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Therapeutic Effect Of Isabgol And Sage On Obese Rats.

Adel Abdel-Moaty, Hamdia Ahmed Helal, Basma Ramadan El-khatib, Reham Hamdi Assar
Nutrition and Food Sciences Dep. Faculty of Home Economics, Menoufia University.

Abstract : Obesity is considered as one important risk factor for many health problems. *Salvia officinalis* is proven to have benefit in cases of hypercholesterolemia, diabetes and obesity. Also, Plantago ovata is believed to have effects on many diseases that affect the body including obesity. This study aims to assess the effect of both *Salvia officinalis* and *Plantago ovata* on weight loss using obese rats with an evaluation of their effects on serum lipids, liver and kidney functions in different levels of concentration. Forty eight male albino rats weighing 150±2g were divided into eight groups and administered *P. ovata* and *S. officinalis* at different levels daily for 28 days. Blood samples were taken from each rat and centrifuged at 3000 rpm for 20 minutes. Serum was separated and stored at -20 degree C until biochemical estimations were carried out then the samples were analysed for HDL. LDL. VLDL , liver enzymes and kidney functions. Results showed that HDL-c levels were significantly increased in the treatment groups, while LDL-c levels were decreased significantly as compared to control positive. Liver enzymes (ALT and AST) were significantly decreased in all treatment groups compared to control positive. Also, concerning uric acid and urea nitrogen, the levels were reduced compared to control positive. Treating obese rats with different levels of *P. ovata*, *S. officinalis* and a mixture of them caused significant improvements in the biochemical measures and the best results seems to be recorded for the mixture diet 7,5% *P. ovata* and *S. officinalis* are useful for obese patients regarding prevention of heart diseases and hardening of arteries.

Key words: Obesity, Obese rats, *P. ovata, S, officinalis*, Isabgol, Sage, Lipid profile, liver,kidney functions.

Introduction

Obesity is an excess of body fat that frequently results in significant impairment of health (World health Organization (2014). It is most commonly caused by a combination of excessive food energy intake, lack of physical activity, and genetic susceptibility. Despite that, few cases are caused primarily by genes, endocrine disorders, medications or psychiatric illness (Kushner, 2007 and Ezekiel., 2009). Obesity increases the risk of death and causes many physical and mental conditions, and medical disorders which include: Cardiovascular diseases, diabetes mellitus type two, high blood pressure, high blood cholesterol and high triglyceride levels (Dixon and Brien, 2002; Sahib *et al*., 2012).

Plantago species are often used as herbal remedies for many diseases (FAO, 2007). *Plantago ovata* seed is useful for constipation, irritable bowel syndrome, dietary fiber supplementation and diverticular disease. Recent research is showing that it is promising in lowering serum cholesterol and triglycerides, controlling diabetes and helping in weight loss. (Anderson *et al.* 1999; Kang *et al.,* 2007; Wei *et al.,* 2009).

Salvia officinalis is asmall perennial evergreen subshrub, with woody stems, greyish leaves and blue to purplish flowers. A member of the family Lamiaceae. It has a long history of medicinal and culinary use (Anon, 2012). The methanolic (MeoH) extract from the leaves of *Salvia officinalis* showed significant inhibition of pancreatic lipase activity, and suppressed serum triglyceride (TG) elevation in olive oil loaded mice, and it also showed a decrease in serum glucose in type I diabetic rats. The extract from *Salvia officinalis* leaves showed inhibitory effect against Pancreatic lipase activity and eventually was effective in reducing body weight and obesity (Ninomiga *et al*., 2004).

Materials and methods

Source of materials

Sage (*Salvia officinalis*) and psyllium(*Plantago ovate*) were purchased from the local market (Haraz company) at Cairo city.

Experimental animals

Forty eight adult male albino rats weighed 150 (2g) were obtained from Research Institute of Ophthalmology, Medical Analysis Department, Giza, Egypt. Rats were housed in galvanized iron cages measuring (40*24*20 cm) (6 Rats in each cage).

Preparation of samples

The powder of both plants were obtained by grinding the seeds of *P. ovata* and the leaves of *S. officinalis*, and they were added to the basal diet of the tested Rats. Also, water was provided to the rats by

glass tubes. The provided feed and water was checked daily, all rats were fed on basal diet before starting the experiment for acclimatization.

Experimental design

All groups of rats were fed on the experimental diet for 28 days according to the following groups:

Group 1: fed on basal diet as control negative

Group 2: fed on basal diet and high fat diet to induce obesity as control positive.

Group 3: fed on basal diet, high fat diet and 5% *Plantago ovata.*

Group 4: fed on basal diet, high fat diet and 7.5*% Plantago ovata.*

Group 5: fed on basal diet, high fat diet and 5% *salvia officinalis*.

Group 6: fed on basal diet, high fat diet and 7.5% *S. officinalis*.

Group 7: Fed on basal diet, high fat diet and 5% mixture of *S. officinalis* and *P. ovata*

Group 8: Fed on basal diet, high fat diet and 7.5% mixture of *S. officinalis* and *P. ovata*.

Basal diet

(Table A) The basal diet composition .

