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سعادة أ. د. رئيس تحرير المجلة المصرية للدراسات المتخصصة المحترم

جامعة عين شمس، كلية التربية النوعية، القاهرة، مصر

تحية طيبة وبعد،،،

يسر **معامل التأثير والاستشهادات المرجعية للمجلات العلمية العربية (ارسيف – ARCIF)**، أحد مبادرات قاعدة بيانات **"معرفة"** للإنتاج والمحتوى العلمي، إعلامكم بأنه قد **أطلق التقرير السنوي التاسع للمجلات للعام 2024**.

ويسرنا تهنئتكم وإعلامكم بأن **المجلة المصرية للدراسات المتخصصة** الصادرة عن **جامعة عين شمس، كلية التربية النوعية، القاهرة، مصر، قد نجحت في تحقيق معايير اعتماد معامل "ارسيف Arcif"** المتوافقة مع المعايير العالمية، والتي يبلغ عددها **(32) معياراً**، وللاطلاع على هذه المعايير يمكنكم الدخول إلى الرابط التالي: http://e-marefa.net/arcif/criteria/

وكان **معامل "ارسيف Arcif " العام** لمجلتكم لسنة 2024 **(0.4167)**.

كما صُنفت مجلتكم في **تخصص العلوم التربوية** من **إجمالي عدد المجلات (127)** على المستوى العربي ضمن الفئة **(Q3)** وهي الفئة الوسطى ، مع العلم أن **متوسط معامل "ارسيف" لهذا التخصص** كان **(0.649)**.

وبإمكانكم الإعلان عن هذه النتيجة سواء على موقعكم الإلكتروني، أو على مواقع التواصل الاجتماعي، وكذلك الإشارة في النسخة الورقية لمجلتكم إلى معامل **"ارسيف Arcif"** الخاص بمجلتكم.

ختاماً، نرجو في حال رغبتكم الحصول على شهادة رسمية إلكترونية خاصة بنجاحكم في معامل " **ارسيف** "، التواصل معنا مشكورين.

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Influence of Chia seeds (Salvia hispanica L.) and Psyllium Husks (Plantago ovata) on Weight Reduction, lipid profile and liver function in Obese Rats

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Abstract

Obesity is a chronic metabolic disease characterized by an excess of fat stores in the body.It is a main cause for many diseases and may lead to disability and death given that it affects not just adults but also children and adolescents.Therefore, this study investigated the effect of Chia seed (Salvia hispanica L.) and Psyllium Husks (Plantago ovata) on weight loss, serum glucose, lipid profile and liver function enzymes in Obese Rats.

Keywords: Obesity, Chia Seed(Salvia hispanica L.), Psyllium Husks (Plantago ovata), Weight Loss, Lipid Profile and Liver Function

ملخص:

العنوان : تأثير بذور الشيا وقشور السيليوم على انقاص الوزن ودهون الدم و وظائف الكبد

المؤلفون : ايفيلين سعيد عبد الله ، سهير نظمى عبد الرحمن قناوى ، ايريني ولسن نجيب ، أيه إبراهيم إمام .

السمنة هي مرض استقلابي مزمن يتميز بزيادة مخزون الدهون في الجسم. وهو سبب رئيسي للعديد من الأمراض وقد يؤدي إلى الإعاقة والوفاة، لأنه لا يؤثر على البالغين فحسب، بل على الأطفال والمراهقين أيضًا. لذلك، تناولت هذه الدراسة تأثير بذور الشيا (Salvia hispanica L).) وقشور السيليوم (Plantago ovata) على فقدان الوزن، وجلوكوز الدم، ومستوى الدهون، وأنزيمات وظائف الكبد في الجرذان السمينة

الكلمات الدالة : بذور الشيا ، قشور السيليوم ، انقاص الوزن ، دهون الدم ، وظائف الكبد

