Potential Anti-Obesity Effects of Fresh Avocado and its Alcohol Extract on Rats Fed on High Fat Diet

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Abstract

Avocados (*Persea Americana,* Mill.) are an excellent source of antioxidants and nutrients.These compounds have demonstrated beneficial effects on human and animal health, helping in controlling weight and lowering the risk for several diseases. The main objective of this study is to evaluate the effectiveness of fresh avocado fruit and its alcohol extract as well as Tulango-slim (anti-obesity dietary supplement) in reducing obesity in obese rats. Eight groups of six male albino rats, each weighing 150g±10g, were divided from the forty-eight rats used in this study. Rats were fed a high-fat diet (20% animal fat) in order to make them obese. The study additionally measured triglycerides (TG), high-density lipoprotein (HDL-c), low-density lipoprotein (LDL-c), very low-density lipoprotein (VLDL-c), atherogenic index (AI), glucose levels, liver enzymes (ALT, AST, & ALP), and renal functions (urea, uric acid, and creatinine). The findings demonstrated that when rats given avocado extract, the obese group had significantly lower glucose levels, liver activities, and renal functions. With statistically significant differences, 100 ml of avocado extract had the lowest total cholesterol and triglyceride levels, as well as the lowest levels of low-density lipoprotein, very low-density lipoprotein, and atherogenic index and vice versa with high-density lipoprotein concentrations. As conclusion, obese rats who received 100 ml of avocado extract had superior lipid profiles, glucose levels, liver, and kidney function.

Key words: Avocados, Avocados Extraet, Tulango –slim,Tryglycerides TG,HDL..c,Renal Functios, Liver enzmes,Glucose

Introduction

Obesity is an important health problem that affects people all over the world. It's linked to metabolic syndrome, which includes hyperglycemia, abdominal obesity, hypertension, raised plasma triglycerides, and low levels of plasma high-density lipoprotein cholesterol **Alberti *et al*.,(0 2009)**. It's defined by excessive body weight and abnormal body fat buildup, and it's quickly becoming a major global health issue **Chang *et al*.,(2017)**.

It is one of the main causes of illness and mortality in industrialized countries, and its prevalence in these populations has been sharply rising over the past several years **Hales *et al*.,(2020)**.

It develops when the body's energy intake exceeds its energy expenditure for an extended period. The volume and number of adipocytes, which are regulated throughout the so-called adipocyte life cycle, determine the degree of obesity **Rayalam *et al*.,(2008)**.

Generally, it can be reduced by decreasing total fat intake, boosting fruit and vegetable consumption, as well as legumes, whole grains, and nuts, limiting sugar intake, and engaging in regular physical activity to attain energy balance and a healthy weight **WHO,(2012)**.

Most cases of obesity are caused by a combination of excessive dietary energy consumption and a lack of physical exercise on an individual level. A small percentage of cases are caused by genetics, medical conditions, or psychiatric disease **Raj,(2010)**.

Medicinal plants have played a vital part in the treatment of obesity in the past and will continue to do so in the future. Since ancient times, medicinal plants have been utilized to treat a variety of diseases. The bioactive compounds responsible for the disease-curing activity of medicinal plants used in the Unani system of medicine must be separated. Anti-obesity qualities can be found in a wide range of medicinal herbs **Akram, (2017)**.

The avocado (*Persea americana* Mill.) is a subtropical/tropical fruit that is a member of the Lauraceae and Persea families. It comes from Mexico. It is widely cultivated and consumed worldwide, especially in several countries in the Central Region of the United States **Melgar *et al*., (2018)**.

Due to its various nutritional composition, phytochemical composition, and health advantages, avocado has recently gained a lot of popularity and is sometimes marketed as a "superfood" **Segovia *et al*., (2018)**.

Traditionally, it has also been used as food and for several medical conditions, such as heart disease, diabetes, high blood pressure, antivirals, and diarrhea **Cortés-Rojo *et al.*, (2019)**.