Ingredient	Basal diet
Corn oil	4
Casein	14
Cellulose	5
Salt mixture	3.5
Corn starch	2 Lp to 100%

According to (AIN, 1993)

(Table B) The composition ofmineral mixture component

Compounds	Mg\kg
K2HPO4	645
CaCO3	600
NaCl	334
MgSO4. 2H2O	204
CaHPO4. 2H2O	150
Fe(C6H5O7)2. 6H2O	55
MnSO4.4H20	10
Kl	1.6
ZnCl2	.5
CuSO4. 5H2O	.06

According to Hegsted *et al*., (1941).

(Table C:) Vitamin mixture formulation:

Vitamin	mg/kg
Choline chloride	200
Inositol	5
Para-amino-benzoic-acid	5
Niacin	4.5
Calcium panthoenic acid	3
Vitamin K menadione	2.25
Pyridoxine	1
Folic acid	.02
Biotin	.02
Vitamin B	.00135
Corn starch	779.2

According to Muller (1964)

Induction of obese rats

Rats were kept for four weeks on high fat diet to induce obesity. High fat diet prepared from fine ingredients per 100 gram according to the following composition: Fat 30% (Tallow 15% + corn oil 15%); Casein (protein) 12%; salt mixture 4%; vitamin mixture 1%; Fiber 5%; D1 methionine .3; choline chloride 2%; bile acid .2; and corn starch up to 100g according to (AIN ,1993).

Biological Evaluation

The different biological parameteic were carried out by determinationof body weight gain (BWG), feed intake from diet, feed efficiency ratio (FER) and relative organ weight according to Champan *et al*., (1959) **Using the following formula:**

Body weight gain% (BWG) = (Final weight – initial weight / initial weight) * 100

Food efficiency ratio (FER) = Gain in body weight (g) / feed intake (g)

Relative organ weight (ROW) = (organ weight / animal body weight) * 100

Blood sampling

Blood samples were collected after 12 hours fasting at the end of the experiment, using the retro orbital method by means of micro capillary glass tubes. Blood was collected into a dry clean centrifugal tube and left to clot in a water bath (37 degree C) at room temperature for half an hour. The blood was centrifuged for 10 minutes at 3000 rpm to separate the serum in clean glass well stoppered tubes, and stored and keptat (-20 degree C) until analysis (Schermer, 1967).

Analytical methods

Determination of liver functions

Alanine Aminotransferase (ALT) and Aspartate Aminotransferase (AST) were determined according to the method of Tietz (1976), Henry (1974) respectively.

Determination of kidney functions

a) Determination of urea nitrogen: Urea was determined according to the enzymatic method of (Fatwett-kand and Socett, (1960)as given by Schultz (1984).

b) Determination of uric acid:uric aced was determined by enzymatic colorimetric test kit according to Fossati andPrencipe (1982).

Determination of serum lipids

- Determination of serum triglycerides (T.G) was carried out according to the method of wahlefeld (1974).

- Calculation of very low density lipoprotein cholesterol was carried out by the equation published by Friedwald *et al*., (1972) as follows: VLDL = T.G/ 5

- High density lipoprotein cholesterol (HDL) was determined colorimetrically according to Richmond (1993).

- Total cholesterol (T.C) was determined according to the method described by Trinder and Ann (1969).

- Low density lipoprotein cholesterol (LDL) was calculated using the equation given by

- Fredweld *et al*., (1972) as follows: LDL= T.C – (VLDL + HDL).

Statistical analysis

The data was analyzed using a completely randomized factorial design SPSS(1998) when a significant main effect was found, the means were separated with the student New man keuls test. Differences between treatments (P less or equal .05) were considered significant using Costat Program. Biological results were analyzed by one way classification ANOVA.

Results and discussion

The effect of feeding different levels of *Plantago ovata* and sage (*Salvia officinalis*) on feed intake, feed efficiency ratio and body weight gain are shown in table.1 and figures 1,2,3. Concerning the feed intake, it was 14.32 ± 1.09 g/day for control positive. However, the feed intake for group 3, 4 and 5 decreased non-significantly compared to control positive, while the same groups 3, 4 and 5 increased significantly compared to control negative The values were 14.14 ± 3.67, 13.14 ± 1.98 and 13.92 ± .98g\day respectively. Also, the feed intake for group 6 and 8 decreased significantly compared to control positive. Finally, group 7 increased significantly compared to control negative and control positive as well.

The feed efficiency ratio was .191 ± .011 for control positive, while the value decreased in the group control negative. Groups 3,4,6,7 and 8 respectively were liss than that of control positive .166 ± .031, .089 ± .008 , .198 ± .017, .120 ± .009 and .091 ± .007 respectively. However, such decrease is statistically significant.

Results of relative body weight gain were 42.27 ± 21.511% for control negative group and increased for control positive group but, decreased for groups 3,4,6,7 and 8 respectively than control positive. The values were 86.038 ± 8.197, 41.486 ± 8.708 , 107.736 ± 5.263, 66.452 ± 9.153 and 41.918 ± 5.75 % respectively. This decrease is statistically significant compended to control (+) and from that we can tell the effect of feeding 5% plantago psyllium, 5% sage and 5% mixture of them on body weight gain. The value were higher in control positive than control negative and in groups3,5,6,7 and 8 decreased than control positive. These results are in the same line with Elsayed *et al*., (2012) who studied the effect of *Salvia officinalis* on obese rats and concluded that the addition of sage to the diet of obese rats decreased the body weight, and increasing the level in feed to 4% will show more reduction in weight than 2% level.