Introduction

The dramatic increase in obesity remained challenging worldwide, and it has been estimated that about 40% of world population will be overweight and 20% will be obese by 2030 **(Liu et al., 2021 and Chenbing et al., 2021)**.Furthermore, an extreme phenotype morbid obesity (MO) has damagingly become a global problem **(Chang et al., 2021).** Obesity is a well- known risk factor for metabolic syndrome which may lead to chronic diseases such as diabetes, cardiovascular diseases and non-alcoholic fatty liver diseases(NAFLD**)(Ashkar et al., 2019 and Doaei et al., 2019)**.Where through the course of the disease that adipocyte hypertrophy lead to hypoxia, inflammation and oxidative stress which increase morbidity and mortality of this complex endocrine and metabolic diseases**(Gregor and Hotamisligil., 2011 and Swınburn et al., 2004)**. Obesity which increases the risk of cardiovascular diseases, hypertension and diabetes mellitus1'" is quite simply the result of caloric intake in excess of body needs. It usually begins in childhood or adolescence and the longer it is allowed to persist the less likely that it can be controlled. Obesity is associated with social and medical risks that especiallymake it a problem**(Kannel., 1987).** According to Framingham study**(William., 1986)**weight gain leads to rise in atherogenic trait and weight loss to decline.**Truswell., (1987)**described that obesity increased the risk of coronary artery diseases 35% more than in non-obese subjects.The mechanism by which obesity leads to death from cardiovascular diseases probably involve risk factors such as hypertension, lipid disturbances and impaired glucose tolerance**(Lorett P and Askevold., 1977)**.Obesity is associated with elevated blood lipids and lipoproteins**(Garden et al., 1977)**.A negative association between HDL and incidence of obesity have been reported in several studies**(Sonja and William., 1982**).Direct correlation between plasma triglycerides and body weight have been noticed as high percentage of patients with myocardial infarction exhibited hypertriglyceridaemia

(Morrison and Laskarzevyiski., 1982).The changes in plasma levels of various hormones and vitamins in obese patients were occurred because functioning of adipose tissue as an endocrine organ.These functions were produced metabolic changes in many organs **(Álvarez et al., 2011)**.The accumulation of fat in the abdominal region represents a stronger predictor of elevated liver enzymes**(Al-Sultan., 2008 andDeeb., 2018).(Ouchi et al., 2011 and Doaei et al., 2019)**Recent studies reported that obesity may be associated with liver diseases and progression of hepatic dysfunction, and obesity may impair liver function by a variety of mechanisms. In comparison with non-obese individuals, abnormalities in liver function tests, including enzyme activity, have been observed more frequently in obese individuals due to the high prevalence of non-alcoholic fatty liver diseases **(Al Akwaa et al., 2011) .**Dietary fibers are non-starch polysaccharides including cellulose, hemicellulose, lignin, pectin, gum, and mucilage and non-polysaccharide (lignin).Health benefits of the consumption of fiber rich foods ranging from prevention and treatment of obesity, reduction of blood glucose and cholesterol level, glycemic regulation, and prevention of intestinal diseases, like constipation, hemorrhoid, diverticular diseases and colon cancer **(Marlettet al., 2002**), and belong to the following categories: edible carbohydrate polymers naturally occurring in the food as consumed; carbohydrate polymers, which have been obtained from food raw material by physical, enzymatic or chemical means and which have been shown to have a physiological effect as evidenced by **(FAO/WHO (CODEX)., 2010).**Besides its structure, dietary fiber has been described in terms of its solubility.Insoluble dietary fibers type which consists cellulose, hemicellulose, and lignin, which improve laxation, soluble dietary fibers type which consists non-cellulosic polysaccharides, includingpectin, gums, and mucilage**(Slavin., 1987**).Chia seeds contain approximately 30–34 g dietary fibers, of which the insoluble fraction (IDF) accounts for approximately 85–93%, while soluble dietary fibers (SDF) is approximately 7–15**%(Marineli, et al., 2015; Reyes, et al., 2008)**. Most of the

species from genus salvia have homeopathic and horticultural importance as a source of many useful natural constituents, like polyphenols, such as chlorogenic and caffeic acids, as well as flavonoids, namely myricetin, quercetin and kaempferol**(Ixtaina, et al., 2011; Reyes, et al., 2008).**Also, psyllium is a soluble fiber and has been evaluated in various human studies for beneficial effects on glucose and insulin homeostasis, lipids and lipoprotein, body weight, bodycomposition and appetite**(Pal, et al., 2011; Delargy, et al., 1997).**Psyllium contains phenolics and flavonoids that possess reducing capacity and reactive oxygen species scavenging activities**(Patel, et al., 2016).**Therefore, this work aims to study the effect of Chia seeds (*Salvia hispanica L.*) and Psyllium Husks (*Plantago ovata)* on weight reduction, lipid profile and liver function in obese rats.

Materials and Methods:

Materials:

Chia seeds (*Slavia.hispanica L.)*, Psyllium husks (*Plantago psyllium*), Corn Oil and Starch were obtained from local market in Cairo, Egypt.Hexane, casein, vitamins, minerals, cellulose, choline chloride, Kits of glucose, total cholesterol, triglycerides, HDL-C, LDL-C, GPT (ALT) and GOT (AST)purchased from El-Gomhoreya Company, Cairo Egypt.