Avocado trees are short and have a grey trunk. Herbal medication is made from the fruit of this plant. The number of simple sugars in avocado fruit is modest, but it contains a significant amount of dietary fiber. Constipation may be relieved, fat absorption reduced, glycemic index and plasma insulin levels reduced, colon fermentation and microbial proliferation altered, and plasma cholesterol reduced **Thenmozhi et *al*., (2012)**.

Avocados are high in carotenoids, minerals, phenolic acids, vitamins, and fatty acids. Avocado has been shown to have lipid-lowering, anti-hypertensive, anti-diabetic, anti-obesity, anti-thrombotic, anti-atherosclerotic, and cardioprotective properties in various research **John and Sons,(2017)**.

Daniels *et al.*, (2014) found that avocados are high in fiber, phytosterols, and other bioactive, in addition to fat-soluble polyphenols and antioxidant vitamins, which may help reduce LDL.

Avocado, according to **Padmanabhan and Arumugam, (2014)**, is a historically consumed fruit that has the ability to reduce body fat. Adiponectin is a hormone that helps to regulate obesity. In HAEPA co-administered animals, the body mass index (BMI), total fat pad mass, and adiposity index were considerably lower than in HFD-fed rats.

Avocado extract, which contains several nutrients and bioactive substances, has been discovered to influence the expression of genes related in fat metabolism and hunger in animals, such as fatty acid synthase, fibroblast growth factor, leptin, and lipoprotein lipase. Various mechanisms, including effects on satiety, metabolism, and gut flora, may assist to explain some of the findings connected to weight fluctuations **Tabeshpour *et al.*,(2017)**.

Material and Methods

Materials:

Avocado fruits was obtained from local market, Cairo City, Cairo Governorate, Egypt.

Experimental animals

A total of 48 adult normal male albino rats Sprague Dawley strain weighing 140±10 g was obtained from Vaccine and Immunity Organization, Ministry of Health, Helwan Farm, Cairo, Egypt.

Casein, cellulose, choline chloride, and DL- Methionine

Casein, cellulose, choline chloride powder, and DL- methionine powder, were obtained from Morgan Co. Cairo, Egypt.

The chemical kits

Chemical kits used for determination the (TC, TG, HDL-c, ALT, AST, ALP, urea, uric acid, creatinine, and glucose) were obtained from Al-Gomhoria Company for Trading Chemical, Drug and Medical Instruments, Cairo, Egypt.

Methods

Preparations of avocado fruits extract

To prepare the dried avocado fruits were obtained from hyper market, then it grinds using an air mill, high speed mixture (Molunix, Al-Araby, Company, Egypt, and weighs until the drying process is complete then serving as powder seize and packed in plastic bags and placed at -18 °C in a deep freezer until further treatments.

The avocado powder was extracted with ethanol by cold maceration method. The extraction method involved weighing 700 g of the avocado powder into a volumetric flask, soaking in 1400 mL of 90% ethanol with intermittent shaking and stirring for 3 days and thereafter, filtering with No 1 Whatman filter paper. The filtrate was concentrated using water bath at 60EC and was further dried in an oven at 50ºC. The extract was kept in a sample bottle and stored in a refrigerator until used as in the animal study design according to **Egbuonu *et al.*, (2018)**.

The induction of obesity

Obesity was inducing in normal healthy male albino rats by fed on high fat diet (20% animal fat) supplemented in the basal diet and used as a positive control group.