Table (1):Effect of feeding different levels of plants on feed intake, FER and BWG % of obese rats

Diet groups	Parameters Animal Groups	Feed intake (g/day) Mean ± SD	FER Mean± SD	BWG Mean ±SD
Group 1	Control negative	12.214±2.34 ^{c}	0.101±0.020^{d}	42.27±21.511^{e}
Group 2	control positive	14.321±1.09 ^{b}	0.191±0.011^{a}	117.866±7.565^{e}
Group 3	level 5% *p.ovata*	14.143±3.67 ^{b}	0.166±0.031^{b}	86.038±8.197^{c}
Group 4	level 7.5% *p.ovata*	13.142±1.98 ^{b}	0.089±0.008^{e}	41.486±8.708^{e}
Group 5	level 5% *S.officinalis*	13.928±0.98 ^{b}	0.157±0.022^{b}	118.960±17.003^{a}
Group 6	level 7.5% *S.officinalis*	12.642±1.04 ^{c}	0.198±0.017^{A}	107.736±5.263^{B}
Group 7	Mixture level 5%	15.357±4.54 ^{A}	0.120±0.009^{c}	66.452±9.153^{d}
Group 8	Mixture level 7.5%	12.678±2.56 ^{c}	0.091±0.007^{e}	41.918±5.715^{e}

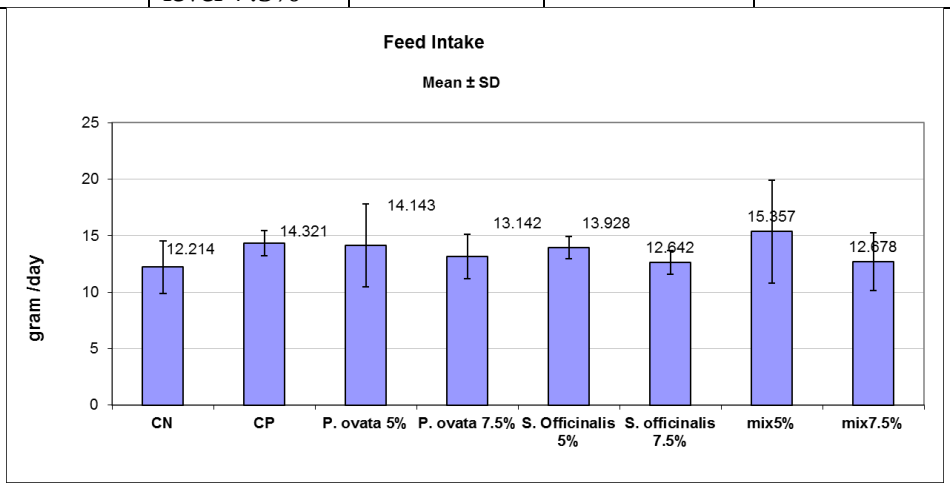

Fig (1): Effect of feeding different levels of plants on feed intake, FER and BWG % of obese rats

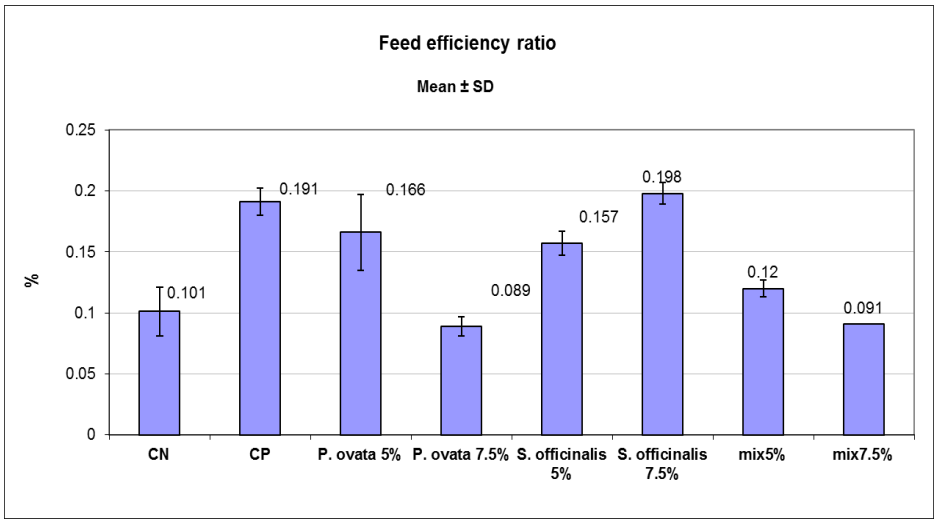

Fig.2 Effect of feeding different levels of plants *(S. Officinalis and P. psyllium* **and a mixture of them at5% and 7.5% level.) on feed efficiency ratio.**