Methods:

Preparation of Chia seeds and Psyllium husks

Chia seeds and Psyllium husks were grounded and kept in plastic containers in normal temperature.

Determination of Chia seeds and Psyllium husks chemical composition:

Moisture, ash, crude protein, crude fiber contents, and total carbohydrates were determined according to the methods of Association of Official Agricultural Chemists **(AOAC 2016).**Total carbohydrates content was calculated by subtracting protein, ash, and crude fiber from total mass of 100.

Biological experiment: Adult male albino rats (n=42, weighed each 120 to 140 g) were obtained from Experimental Animal House, Food Technology Research Institute, A.R.C., Giza, Egypt. The animals were fed for one week on basal diet that included 4% salt, 10% corn oil, 1% vitamin, 70% corn starch, 10% casein, and 5% cellulose for adaptation in the experimental animal cages .After the adaptation period, the rats were divided into two groups, (6 rats as (normal control) and 36 rats (positive control)), and they were fed on high fat diet (30% fat, 15% casein (protein), 46% starch, 4% salt, 1% vitamin, 5% cellulose)for 4 months until obesity occurred.

Experimental Design:

Group one (G1):6 Rats fed on basal diet (- control).

36 rats (+ control) were divided into 6 groups as follows:

Group two (G2):6 Obese rats fed on a high fat diet (+ control).

Group three (G3):6 Obese rats fed on a high-fat diet + ground chia seeds only for 15% of the meal.

Group four (G4):6 Obese rats fed on a high-fat diet + ground psyllium husks for only 15% of the meal.

Group five (G5):6 Obese rats fed on a high-fat diet +ground chia seeds by 7.5% +groundpsyllium husks by 7.5% of the meal.

Group six (G6):6 Obese rats fed on a high-fat diet + ground chia seeds by 3.75% + ground psyllium husks by 11.25% of the meal.

Group seven (G7):6 rats fed on a high-fat diet + ground chia seeds at a rate of 11.25% + ground psyllium husks at a rate of 3.75% of the meal.

The duration of experiment 4 months. Also, Rats body weight was recorded weekly.

Blood Sampling: At the end of the experiment period, the rats were fasted overnight then the rats were anaesthetized and sacrificed and blood samples were collected and centrifuged for 15 minutes at 3000 rpm to separate the serum was carefully separated into dry clean Wassermaan tubes by using Pasteur pipette and kept frozen till analysis at-20^{o}C.Heart, Liver, Kidney and Spleen were removed from each rat, cleaned from adhestive matter and weighted then stored in formaldehyde solution 10% in normal temperature according to method mentioned by (**Drury and Wallington., 1980**).

Biochemical analyses of serum: Blood glucose (mg/dL) was estimated by glucose oxidase method using the kit supplied by SPINREACT(SantEstevadeBas, Girona, Spain) according to **(Tietz., 1995)**.TC, TG, HDL and LDL assays Total Cholesterol (TC) was determined according to the method described by **(Allain et al., 1974)** and triglycerides was determined according to the method described by **(Fossati and Prencipe., 1982)**.High Density Lipoprotein Cholesterol (HDL-C) was determined according to the method described by **(Lopez-virella et al., 1977)** and Low-Density Lipoprotein Cholesterol (LDL-C) levels were calculated for serum sample using the formula **of (Friedewald et al., 1972).**Serum transaminases sAST and sALT (Aspartate transferase and Alanine transferase) were measured colorimetrically according to the method described by **(Reitaman and Frankel., 1957).**

Statistical analysis:

Statistical analysis was carried out according to Fisher (1970) calculation LSD was used to compare the significant differences between means of treatments.

Results and Discussion:

1.Chemical composition of Chia Seeds and Psyllium Husks:

The results showed that chia seeds had the higher values of proteins, fats, ash, and crude fibers content than that of psyllium husks, it contains 28.19, 31.51, 6.338, and 29.663 % of proteins, fats, ash, and crude fibers, respectively. **(Mona., 2017)** psyllium husk is higher in ash, fibers and carbohydrates, compared with WF as recorded 2.30 ± 0.57, 8.10 ± 0.28 and 78.02 ± 0.2%, respectively**.**Psyllium seed husk is a good source of DFs (61.5 ± 2.6%) and the proximate composition including moisture, ash, crude fat, crude protein, crude fibers, and Nitrogen freeextract (NFE) was 4.9 ± 0.01, 4.1 ± 0.01, 1.2 ± 0.01, 3.9 ± 0.05, 20.23 ± 0.4 and 78.2 ± 4.01 g/100 g, respectively**(Muhammad et al., 2022)**.High concentrations of dietary fiber (33.4 %), lipids (32.2 %) and proteins(18.2 %) were found in chia **(da Silva et al., 2016)**.