Experimental design

The study was carried out and approved at Animal House, Department of Nutrition and Food Science, Faculty of Home Economics, Menoufia University, Egypt. Forty-eight adult male white albino rats, Sprague Dawley Strain, 10 weeks age, weighing (140±10g) were used in this experiment. All rats were fed on basal diet prepared according to **Reeves *et al.*, (1993)** for 7 consecutive days. After this adaptation period, rats are divided into 8 groups, each group consists of six rats as follows: Group (I) rats fed on basal diet as negative control. Group (2) Obese rats induced by fed on high fat diet (20% animal fat) supplemented in the basal diet and used as a positive control group. Group (3) A group obese rats adminstrated on fresh avocado fruit juice by 20% of the weight of basal diet. Group (4) A group obese rats fed on avocado alcohol extract by 100ml/kg b.w. of basal diet. Group (5) A group obese rats fed on 100ml/kg anti-obesity drug (Tulango slim as dietary supplement) of the weight of basal diet. Group (6) A group obese rats fed on avocado alcohol extract by 100ml/kg b.w. of basal diet containing 15% casin. Group (7) A group obese rats fed on avocado alcohol extract by 100ml/kg b.w. of basal diet containing 15% coconut oil. Group (8) A group obese rats fed on avocado alcohol extract by 100ml/kg b.w. of basal diet containing 15% corn starch.

At the end of the experiment period (4weeks), animals were fasted for 12-h then rats were scarified. Blood samples were collected from the portal vein into dry clean centrifuge tubes for serum separation, blood samples centrifuged for 10 minutes at 4000 rpm to separate, the serum according to **Schermer, (1967)**. Serum samples were frozen at -18 °C until chemical analysis.

Lipid profile

Total cholesterol (TC), Triglycerides (TG), High Density Lipoprotein (HDL-c), Low Density Lipoprotein (LDL-c), and Very Low Lipoprotein (VLDL-c) and atherogenic index (AI) was determined according to **Allain, 1974; Fossati & Prencipe, 1982; Lopez 1977; Lee & Nieman 1996 and Kikuchi-Hayakawa 1998)**.

Liver functions

Alanine amino transferase (ALT) activities were measured in serum using the modified kinetic method of **Hafkenscheid, (1979)**. Aspartate amino transferase (AST) activities were measured in serum using the modified kinetic method of **Henary, 1974 and Moss, 1982)**.

Serum glucose

Enzymatic determination of Serum glucose was carried out calorimetrically according to the method of **Wang *et al.*, (2010)**.

Kidney functions

Serum uric acid, serum urea and serum creatinine were determined by enzymatic method according to **(Barham & Trinder, 1972; Henry, 1974** and **Patton & 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 Costat Program. Biological results were analyzed by One Way ANOVA.

RESULTS AND DISCUSSION

Table (1) displays the influence of various doses of fresh avocado fruit and its extract on the blood triglycerides (TG) and total cholesterol (TC) of obese rats. The obtained results showed that the mean TC of the positive control group was significantly higher than that of the negative control group which were 160.00 and 78.50 mg/dl, respectively. In the treatment groups (obesity groups), there were no significantly differences between the lowest value recorded for 100 ml of avocado alcohol extract and the highest value recorded for 100 ml of dietary supplement (anti-obesty medicine). The average values were 88.80 and 125.90 mg/dl, respectively.

Triglyceride levels were also examined, and the results revealed that the positive control group's mean serum triglyceride level was significantly greater than the negative control group's, which were

141.50 and 65.00 mg/dl, respectively. Although the obese groups that had received treatment had the highest serum triglyceride levels ever recorded. The highest value was 100ml of avocado alcohol extract plus 15% casein, while the least significant changes were 100ml of avocado alcohol extract alone. The corresponding mean values were 93.80 and 71.45 mg/dl. These findings are in line with those of **Sadava *et al.*, (2011),** who claimed that the avocado seed, fruit, and leaf extracts significantly reduced the levels of plasma and liver cholesterol. Additionally, it appears that by lowering cholesterol levels, avocado extracts would likely prevent cardiovascular diseases, obesity, and heart diseases. However, it is also claimed that the drop in plasma cholesterol that occurs after this extract is administered can impact bile salt metabolism.

According to **Pérez and García, (2007)**, avocado pulp dosage had a hypolipidemic impact on Wistar rats. They used 1% cholesterol to cause hypercholesterolemia, and they found that both triglycerides and total cholesterol significantly decreased.

