناهم بمضادات الأكسدة والمركبات الفينولية وتم دراسة تأثيرهم علي كل من معدل الوزن المكتسب والمأخوذ من الطعام ومعدل الإستفادة من الغذاء ودهون الدم ووظائف الكلي والكبد. حيث اجريت الدراسة على اربعون من فئران التجارب البالغين وتم تقسيمهم الي مجموعتين رئيسيتين. ووضعت المجموعة الرئيسية الأولي كمجموعة ضابطة سالبة بينما المجموعة الرئيسية الثانية كانت مكونة من 35 فأر تم إصابتهم بالسمنة ثم تقسيمهم الي 7 مجاميع حيث وضعت المجموعة الأولي كمجموعة ضابطة موجبة بينما المجموعة الثانية والثالثة تم تغذيتها علي الوجبة الأساسية مخلوطة بورق التوت بتركيز 2.5% و 5 %. والمجموعة الرابعة والخامسة علي الوجبه الأساسية مخلوطة بورق التين بتركيز 2.5 %و5 %. والمجموعة السادسة والسابعة علي الوجبه الأساسية مخلوطة بورق الزيتون بتركيز 2.5 %و5 %. وأوضحت النتائج أن تناول كل من ورق التوت والتين والزيتون أدي الي إنخفاض معنوي في بعض التحاليل مثل معدل إكتساب الوزن – الغذاء المأكول – معدل الإستفادة من الغذاء – التراي جلسريد – الكوليسترول – الليبروتينات منخضة الكثافة - الليبروتينات منخضة الكثافة جدا– ووظائف الكبد (ALT-AST-ALP) – ووظائف الكلي. ولكن مع ارتفاع معنوي في الليبوبروتينات مرتفع الكثافة وذلك عند مقارنتهم بالمجموعة الضابطة الموجبة وقد امكن استنتاج ان الغذاء المحتوى على 5%اوراق الزيتون تحسن بوضوح حالة الدهون ووظائف الكبد والكلى

الكلمات الأفتتاحية: ورق التوت – ورق التين- ورق الزيتون – دهون الدم– وظائف الكبد والكلى- السمنة – فئران.