Table(1) Chemical composition of Chia seeds and Psyllium husks

Samples	Moisture %	Ash %	Fat %	Fiber %	Protein %	CHO %
CHI	5.707[b] ±0.131	6.338 [a] ±0.073	31.51 [a] ± 1.286	29.663 [a] ± 0.0351	28.19 [a] ± 0.43	30.12 [a] ±0.31
PSY	7.755[a] ±0.754	2.6286[b] ±0.148	1.667 [b] ± 0.129	2.347 [b] ± 0.1025	2.055 [b] ± 0.335	84.0 [a] ± 0.41
LSD	1.227	0.265	2.0725	0.1736	0.8737	0.271

Data are presented as means ± SDM (n=3). Significant at 0.05 levels of probability

2.Effect of feeding diets containing Chia Seeds and Psyllium Husks on Body Weight gain and Deficiency Weight of the experimental rats:

Table (2) showed that the growth response, total body weight gain g / 4 months, food intake, feed efficiency and feed efficiency ratio. The results indicated that, the G2 (positive control fed on a high fat and high protein diet) had the highest total body weight gain (183.733 ±6.702 g/4 months). While body weight of G1 (normal control) fed on basal diet significantly was increased by about (7.4 [b] ±4.167 g/4 months) of the initial body weight. On the other hand, the body weight of the other groups G3, G4, G5, G6, and G7 were significantly ($p \leq 0.05$)

lost.Concerning to G4 and G6 which fed on high-fat and high protein diet + ground psyllium husks for only 15% and high-fat and high protein diet + ground chia seeds by 3.75% + ground psyllium husks by 11.25%, respectively had the highest loss in body weight of -125.266 ±6.068 and - 109.2 ±8.3809 g/4 months. In contrast G3 which fed on high-fat and high protein diet + ground chia seeds only for 15% showed low significantly decreased in body weight gain of -64.133 ±18.068 g/4 months. It is clear that psyllium husks losses body weight of the obese rats compared with chia seeds.

Concerning to total food intake, feed efficiency and feed efficiency ratio, the results are shown in the same Table (2).Total food intake was significantly increase in G2 (obese control) compared with normal control (G1) and other groups (G3, G4, G5, G6, and G7).The calculated data of feed efficiency ratio (FER) for groups are summarized in Table (2). It is observed that, the feed efficiency ratio of G2 (0bese control) had the highest value, while G4 and G6 had lowest value of - 7.9833 ±0.297and - 6.6566 ±0.5510gm, respectively, followed by G5, G7 and G3 of - 5.5133 ±0.2055, - 4.7966 ±0.3156 and - 3.1466±1.0288gm, respectively. which fed on a high-fat and high protein diet + ground chia seeds by 7.5% +ground psyllium husks by 7.5%, high-fat and high protein diet + ground chia seeds at a rate of 11.25% + ground psyllium husks at a rate of 3.75% and high-fat and high protein diet + ground chia seeds only for 15%, respectively.

Our results agree with **(Rabeh et al., 2022)** they found that there was no substantial difference in the initial body weight of all treated rats, while the final body weight (FBW), BWG%, and FER were significantly ($P<0.05$) decreased by Psyllium seeds or its husk at both levels compared to the +ve control group. There is a meaningful difference in FBW, BWG%, and FER among the treated groups.Psyllium husk was more effective in weight reduction than psyllium seeds; moreover, the higher percentage of either psyllium seeds or husks, the lower the weight reduction

was observed. The most inferior reduction of FBW and BWG% was recorded at the group fed on psyllium husk at 5%, followed by psyllium seeds at 2.5%. The percent of weight reduction ranged between (-33 to -24%) for psyllium husk and its seeds, respectively.the animals that received a high-fat diet had higher final body weight (HF: + 34 % vs C group; HFC: +39 % vs CC group; $p < 0.05$) and weight gained more during the experimental period than their respective controls (HF: +99 % vs C group; HFC: 1.2-fold increase vs CC group; $p < 0.05$) **(Batista et al., 2023)**.Animals fed with chia showed weight gain, FER, PER, NPR and TD lower ($p < 0.05$) than the control group (casein).The PER values observed in the groups fed with chia ranged from 1.73 to 1.92.The lower digestibility observed in the groups fed with chia may be associated with a higher concentration of soluble fiber present in the food matrix (2.89 g/ 100 g) compared to casein (control) and the presence of phenolic compounds (0.97 g/100 g) and phytic acid (0.96 g/ 100 g) that can act as anti-nutritional factors **(da Silva et al., 2016)**.The phenolic compounds, phytic acid and dietary fiber can complex with the intestinal contents, preventing access of digestive enzymes and absorption of nutrients; and reducing protein digestibility **(Dykes andRooney., 2006;Devi et al., 2014).**Chia seeds preventing overweight and obesity by inhibiting adipogenesis and reducing the level of PPAR-γ protein **(Grancieri et al., 2021).**