Table (1) Effect of avocado fruits and its extract on serum total cholesterol, and triglycerides of obese rats

Parameters / Groups	Total cholesterol mg/dl	Triglycerides mg/dl
G_1 C (-)	$78.50^{g}\pm1.75$	$65.00^{g}\pm1.58$
G_2 C (+)	$160.00^{a}\pm3.32$	$141.50^{a}\pm2.85$
G3 (20% Fresh avocado)	$105.55^{d}\pm2.54$	$85.60^{d}\pm3.41$
G4 (100ml/kg Avocado alcoholic extract)	$88.80^{f}\pm2.01$	$71.45^{f}\pm2.04$
G5 (100ml/kg Tulango – slim dietary supplement)	$125.90^{b}\pm3.10$	$90.30^{c}\pm2.34$
G6 (100ml/kg Avocado alcoholic extract +15% Casein)	$106.50^{d}\pm2.63$	$93.80^{b}\pm2.60$
G7 (100ml/ kg Avocado alcoholic extract +15% Coconut oil) 100ml/kg Avocado alcoholic	$110.15^{c}\pm2.80$	$89.15^{c}\pm2.12$
G8 (100ml/ kg Avocado alcoholic extract +15% Corn starch)	$95.10^{e}\pm2.31$	$78.50^{e}\pm2.15$
LSD ($P \leq 0.05$)	**3.480**	**2.850**

Each value is represented as mean ± standard deviation (n = 3).
Mean under the same column bearing different superscript letters are different significantly ($P \leq 0.05$).

According to the information in Table 2, different levels of fresh avocado fruit and its extract have an influence on obese rats' levels of high-density lipoprotein cholesterol (HDL-c), low-density lipoprotein cholesterol (LDL-c),very low-density lipoprotein cholesterol (VLDL-c), and atherogenic index (AI). The acquired results showed that, with significant differences, the positive control group had the lowest high density lipoprotein cholesterol levels, and the negative control group had the highest levels. They were 51.17 and 34.50 mg/dl on average, respectively. However, there were significant differences between the highest levels of high-density lipoprotein cholesterol in treated groups (obese groups) measured for 100ml/kg avocado alcoholic extract and the lowest values measured for 100ml/kg dietary supplement (anti-obesty drug), the mean values which were 46.75 and 39.70 mg/dl, respectively.

Results also showed that, with statistically significant differences, the positive control group had the highest levels of low density lipoprotein cholesterol while the negative control group had the lowest values. The relative mean values were 97.20 and 14.33 mg/dl. On the other hand, 100ml/kg avocado alcoholic extract had the greatest low density lipoprotein cholesterol levels among the treated groups (obese groups), while100ml/kg dietary supplement (anti-obesty drug) had the lowest value, with significant differences, the respective means were 67.54 and 27.76 mg/dl.

It was found that the positive control group had the greatest amounts of very low-density lipoprotein cholesterol, whereas the negative control group had the lowest levels, with statistically significant differences. The relative mean values were 28.30 and 13.00 mg/dl. In contrast, 100ml/kg avocado alcoholic extract had the greatest VLDL-c levels among the treated groups (obese groups), while 100ml/kg avocado alcoholic extract + 15 % casein had the lowest value, with differences that were statistically significant, which were 18.76 and 14.29 mg/dl respectively.

As for atherogenic index (AI), the obtained results indicated that with statistically significant differences, the positive control group had the highest levels of AI while the negative control group had the lowest values, which were 3.64 and 0.53 %. On the other hand, 100ml/kg avocado alcoholic extract had the greatest AI levels among the treated groups (obese groups), while100ml/kg dietary supplement (anti-obesty drug) had the lowest value, with significant differences, the corresponding means values were 2.17 and 0.90 mg/dl, respectively. According to **Fulgoni-Iii *et al.*, (2013),** avocado fruit consumers tend to have higher levels of high-density lipoprotein (HDL) cholesterol, a lower risk of developing metabolic syndrome, and lower weight, body mass index (BMI), and waist circumference than avocado nonconsumers. These findings are in line with their findings.