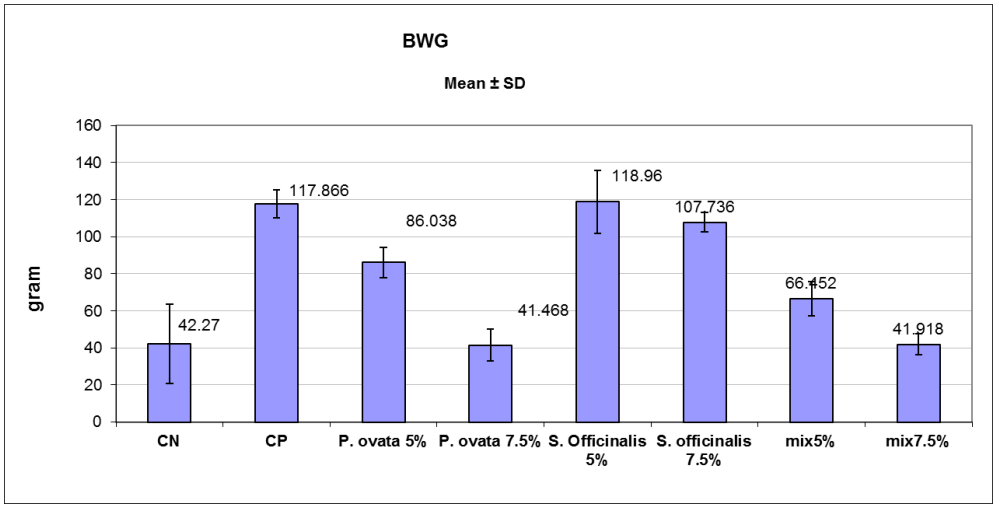

Fig.3 Effect of feeding different levels of plants (*P. ovata, S. officinalis* **5% and 7.5% and a mixture of them on body weight gain.**

Blood lipid profile was affected by feeding 5%. 7.5% Isabgaol , 5%, 7.5% sage and 5%, 7.5% mixture of them. As shown in table 2 and figures 4,5,6,7. The control negative presented a level of 50.58 ± 3.62 mg/dl for HDL-c.while control positive presented a level of 28.38± 5.33 mg/dl, there is a significant difference between control positive and all groups. The values were 48.38±4.36, 50.45±4.08, 50.81±7.63, 49.55±1.64, 52.08±4.16 and 53.46±1.94 mg/dl, respectively. All groups values showed pronounced statistical significance in relation to control positive.

The control negative group showedevel of 15.12±2.74 mg/dl for low density lipoprotein cholesterol LDL-c. Control positive presented a level 134.33±8.07 mg/dl, there is pronounced statistical difference between control positive and groups 3,4,5,6,7 and 8. The values were 100.83±6.59, 46.61±8.58, 90.33±3.71, 58.29±6.61, 102

.43±8.48 and 50.6±4.97 mg/dl respectively. Group 3,4,5,6,7 and 8 showed lower values with statistical differences compared to control positive.

The control negative presented a level of 24.08±.19 mg/dl for VLDL-c. control positive presented a higher level of 43.84±.64 mg/dl, there is no significant difference between Control positive and groups 3,5. The values were 42.08±.76 and 40±.76 mg/dl for past two group. Groups 4,6,7 and 8 showed lower values than control positive. The values were 38.06±.28, 31.62±20.58, 39.8±.94 and 26.42±.57 mg/dl respectively.

These results(table 2) are consistent with the results of Brown *et al.*, (1999) who performed a meta-analysis to quantify the cholesterol-lowering effect of major dietary fibers including pectin, oat bran, guar gum and psyllium and found that various soluble fibers reduced total and LDL cholesterol by similar amounts, but the effect was small within the practical range of intake. Also, Anderson *et al.*, (1999) demonstrated that psyllium supplementation could significantly lower serum total and LDL cholesterol concentrations in subjects consuming a low-fat diet.

The mean values of the ratio between LDL-c/HDL-c of all rats at all levels plantago psyllium, sage and the mixtures of both were decreased significantly (P less than .05), as compared to positive control. The values were 2.08 ±.26, 1.78±.573 and 1.97±.22 mg/dl for groups 3,5,7. Also, the mean values of the ratio between LDL-c/HDL-c of rats for groups 3,6,7 mixture were significantly lower as compared to control positive but not significantly different compared to each other. The values were .923±.19, 1.18±.13 and .95±.008 respectively. The best

mean value of the ratio fo tested groups were observed in the group fed on level 7.5% psyllium.

Table (2): Effect of feeding different levels of plants on HDL-c, LDL-c, VLDL-c and the ratio between LDL-c/HDL-c levels (mg/dl) in obese rats.

	Lipid fraction Animal groups	HDL-c Mean±SD	LDL-c Mean ±SD	VLDL-c Mean±SD	LDL-c/HDL-c Mean±SD
Group 1	**Control negative**	**50.58±3.62^{a}**	**15.12±2.74^{e}**	**24.08±0.19^{C}**	**0.299±0.04^{d}**
Group 2	**Control positive**	**28.38±5.33^{b}**	**134.33±8.07^{a}**	**43.84±0.64^{a}**	**4.73±1.03^{a}**
Group 3	**level 5% *P.ovata***	**48.38±4.36^{a}**	**100.83±6.59^{b}**	**42.08±0.76^{a}**	**2.08±0.26^{b}**
Group 4	**level 7.5% *P.ovata***	**50.45±4.08^{a}**	**46.61±8.58^{d}**	**38.06±0.28^{b}**	**.923±0.19^{c}**
Group 5	**level 5% *S.officinalis***	**50.81±7.63^{a}**	**90.33±3.71^{c}**	**40.00±0.76^{a}**	**1.78±0.573^{b}**
Group 6	**level 7.5% *S. officinalis***	**49.55±1.64^{a}**	**58.29±26.61^{d}**	**31.62±20.58^{c}**	**1.18±0.13^{c}**
Group 7	**Mixture level 5%**	**52.08±4.16^{a}**	**102.43±8.48^{b}**	**39.8±0.94^{b}**	**1.97±0.22^{b}**
Group 8	**Mixture level 7,5**	**53.46±1.94^{a}**	**50.6±4.97^{d}**	**26.42±0.57^{c}**	**.95±0.08^{c}**