Table (2):Effect of feeding diets containing Chia Seeds and Psyllium Husks on(initial &final body WT), body WT gain, daily gain in body WT, food intake, daily food intake, feed efficiency and feed efficiency ratio of experimental rats.

Treatments	Initial body weight (gm)	Final body weight(gm)	Gain in body weight(gm)	Daily gain in body weight(gm)	Food intake(gm)	Daily food intake(gm)	Feed efficiency(gm)	Feed efficiency ratio(%)
G1(NC)	296.260^{b} ±10.020	303.866^{b} ±5.93	7.4^{b} ±4.167	0.063^{b} ±0.037	2369.66^{b} ±80.226	26.323^{b} ±0.891	0.003^{b} ± 0.0018	0.3233^{b} ± 0.185
G2(PC)	318.23^{a} ±5.513	501.966^{a} ±8.457	183.733^{a} ±6.702	1.555^{a} ±0.055	4015.333^{a} ±67.71	44.61^{a} ±0.752	0. 0457^{a} ± 0.0012	4.57^{a} ± 0.121
G3	321.46^{a} ±4.424	257.333^{c} ±14.622	-64.133^{c} ±18.068	- 0.5366^{c} ±0.155	2058.333^{c} ±116.76	22.866^{c}± 1.294	- 0.0314^{c} ±0.0102	- 3.1466^{c} ±1.0288
G4	321.23^{a} ±8.354	195.966^{f} ±2.402	-125.266^{f} ±6.068	-1.0566^{f} ±0.049	1567.333^{f} ±19.008	17.413^{f} ±0.2100	- 0.7983^{f} ±0.0029	- 7.9833^{f} ±0.297
G5	310.5^{ab} ±6.055	215.366^{de} ±1.778	-95.1333^{de} ± 4.4003	- 0.8^{de} ± 0.04	1722.666^{de} ±14.189	19.14^{de} ± 0.157	- 0.05513^{d} ±0.00205	- 5.5133^{d} ±0.2055
G6	314.16^{ab} ±7.184	204.966^{ef} ±1.205	- 109.2^{e} ±8.3809	- 0.92^{e} ± 0.072	1639^{ef} ±9.539	18.21^{ef} ± 0.105	- 0.0665^{e} ± 0.0055	- 6.6566^{e} ±0.5510
G7	310.133^{ab} ±7.226	224.1^{d} ±2.7055	- 86.0333^{d} ± 5.909	- 0.7233^{d} ± 0.050	1792.333^{d} ± 21.548	19.91^{d} ± 0.240	- 0.04796^{d} ±0.00315	- 4.7966^{d} ±0.3156
LSD	11.378	13.294	15.512	0.1327	106.260	1.1794	0.00848	0.8405

G1): Normal rats (- control) fed on basal diet, (G2): Obese rats fed (+ control) on a high fat and high protein diet, (G3): Obese rats fed on a high-fat and high protein diet + ground chia seeds only for 15% of the meal, (G4): Obese rats fed on a high-fat and high protein diet + ground psyllium husks for only 15% of the meal, (G5): Obese rats fed on a high-fat and high protein diet + ground chia seeds by 7.5% +ground psyllium husks by 7.5% of the meal, (G6): Obese rats fed on a high-fat and high protein diet + ground chia seeds by 3.75% + ground psyllium husks by 11.25% of the meal, (G7): rats fed on a high-fat and high protein diet + ground chia seeds at a rate of 11.25% + ground psyllium husks at a rate of 3.75% of the meal, ± S.D: standard deviation. Data are presented as means ± SDM. Data in a row with different superscript letters are statistically different ($P \leq 0.05$).