Additionally, according to **Wang *et al.* (2015),** avocado-containing diets increased HDL cholesterol levels in comparison to low-fat, cholesterol-lowering diets, while triglyceride, low-density lipoprotein (LDL) cholesterol, and total cholesterol (TC) levels remained the same or decreased. To ascertain the effect of dietary fat consumption on serum lipids, these trials instead used avocados as a source of MUFA in dietary treatments that replaced macronutrients.

These findings corroborated **Schafer. (2008),** findings, which showed that eating avocado fruit caused a significant drop in serum cholesterol, triglycerides, total lipid, LDL-c, and VLDL-c levels as well as an increase in HDL-c.

Table (2): Effect of avocado fruits and its extract on lipid profile of obese rats

Parameters / Groups	HDL-C mg/dl	LDL-c mg/dl	VLDL-c mg/dl	AI %
G_1 C (-)	51.17^{a}±1.58	14.33^{h}±1.13	13.00^{d}±1.06	0.53^{d}±0.18
G_2 C (+)	34.50^{e}±1.20	97.20^{a}±2.30	28.30^{a}±1.25	3.64^{a}±0.28
G3 (20% Fresh avocado)	43.40^{c}±1.42	45.03^{d}±1.48	17.12^{b}±1.28	1.43^{b}±0.58
G4 (100ml/kg Avocado alcoholic extract)	46.75^{b}±1.50	27.76^{g}±1.22	14.29^{c}±1.13	0.90^{c}±0.18
G5 (100ml/kg Tulango – slim dietary supplement)	39.70^{d}±1.28	67.54^{b}±1.51	18.66^{b}±1.27	2.17^{b}±0.70
G6 (100ml/kg Avocado alcoholic extract +15% Casein)	45.85^{b}±1.61	41.89^{e}±1.46	18.76^{b}±1.24	1.32^{c}±0.58
G7 (100ml/ kg Avocado alcoholic extract +15% Coconut oil)	40.70^{d}±1.36	51.62^{c}±1.50	17.83^{b}±1.30	1.70^{b}±0.25
G8 (100ml/ kg Avocado alcoholic extract +15% Corn starch)	41.15^{d}±1.35	38.25^{f}±1.37	15.70^{c}±1.19	1.31^{c}±0.23
LSD (P ≤ 0.05)	**2.160**	**2.890**	**1.920**	**0.741**

Each value is represented as mean ± standard deviation (*n* = 3)
Mean under the same column bearing different superscript letters are different significantly (P≤ 0.05).

The effect of fresh avocado fruit and its extract on the glucose levels of obese rats is demonstrated by the data in Table (3). It is obvious to see that the positive control group had the highest glucose levels, whilst the negative control group had the lowest value with statistically significant differences, the corresponding mean values were 162.05 and 101.13 mg/dl. On the other hand, the greatest glucose levels of the treated groups (obese groups) were found in a 100 ml/kg dietary supplement (anti-obesty drug) and vice versa with 100 ml/kg avocado alcohol extract, with significant differences between them. The mean values were respectively 139.25 and 127.20 mg/dl. The findings are in line with those of **Anyakudo and Adediji (2021),** who discovered that eating avocados reduced blood sugar levels and body weight growth while improving lipid profiles and glycemic tolerance in experimental diabetic rats. However, the manner of consumption had an impact on the prospective effects of the fruit.

Moreover, avocados include monounsaturated fats, which have been shown to increase insulin sensitivity and decrease postprandial insulin, according to **Mahadeva-Rao's (2017)**. Avocado extracts reduce oxidative stress in the rat pancreas while inhibiting enzymes like amylase. Additionally, research with avocado extracts revealed that it influences how rats' carbohydrate metabolic enzymes behave.