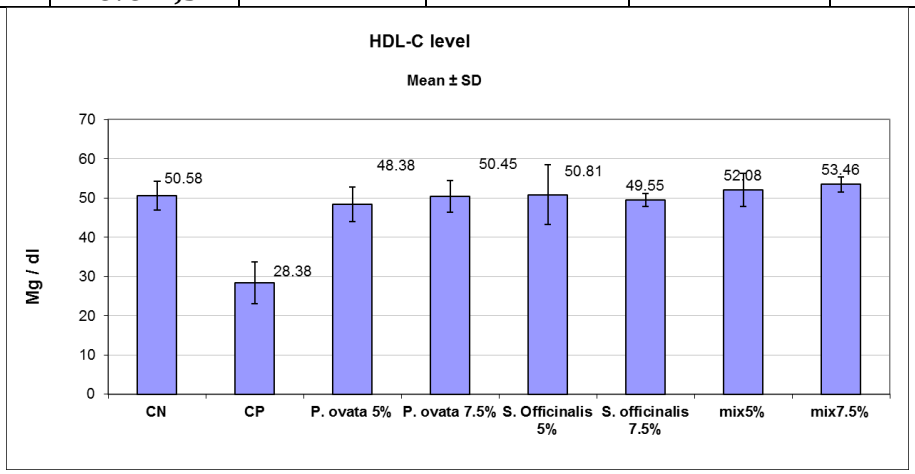

Figure (4): Effect of feeding different levels of plants on HDL-c level on the blood of obese rats

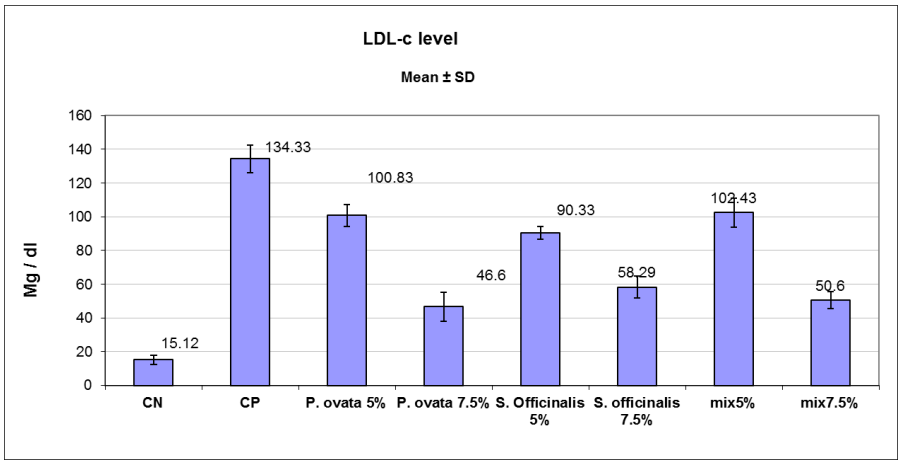

Fig.(5): Effect of feeding different levels of plants on serum LDL-c of obese Rats

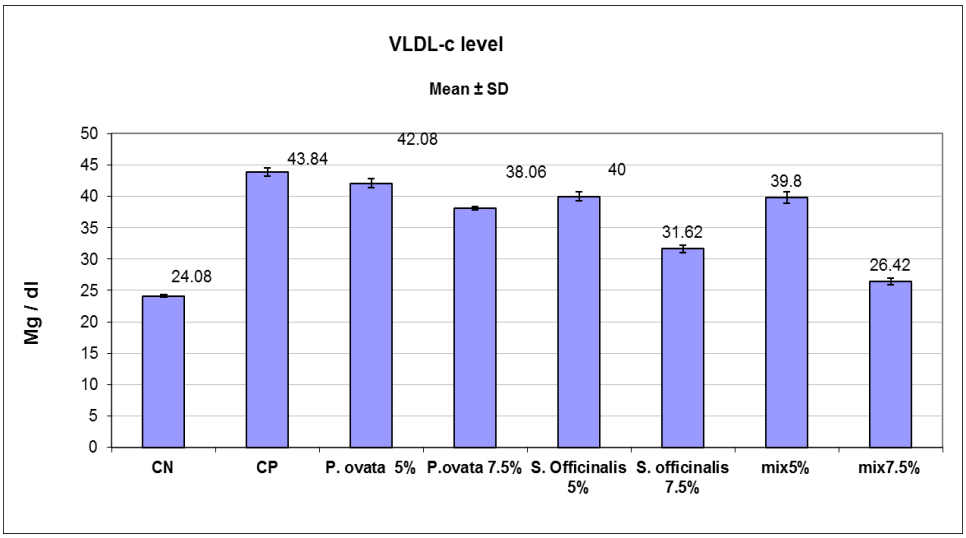

Fig.(6): Effect of feeding different levels of plants on serum VLDL-c (mg/dl) of obese rats