3.Effect of feeding diets containing Chia Seeds and Psyllium Husks on Organs Weight of the experimental rats:

The weight of organs of normal and obese rats fed on different diets were measured and the results are shown in Table (3). It could be observed that kidney, liver and heart weights were significantly ($p \leq 0.05$) increased in obese rats G2 (3.74±0.164, 10.123±0.437, and 1.22a±0.045g, respectively). On other hand, G4 and G6 kidney, liver and heart weights give results near or closed with normal control (G1).Also, G3, G5 and G7 had low weights of spleen, kidney, liver and heart compared to obese rats G2.The hearts of control negative group and rats fed on diets with added 10 and 20% Psyllium husks weighed significantly less than the Doum groups **(Samah, 2017).Muna, (2020)** reported thatit could be observed that the mean value of liver weight, heart weight, spleen weight and kidneys weight of control (+) group was higher than control (-) group. The best liver weight heart weight, spleen weight and kidneys weight were showed for groups 5 (rats fed on basal diet containing 5% mixture of moringa leaves, chia seeds) when compared to control (+) group .

Table (3):Effect of feeding diets containing Chia Seeds and Psyllium Husks on the weight of(spleen, kidney, liver, and heart) of the experimental rats.

Treatments	Spleen gm	Kidney gm	Liver gm	Heart gm
G1	0.90c±0.086	2.05c±0.026	5.65e ±0.44	0.623f±0.15
G2	0.98c±0.076	3.74a±0.164	10.123a±0.437	1.22a±0.045
G3	1.316a±0.076	2.906b±0.215	8.613b±0.100	1.013b±0.041
G4	0.97c±0.043	1.86c±0.158	5.45e±0.255	0.626f±0.011
G5	1.16b±0.01	2.58b±0.132	7.203cd±0.050	0.0823d±0.032
G6	1.11b±0.098	2.003c±0.331	6.95d±0.050	0.703e±0.023
G7	1.313a±0.080	2.756b±0.132	7.65c±0.261	0.91c±0.034
LSD	0.125	0.327	0.483	0.549

G1): Normal rats (- control) fed on basal diet, (G2): Obese rats fed (+ control) on a high fat and high protein diet, (G3): Obese rats fed on a high-fat and high protein diet + ground chia seeds only for 15% of the meal, (G4): Obese rats fed on a high-fat and high protein diet + ground psyllium husks for only 15% of the meal, (G5): Obese rats fed on a high-fat and high protein diet + ground chia seeds by 7.5% +ground psyllium husks by 7.5% of the meal, (G6): Obese rats fed on a high-fat and high protein diet + ground chia seeds by 3.75% + ground psyllium husks by 11.25% of the meal, (G7): rats fed on a high-fat and high protein

diet + ground chia seeds at a rate of 11.25% + ground psyllium husks at a rate of 3.75% of the meal, ± S.D: standard deviation. Data are presented as means ± SDM. Data in a row with different superscript letters are statistically different ($P \leq 0.05$).

4.Effect of feeding diets containing Chia Seeds and Psyllium Husks on Serum Glucose and Lipid Profile:

Serum blood glucose and lipid profile levels are summarized in Table (4). From the present data we found that, Serum glucose, total-cholesterol, triglyceridesand LDL-C in Obese rat group (+ control) were increased significantly ($p \leq 0.05$) to 216.25;340.02;94.44;296.22 mg/dlrespectively, compared with normal rats (-control)79.90;181.97, 60.32;35.83 mg/dl, respectively. While, HDL-C level in obese rat group (+ control) was decreased significantly ($p \leq 0.05$) to 43.79 mg/dl compared with (– control) (146.13 mg/dl).On other hand, the levels of serum glucose, total-cholesterol, triglyceridesand LDL-C were decreased significantly ($p \leq 0.05$) and HDL-C was increased significantly ($p \leq 0.05$) in all groups that fed on chia seeds and psyllium husks than Obese rats group (+ control). It is clear that the levels of serum glucose, total-cholesterol and triglycerides in (G4) that fed on a high-fat and high protein diet + ground psyllium husks for only 15% did not differ from those of (- control), also give the best results of the levels of LDL-C and HDL-C.Moreover(G5) that fed on a high-fat and high protein diet + ground chia seeds by 7.5% + ground psyllium husks by 7.5% of the meal, and (G6) that fed on a high-fat and high protein diet + ground chia seeds by 3.75% + ground psyllium husks by 11.25% of the meal groups showed a significantly ($p \leq 0.05$) decreased Serum glucose, total-cholesterol, triglycerides, and LDL-C levels and increased serum LDL-C level compared to + control, they results very near to the – control.