Table (3) Effect of avocado fruits and its extract on glucose level of obese rats

Parameters / Groups	Glucose mg/dl
G_1 C (-)	$101.13^{e}\pm1.50$
G_2 C (+)	$162.05^{a}\pm2.17$
G3 (20% Fresh avocado)	$138.33^{b}\pm2.01$
G4 (100ml/kg Avocado alcoholic extract)	$127.20^{d}\pm1.97$
G5 (100ml/kg Tulango – slim dietary supplement)	$139.25^{b}\pm2.10$
G6 (100ml/kg Avocado alcoholic extract +15% Casein)	$134.15^{c}\pm1.83$
G7 (100ml/ kg Avocado alcoholic extract +15% Coconut oil)	$138.25^{b}\pm1.97$
G8 (100ml/ kg Avocado alcoholic extract +15% Corn starch)	$137.15^{b}\pm1.90$
LSD (P≤ 0.05)	**3.452**

Each value is represented as mean ± standard deviation (n = 3).
Mean under the same column bearing different superscript letters are different significantly (P ≤ 0.05).

The effects of fresh avocado fruit and its extract on the liver enzyme activity like ALT, AST, and ALP levels of obese rats are shown by the data in Table (4). It is obvious to note that the positive control group had the highest ALT liver enzyme levels, whereas the negative control group had the lowest value, with significant differences. The corresponding mean values were 93.20 and 45.20 U/L, respectively. In contrast, 100 ml/kg dietary supplement (anti-obesty drug) had the highest ALT liver enzyme among the treated groups (obese groups), while 100 ml/kg avocado alcohol extract had the lowest value, with differences that were statistically significant. The average values were respectively 72.70 and 51.25U/L, respectively.

On the other hand, the positive control group had the highest levels of the AST liver enzyme, whereas the negative control group had the lowest values, with significant differences. The relative mean values were 72.95 and 36.95U/L, respectively. Contrarily, the greatest AST liver enzyme of treated groups (obesity groups) was found in 100 ml/kg dietary supplement (anti-obesty drug), while the lowest value was found in a 100 ml/kg avocado alcohol extract, with differences that were statistically significant. The corresponding mean values were 51.45 and 38.30U/L, respectively.

As for ALP liver enzyme, data indicated that the positive control group had the highest levels whereas the negative control group had the lowest levels, with significant differences. There were 65.48 and 30.05 U/L on average, respectively. Regarding ALP liver enzyme, treatment groups (obesity groups) recorded the highest values for 100 ml/kg dietary supplement (anti-obesty drug) and the lowest values for a 100 ml/kg avocado alcohol extract, with a significant difference, which were 48.45 and 33.15 U/L on average, respectively. These findings support the findings of **Al-Dosari (2011),** feeding on a high-cholesterol diet with avocado fruit fortified at 15% and 25% led to a substantial drop in serum aspartate aminotransferase (AST) and alanine aminotransferase (ALT) levels that was $P \leq 0.05$ lower than the positive control group.

Additionally, **Mahmoed and Rezq, (2013)** found that avocado significantly increased the activity of SOD, GPX, and CAT enzymes compared to that of the positive control rats and significantly decreased the serum concentrations of liver enzymes like AST, ALT, ALP, TP, total and direct bilirubin, and MDA. Due to the phenloic and flavonid chemicals in avocado fruit, it also significantly strengthened liver functions and the antioxidant system.

Table (4) Effect of avocado fruits and its extract on liver functions of obese rats