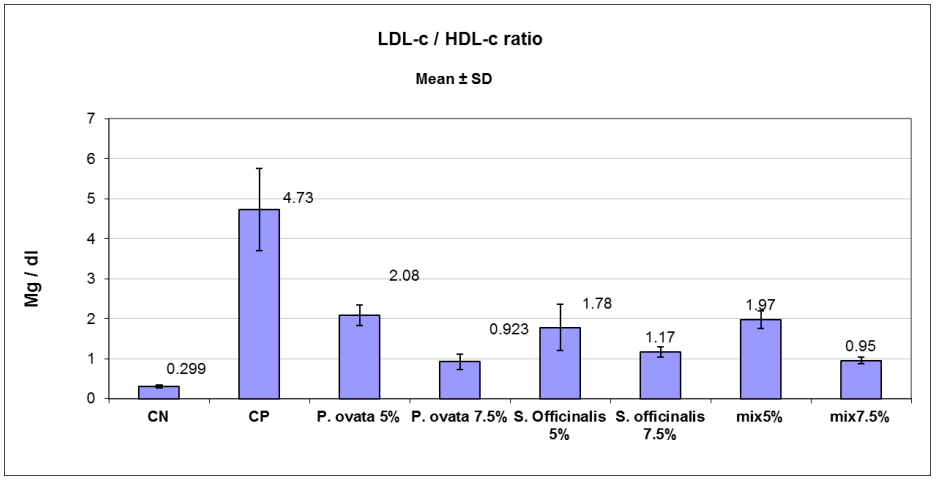

Fig.(7): The effect of feeding different levels of plants on LDL-c/HDL-c ratio of obese rats

The effect of feeding different levels of plants on ALT and AST levels of obese rats is shown in table (3) and figures(8 and 9). The control negative presented a level of 28.06±1.07 U/L for AST, while control positive presented 57.25±5.82 U/L. There is significant difference between control negative and groups 3,4,5,6,7, and 8. The values are 38.66±1.76, 34.87±.42, 47.52±7.22, 32.31±1.8, 45.1± 4.92 and 36.12±.51 U/L. the control negative showed a lower statistical difference compared to the control positive. Control positive group was significantly higher than groups 3,4,5,6,7 and 8. It should be noted that *P. ovata* and *S. officinalis* improved the function of the liver lowering the AST level in the serum which can be attributed to the increase of the fiber content in *P. ovata* and *S. officinalis*.

The control negative group showed a level of 28.51±.94 U/L for ALT, while control positive presented 56.1±1.1 U/L. All the treatment groups showed a statistically significantly lower levels of ALT compared to the control positive groups, the values were 41.29±0.26 , 31.79±2.28 , 45.93±1.25 , 30.44±0.79 , 44.43±1.21 , 28.80±0.48 for groups 3,4,5,6,7 and 8. Lowest level was observed in groups 4,6 and 8component to group 2. The last group Alt did not differ from control negative group but considerably lower than control positive group.

Chlorella vulgaris and silybum marianum have shown efficacy in reduction of ALT and AST levels in patients with liver diseases. Also, silymarin have proven efficacy in reduction of ALT and AST levels in

Alchoholic patients with liver fibrosis (Nikkhajoei et al., 2016). Further studies on human subjects are needed to evaluate the effects of *S. officinalis* and *P. ovata* on ALT and AST levels.

Table (3): Effect of feeding different levels of plants on AST and ALT levels of obese rats.

	Liver functions Animal Groups	AST Mean ± SD	ALT Mean ± SD
Group 1	Control negative	28.06±1.07^{d}	28.51±0.94^{c}
Group 2	Control positive	57.25±5.82^{A}	56.10±1.10^{A}
Group 3	el 5% *P.ovata*	38.66±1.76^{c}	41.29±0.26^{b}
Group 4	level 7.5% *p.ovat*a	34.87±0.42^{c}	31.79±2.28^{c}
Group 5	level 5% *S. officinalis*	47.52±7.22^{b}	45.93±1.25^{b}
Group 6	Level7,5% *S.officinalis*	32.31±1.80^{c}	30.44±0.79^{c}
Group 7	level 5% Mixture	45.10±4.92^{b}	44.43±1.21^{b}
Group 8	level 7.5% Mixture	36.12±0.51^{c}	28.80±0.48^{c}

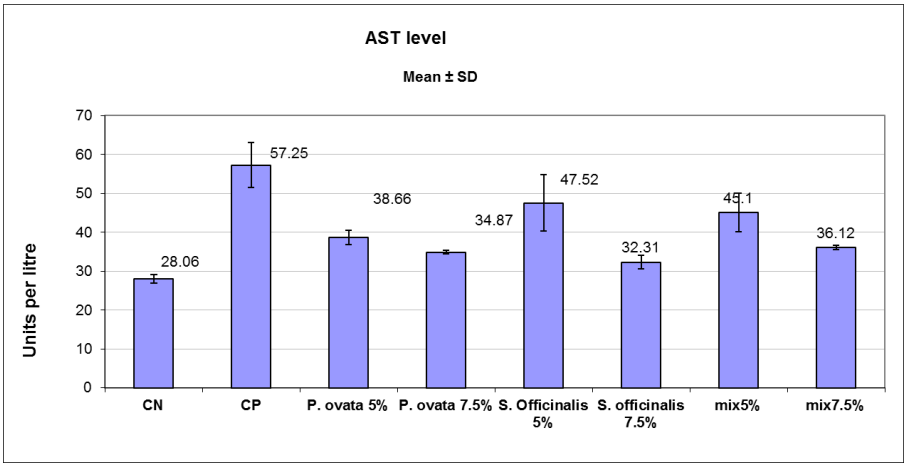

Fig. (8): Effect of feeding different levels of plants on serum AST of obese rats