Our findings concur with those of(**Eun Young Jung et al., 2016)**, who noted that plasma glucose, total cholesterol and HDL cholesterol levels in the dietary supplement groups were similar to those of the F-control.When compared to F-control (135.0 mg/dL), psyllium-2 (86.7 mg/dL) had a considerably ($p \leq 0.05$) lower triglycerides level.Chitosan-1, psyllium-1 and psyllium-2

all had considerably lower LDL cholesterol levels than the F-control(34.8mg/dL)at17.9, 19.2and23.2mg/dL, respectively. Supplementation rat diets with 5 % of psyllium seeds, 3 and 5 % husks improved serum glucose levels in diabetic rats compared with positive control. Moreover, the best serum glucose was recorded for diabetic rats treated with psyllium husks by 5%**(Elhassaneen et al., 2021)**. Also, **Karhunen et al., (2010)** found that psyllium husks and its seeds fiber enriched meals improve glucose level significantly than non- fiber enriched meals **(Pal et al., 2014)**.**Kalaiarasi and Pugalendi., (2009); and Mohammed et al., (2015)** reported that the hypoglycemic activity of psyllium husks and its seeds may be due to the inhibition of liver gluconeogenesis.Psyllium seeds or husk at the tested levels appreciably ($P<0.05$) reduced thelipid parameters (TC, TG, VLDL-c, and LDL-c) and significantly increased serum HDL-c in comparison to the +control group.There is a substantial reduction in the mean values of (TC, TG, VLDL-C, and LDL-C) and a substantial increase in serum HDL-C for rats fed psyllium seeds at 5% compared with psyllium seeds 2.5%.The same trend was observed in the rats fed on psyllium husk 5% and 2.5%.The most remarkable improvement of lipid profile was recorded at the group fed on psyllium seeds 5%**(Rabeh et al., 2022)**.

The hypolipidemic activity of psyllium seeds and husks due to soluble fiber, phenolic substance, flavonoids, oleic, linoleic, linolenic, caffeic and chlorogenic acids contents.Flavonoids may function by raising the density of LDL-c receptors in the liver and binding to apo-lipoprotein B, allowing liver cells to remove LDL-c more efficiently from the bloodstream **Gunness and Gidley., (2010); Pourbehi et al., (2016)**, reported that there was a substantial decrease in TC, TG, and serum LDL levels and a significant increase in HDL levels in rats treated with psyllium seeds (5 g in 250 mL of water) or their extracts.**Likewise and Ali., (2017)** found that supplementation with psyllium seeds at (0.5 and 1.0%) caused a decrease($P<0.05$)

in serum lipid profile levels and substantial boost (P<0.05)in serum HDL-c levels.The animals fed with different diets containing chia showed blood glucose levels lower ($p < 0.05$) than animals fed with casein **(da Silva et al., 2016)**.This fact may be associated with the increased presence of soluble dietary fiber fraction of chia compared to control diet (casein), which received only cellulose.The soluble dietary fiber increases the viscosity of the intestinal lumen, reducing the contact of glucose with the enterocyte, thus decreasing its absorption **(Weickert and Pfeiffer., 2008).**

The effect of chia intake in our study was beneficial, because the food promoted greater control of plasma glucose levels in a short period of time (28 days).The groups fed with chia seed or flour, with or without heat treatment, decreased ($p < 0.05$) TGL, TC, LDL, VLDL and increased HDL **(da Silva et al., 2016)**.This can be justified by the supply of chia that satisfied 100 % of the need for fiber and fat of animals. It is known that high concentrations of fatty acids present in the n-3 chia are related to the reduction of VLDL and TGL **(Ayerza and Coates., 1995).**

Table (4): Effect of feeding diets containing Chia seeds and Psyllium husks on Serum Glucose, Total Cholesterol (TC), Triglycerides (TG), LDL-Cholesterol (LDL-C), and HDL-Cholesterol (HDL-C) levels of experimental rats.

Treatments	Glucose mg/dl	TC mg/dl	TG mg/dl	LDL-C mg/dl	HDL-C mg/dl
G1	79.90±1.126e	181.97±1.70f	60.32±0.341e	35.83±0.712e	146.13±1.034a
G2	216.25±0.844a	340.02±3.58a	94.44±0.972a	296.22±6.003a	43.79±3.30e
G3	101.74±1.711b	208.59±2.11b	70.15±0.262b	114.04±3.164b	94.55±5.146d
G4	81.155±0.878e	182.28±1.65f	61.07±1.28e	81.37±2.03d	100.90±1.775bc
G5	91.432.0.847c	194.19±2.52d	65.375±1.86c	96.08±1.153c	98.115±2.395cd
G6	86.102±1.235d	186.51±1.00e	63.43±1.077d	82.78±2.19d	103.73±2.457b
G7	93.072±1.376c	200.39±1.007c	66.285±0.918c	99.13±1.52c	101.1±2.215bc
L.S.D	1.741	3.115	1.599	4.276	4.244