Groups \ Parameters	ALT U/L	AST U/L	ALP U/L
G_1 C (-)	45.20^{f}±1.10	36.95^{e}±1.21	30.05^{f}±1.22
G_2 C (+)	93.20^{a}±1.65	72.95^{a}±1.55	65.48^{a}±1.48
G3 (20% Fresh avocado)	57.50^{d}±1.23	45.40^{c}±1.40	39.40^{d}±1.35
G4 (100ml/kg Avocado alcoholic extract)	51.25^{e}±1.15	38.30^{e}±1.25	33.15^{e}±1.24
G5 (100ml/kg Tulango – slim dietary supplement)	72.70^{b}±1.50	51.45^{b}±1.42	48.45^{b}±1.41
G6 (15% Casein + 100ml/kg Avocado alcoholic extract)	60.80^{c}±1.17	41.25^{d}±1.25	38.27^{d}±1.31
G7 (15% Coconut oil + 100ml/kg Avocado alcoholic extract)	63.25^{c}±1.44	45.10^{c}±1.38	48.25^{b}±1.40
G8 (15% Corn starch +100ml/ kg Avocado alcoholic extract)	62.70^{c}±1.25	42.25^{d}±1.27	45.15^{c}±1.36
LSD (P ≤ 0.05)	**3.170**	**2.602**	**2.711**

The effects of fresh avocado fruit and its extract on renal functions (urea, uric acid, and creatinine) are shown in obese rats by the data in Each value is represented as mean ± standard deviation (*n* = 3).
Mean under the same column bearing different superscript letters are different significantly (P≤ 0.05).

Table (5). The collected results showed that the positive control group had the highest serum urea levels, whereas negative control group had the lowest value with statistically significant differences. The corresponding mean values were 35.50 and 17.52 mg/dl. On the other hand, the greatest urea levels of the treated groups (obese groups) were found in 100 ml/kg dietary supplement (anti-obesty drug), while the lowest value was found in the 100 ml/kg avocado alcohol extract. These differences were statistically significant. The corresponding mean values were 29.40 and 22.35 mg/dl, respectively.

The acquired results demonstrated that the positive control group had the highest serum uric acid levels, whereas the negative control group had the lowest value, with significant differences. 9.95 and 5.70 mg/dl on average, respectively. On the other hand, the treated groups (obese groups) had serum uric acid levels that were highest when 100 ml/kg dietary supplement (anti-obesty drug), was used, and lowest when a 100 ml/kg avocado alcohol extract was used, with statistically significant. They were 7.50 and 6.40 mg/dl on average, respectively.

The positive control group had the highest serum creatinine levels, while the negative control group had the lowest levels, according to the findings, with statistically significant differences between the two groups. The respective relative mean values were 0.93 and 0.57 mg/dl. On the other hand, the treated groups (obese groups) exhibited serum creatinine levels that varied, with differences that were statistically significant, from the highest for 100 ml/kg dietary supplement (anti-obesty medication) to the lowest recorded for 100 ml/kg avocado alcohol extract. The means values were 0.85 and 0.75 mg/dl, respectively. These findings support the findings of **Mahadeva *et al.*, (2014)** who claimed that avocado fruit extract has nephroprotective properties. It has been demonstrated that a diet high in avocado extract alters kidney functioning.

Additionally, avocado extract improved kidney vascular function during the contraction caused by the stimulation of the AT1 receptors and lowered blood pressure in hypertensive rats. How avocado extract affects renal vasoconstriction in response to adrenergic stimulation, and whether this affects renal damage and mitochondrial activity **Márquez-Ramrez *et al.,(* 2018)**.

Table (5): Effect of avocado fruits and its extract on kidney functions of obese rats

Parameters / Groups	Urea mg/dl	Uric acid mg/dl	Creatinine mg/dl
G_1 C (-)	17.52[e]±1.21	5.70[d]±0.25	0.57[c]±0.25
G_2 C (+)	35.50[a]±1.85	9.95[a]±0.64	0.93[a]±0.21
G3 (20% Fresh avocado fruit)	24.71[c]±1.50	6.80[c]±0.31	0.77[b]±0.15
G4 (100ml/kg Avocado alcoholic extract)	22.35[d]±1.42	6.40[c]±0.43	0.75[b]±0.13
G5 (100ml/kg Tulango – slim dietary supplement)	29.40[b]±1.36	7.50[b]±0.55	0.85[a]±0.17
G6 (15% Casein + 100ml/kg Avocado alcoholic extract)	26.15[c]±1.31	7.20[b]±0.50	0.76[b]±0.14
G7 (15% Coconut oil + 100ml/kg Avocado alcoholic extract)	28.80[b]±1.43	7.70[b]±0.47	0.77[b]±0.16
G8 (15% Corn starch +100ml/ kg Avocado alcoholic extract)	25.18[c]±1.33	6.70[c]±0.40	0.76[b]±0.15
LSD ($P \leq 0.05$)	**1.580**	**0.721**	**0.048**