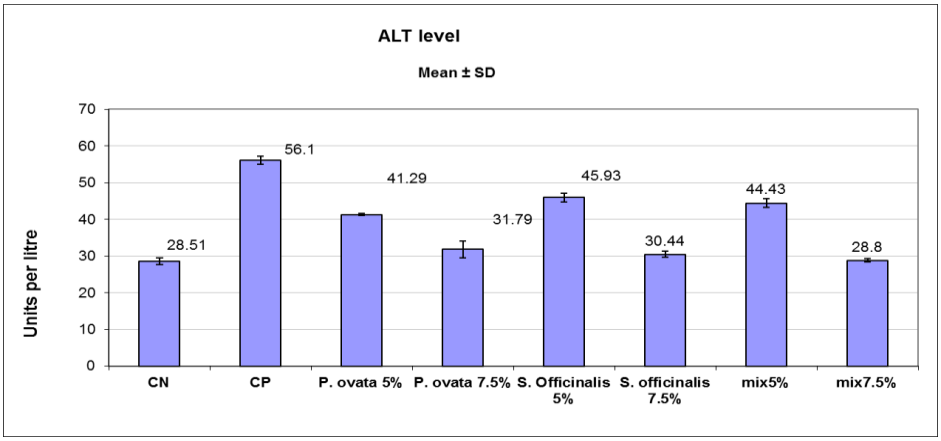

Fig.(9): The effect of feeding different levels of plants on serum ALT levels in obese rats

Kidneys Function

The effect of feeding different levels of plants on uric acid and urea nitrogen levels (mg/dl) of obese rats is illustrated in table (4)and figures (10,11). Concerning uric acid, control negative group showed a level of .85±.11 mg/dl. The groups 3,4,5,6,7 and 8 showed a lower statisticaly different values compared to control positive. The values were 2.74±.09, 1.53±.11, 2.42±.05, 1.71±.15, 2.47±.10 and 1.40±.72 mg/dl, respectively. The control positive group was higher than the control negative group for uric acid level. Also, the control positive group was higher than all groups 3,4,5,6,7 and 8. This indicates that both *S. officinalis* and *P. ovata* can improve kidney functions of obese rats.

For the urea nitrogen levels the control positive group showed a level of 26.6± 2.2, the level significantly decreased in *S. officinalis* 7.5% and *P. ovata* 7.5% and the mixture of them 7.5% with levels of 19.1±.8, 20.9±.6 and 20.1±1.2 respectively. Even though they decreased but non of them significantly reached the level of the control negative. The *P. ovata* 5%, *S. officinalis* 5% and the mix 5% did not differ significantly from the control positive with levels of 24.6±1.4, 24.6±1.9 and 24.1±.9 respectively.

There are a large number of Chinese medicines or the extracted compounds proved to be able to inhibit XOD activity to attenuate production of uric acid. Glabrous greenbrier rhizome, radix puerariae, mangiferin, celery, turmeric, motherwort, berberine, and so forth have been evaluated as active in inhibiting the enzyme XOD. Also, Esculetin

and esculin were found to improve hyperuricemia and renal dysfunction through upregulating OAT1. Through inhibiting GLUT9 or URAT1 in kidneys of hyperuricemic mice (Hao *et al*., 2016). Further studies are needed on human subjects to evaluate the effects of *S. officinalis* and *P. ovata* on kidney functions.

Table (4): Effect of feeding different levels of plants on uric acid and urea nitrogen levels (mg/dl) of obese rats.

	Kidney function Animal Groups	Uric acid Mean ± SD	Urea Nitrogen Mean ±SD
Group 1	Control negative	0.85 ± 0.11^{d}	14.7 ± 0.9^{c}
Group 2	Control positive	3.88 ± 0.12^{A}	26.6 ± 2.2^{a}
Group 3	Level 5% *P. ovata*	2.74 ± 0.09^{b}	24.6 ± 1.4^{a}
Group 4	level 7.5% *P. ovata*	1.53 ± 0.11^{C}	20.9 ± 0.6^{b}
Group 5	level 5%*S. officinalis*	2.42 ± 0.05^{b}	24.6 ± 1.9^{a}
Group 6	level 7.5% *S. officinalis*	1.71 ± 0.15^{c}	19.1 ± 0.8^{b}
Group 7	level 5%Mixture	2.47 ± 0.10^{b}	24.1 ± 0.9^{a}
Group 8	level 7.5% Mixture	1.40 ± 0.72^{c}	20.1 ± 1.2^{b}