G1): Normal rats (- control) fed on basal diet, (G2): Obese rats fed (+ control) on a high fat and high protein diet, (G3): Obese rats fed on a high-fat and high protein diet + ground chia seeds only for 15% of the meal, (G4): Obese rats fed on a high-fat and high protein diet + ground psyllium husks for only 15% of the meal, (G5): Obese rats fed on a high-fat and high protein diet + ground chia seeds by 7.5% +ground psyllium husks by 7.5% of the meal,

(G6): Obese rats fed on a high-fat and high protein diet + ground chia seeds by 3.75% + ground psyllium husks by 11.25% of the meal, (G7): rats fed on a high-fat and high protein diet + ground chia seeds at a rate of 11.25% + ground psyllium husks at a rate of 3.75% of the meal, ± S.D: standard deviation. Data are presented as means ± SDM. Data in a row with different superscript letters are statistically different ($P \leq 0.05$).

5.Effect of feeding diets containing Chia Seeds and Psyllium Husks on Liver Function of the Experimental rats.

From the present data in (Table 5), we found that ALT and AST activities were significantly ($p \leq 0.05$) inhibited in (+ control) (26.392, 96.94 U/ L, respectively) than (– control) (44.762; 137.67 U/ L, respectively).The treatments of G3, G5and G7 increased ALT activities of the obese rats but there were insignificant differences between them also, increased AST activities compared to (+ control).(G6) has highly significantly inhibit of ALT and AST activities, which their results are near to the (– control)while, the treatment of G4 significantly inhibit the activities of ALT activity to 43.26 and AST to 136.035 U/ L than to the(+ control) (G2), these results close to the results that observed in (– control) (44.762, 137.67 U/ L, respectively).These Results agreed with **(Rabeh et al., 2022)** whom said that positive control group had a substantial ($P<0.05$) increase in AST and ALT levels in comparison to the negative control group.The supplemented Psyllium husk or seed at the different levels significantly ($P<0.05$) decreased the mean levels of liver functions in comparison to the + control group. Besides, there are substantial alterations among the treated groups.It was also observed that the higher percentage of Psyllium seed or husk supplementation, the lower liver enzymes.These findings might be due to the components of psyllium husk "9, 12-octadecadienoic acid, methyl ester, and -sitosterol, " which act as hepatoprotective agents **(Devaraj et al., 2020)**.Likewise, **Elhardallou et al., (2015); Ali., (2017)** found that diabetic rats fed a diet enriched with psyllium seed husk, alone or in combination, for 4 weeks discovered a significant reduction in liver enzymes in comparison to the positive control group. The obtained findings were also in line with **Hashem et al., (2021)**,

who found that psyllium husk ethanolic extract (250 g was extracted in 1L 70% ethanol) significantly reduced liver parameters in tritoninduced hyperlipidemic rats.

Table (5). Effect of feeding diets containing Chia seeds and Psyllium Husks on Serum Alanine Transferase (ALT) and Aspartate Transferase (AST) activities of the experimental rats.

Treatments	ALT (U/ L)	AST (U/ L)
G 1	44.762±0.398a	137.67±0.620a
G 2	26.392±0.367e	96.94±0.457e
G 3	38.632±0.964d	124.68±2.803d
G 4	43.26±0.502b	136.035±1.753ab
G 5	39.015±0.872d	129.64±1.221c
G 6	41.155±0.960c	134.132±1.978b
G 7	38.99±0.937d	129.035±0.871c
L.S.D	1.116	2.337

G1): Normal rats (- control) fed on basal diet, (G2): Obese rats fed (+ control) on a high fat and high protein diet, (G3): Obese rats fed on a high-fat and high protein diet + ground chia seeds only for 15% of the meal, (G4): Obese rats fed on a high-fat and high protein diet + ground psyllium husks for only 15% of the meal, (G5): Obese rats fed on a high-fat and high protein diet + ground chia seeds by 7.5% +ground psyllium husks by 7.5% of the meal, (G6): Obese rats fed on a high-fat and high protein diet + ground chia seeds by 3.75% + ground psyllium husks by 11.25% of the meal, (G7): rats fed on a high-fat and high protein diet + ground chia seeds at a rate of 11.25% + ground psyllium husks at a rate of 3.75% of the meal, ± S.D: standard deviation. Data are presented as means ± SDM. Data in a row with different superscript letters are statistically different ($P \leq 0.05$).

Conclusion:

The results show that:Fiber intake from Chia seeds and Pysllium Husks were effective in weight reduction. While Psyllium Husks was more effective in Weight Reductionthan Chia Seeds.

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