Each value is represented as mean ± standard deviation ($n = 3$).
Mean under the same column bearing different superscript letters are different significantly ($P \leq 0.05$).

Conclusion

Fresh avocados and their alcohol extracts improved the serum lipid profiles of rats and decreased obesity, liver enzymes, and renal function. This study therefore suggests the possibility of using fresh avocado and its extract as natural dietary supplements to improve diets and reduce risk factors for chronic diseases, including obesity.

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التأثيرات المحتملة المضادة للسمنة لفاكهة الأفوكادو الطازة ومستخلصها الكحولى على الفئران التي تم تغذيتها على نظام غذائي عالى الدهون

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الملخص العربى

الأفوكادو مصدر ممتاز لمضادات الأكسدة والعناصر الغذائية الضرورية. أظهرت هذه المركبات آثارًا مفيدة على فئران التجارب ، مما يساعد في التحكم في الوزن وتقليل مخاطر الإصابة بالعديد من الأمراض. الهدف الرئيسي من هذه الدراسة هو تقييم فعالية فاكهة الأفوكادو الطازجة ومستخلصها الكحولي وكذلك دواء التلانجو–سلم (مكمل غذائي مضاد للسمنة) في تقليل السمنة لدى الفئران البدينة. تم تقسيم الفئران إلى ثماني مجموعات كل مجموعة مكونة من ستة إناث فئران ألبينو ، متوسط أوزن كل مجموعة ١٥٠جم ± ١٠ جم ، من ثمانية وأربعين فأرًا مستخدمة في هذه الدراسة. تم تغذية الفئران بنظام غذائي عالي الدهون (٢٠٪ دهون حيوانية) للوصول إلى درجة من الزيادة في الوزن أو السمنة. قامت الدراسة أيضًا بقياس الدهون الثلاثية (TG) والبروتين الدهني عالي الكثافة (HDL–c) والبروتين الدهني منخفض الكثافة (LDL–c) والبروتين الدهني منخفض الكثافة جدًا (VLDL–c) ومؤشر تصلب الشرايين (AI) ومستويات الجلوكوز و إنزيمات الكبد (ALT و AST و ALP) ووظائف الكلى (اليوريا وحمض البوليك والكرياتينين). أظهرت النتائج أنه عندما أعطيت الفئران مستخلص الأفوكادو ، كان لدى المجموعة البدينة مستويات جلوكوز منخفضة وأنشطة كبدية ووظائف كلوية منخفضة بشكل ملحوظ. مع وجود فروق ذات دلالة إحصائية ، المجموعة التي تغذت على ١٠٠مل من مستخلص الأفوكادو سجلت أقل مستويات من الكوليسترول الكلي والدهون الثلاثية ، وكذلك أدنى مستويات البروتين الدهني منخفض الكثافة ، والبروتين الدهني منخفض الكثافة للغاية ، ومعامل الخطورة تصلب الشرايين. والعكس مع البروتين الدهني عالي الكثافة.كانت الفئران البدينة التي تلقت ١٠٠ مل من مستخلص الأفوكادو تتمتع بمظهرمرضي أو مقبول للدهون ، ومستويات الجلوكوز ، ووظائف الكبد والكلى.

الكلمات الأفتتاحية: فاكهة الأفوكادو, نظام غذائي عالي الدهون, الكوليسترول الكلي, الدهون الثلاثية, وظائف الكبد والكلى, مستويات الجلوكوز.