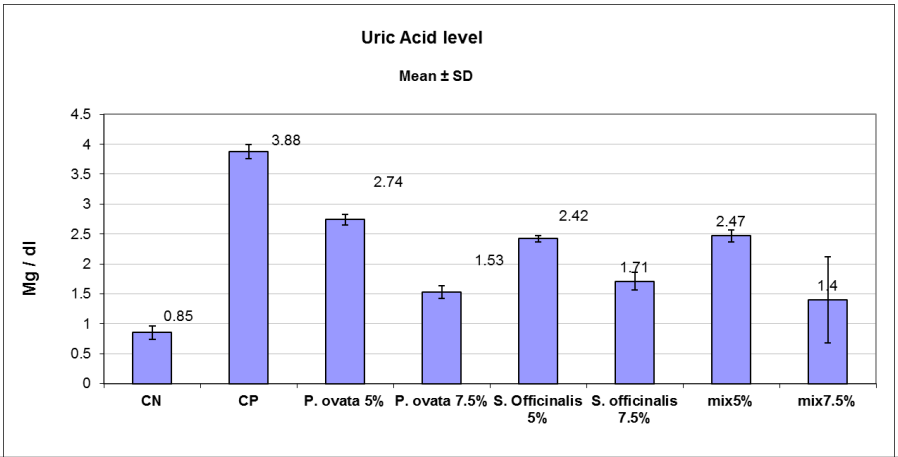

Fig.(10): Effect of feeding different levels of plants on uric acid level in obese rats rats

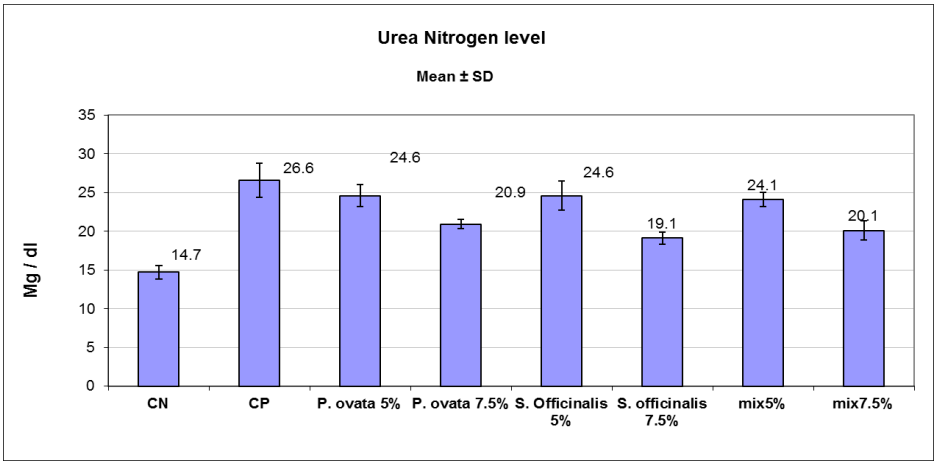

Fig.(11): Effect of feeding different levels of plants on urea nitrogen levels of obese rats

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دراسة التأثيرالعلاجي للقطونة والمريمية على الفئران البدينة

عادل عبدالمعطي أحمد , حمدية احمد هلال, بسمة رمضان الخطيب, ريهام حمدي عصر
قسم التغذية وعلوم الأطعمة – كلية الاقتصاد المنزلي – جامعة المنوفية

المستخلص العربي:

تعتبر البدانة أحد أهم العوامل التي تؤدي الي مشاكل صحية. يوجد بعض الأدلة أن المريمية (قصعية) تقلل من كوليستيرول الدم والدهون الثلاثية والسكر. كذلك أيضا تعتبر القطونة (حشيش البراغيث, اسابجول) أحد النباتات التي لها تأثير إيجابي على الجسم فيما يخص البدانة. تهدف هذه الدراسة الى تقييم تأثير كلا من القطونة والمريمية على البدانة ودهون الدم ووظائف الكبد والكلى في الفئران البدينة.

48 من الفئران الذكور يزن كل منهم 150 جرام (+,- 2 جم) تم تقسيمهم الى 8 مجموعات تحتوى المجموعة على 6 فئران, كل الفئران كانت مصابة بالبدانة ماعدا مجموعة واحدة ليست بدينة تغذت على الغذاء القياسي حتى نهاية التجربة وهى الضابطة السالبة, فى نهاية التجربة بعد 28 يوم تم ذبح الفئران وفصل السيرم بالطرد المركزي, وتم حفظة فى الثلاجة عند درجة -20 درجة مئوية لحين عمل التحاليل البيوكيميائية. تم تقدير نسبة وكذلك نشاط انزيمات الكبد ووظائف الكلي.

HDL-c, LDL-c, VLDL-c

وجاءت النتائج كالتالي: حدثت زيادة معنوية في قيمة ال(أتش دي إل) في المجموعات التى تغذت على القطونة والمريمية وخليطها بنسب 5% و 7.5% , أيضا حدث انخفاض معنوي في قيمة ال(إل دي إل) مقارنة بالمجموعة الضابطة الموجبة وهذا التحسن بسبب وجود مستويات من القطونة والمريمية وخليطهما.

أما بالنسبة للانزيمات الكبدية فقد حدث نقص معنوي لكل من انزيمي ال(أى إل تي) وال (أي إس تي) فى مجموعات الفئران التي تغذت علي القطونة والمريمية وحدث نقص معنوي لحمض اليوريك مقارنة بالمجموعة الضابطة الموجبة.

وتخلص الدراسة بأن استخدام القطونة بنسب 5% و7.5% والمريمية وخليطهما بنفس النسب كانت مفيدة لتحسين دهون الدم ووظائف الكبد والكلي وبالتالى مفيدة فى أمراض القلب والشرايين وخاصة مجموعة 8 خليط 7.5%.

الكلمات المفتاحية:
الكوليستيرول – القطونة – المريمية – فئران – صورة الدهون – وظائف الكبد والكلي. البدانة-