EVALUATION OF L-CARNITINE NATURAL SOURCES AS SERUM HYPOCHOLESTEROLEMIC

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ABSTRACT:

The present work aimed to evaluate the effect of of L- carnitine, avocado, almond, grape seeds &mixture of all on hypercholesterolemic rats. For this purpose, the studies included about 35 rats 150/±10 (g) weight .Rats were fed on normal (basal) diet. The animals were divided to 7 equal group, group(1)was kept as control- ve group, while the other 6 groups were fed of high fat diet and cholesterol by 1.5% of the basal diet for two weeks.Group (2): Control positive (+ve), in which hypercholesterolemic which rats were fed on basal diet for 28 days. Group (3): Hypercholesterolemic rats were fed on basal diet containing7.5% L-carnitine for 28 days .Group (4): Hypercholesterolemic rats were fed on basal diet containing 7.5% avocado for 28 days.Group (5): Hypercholesterolemic rats were fed on basal diet containing 7.5% Almond for 28 days.Group (6): Hypercholesterolemic rats were fed on basal diet containing 7.5% grape seeds for 28 days.Group (7): Hypercholesterolemic rats were fed on basal diet containing 7.5% combination of all plants for 28 days. At the end of experimental period (28 day), animals were scarificed. Blood samples were collected to determine the following parameters: Level of serum liver enzymes (ALT, AST and ALP).total cholesterol, triglycerides, lipoprotein fractions (HDL-c, LDL-c and VLDL-c), uric acid, urea nitrogen, creatinine .The results could be summarized as follows: Due to hypercholesterolemia, rats BWG, FI and FER were increased. Feeding on basal diet contained L- carnitine, avocado, almond, grape seeds &mixture of (as7.5%) lowered the BWG, FI and FER.Inflicting with hypercholesterolemia raised the internal organ weight, while the reverse indicated on feeding with L- carnitine, avocado, almond, grape seeds &mixture of all (as7.5%).

Hypercholesterolemic rats showed increased levels of TC, TG, LDL, & VLDL ,but decreased the serum HDL.Rats fed on mixture of all plants and seeds (group7) recorded the best potencyin lowering TC. Best treatment for BWG &FER was the almond, for FI, Creatinine, AST, ALT& Uric acid was the grape seeds , for HDL was avocado, while for internal organs weights, TC ,TG,LDL,VLDL,AST,ALT,ALP,Urea and glucose was the mixture of all plants.

Key words: - grape seeds (Vitis vinifera), avocado (Persea Americana) almond (Prunus dulcis) , l_carnitine , cholesterol, triglycerides, liver function, kidney function , serum glucose.

تقييم المصادر الطبيعية للكارنيتين اليساري (L-Carnitine) كوسيله لخفض مستوي الكوليستيرول في السيرم

الملخص العربي :

تم اجراء هذه الدراسه الحاليه لمعرفه تأثير بعض المصادر الطبيعيه النباتيه للكارنيتين (الافوكادو– بذور العنب& اللوز ومخلوطهم بنسبه ٧.٥ %) علي دهون الدم في فئران التجارب المصابة بإرتفاع الكوليتسرول . وقد اجريت هذه الدراسه على عدد ٣٥ فأر ابيض بالغ وزن كل منهم (١٥٠± ١٠ جم) ويتم تغذيتها على الغذاء الاساسى كما قدم لها الماء طوال التجربه.وتم تقسيم الفئران الى ٧ مجموعات متساويه وتركت احداها كمجموعه ظابطه (سالبه) اما المجموعات الست الاخرى فتم احداث ارتفاع للكوليستيرول بتغذية الفئران علي وجبه مرتفعة في الدهون (أضيف ١٠% خروف و ١.٥ % كوليستيرول من الوجبة الكليه لمدة أسبوعين . وتم تقسيم الفئران المصابه بإرتفاع الكوليستيرول الى مجموعات كالاتى :

٢– الثانيه : تركت كمجموعه ضابطه موجبه ويتم تغذيتها على الغذاء الاساسى .

٣– الثالثه : اعطيت الغذاء الاساسى بالاضافه الى ٧,٥% من مسحوقL-Carnitine (كارنتين يساري).

٤– الرابعه : اعطيت الغذاء الاساسى بالاضافه الى ٧,٥% من مسحوق الافوكادو.

٥– الخامسه: اعطيت الغذاء الاساسى بالاضافه الى ٧,٥% من مسحوق اللوز.

٦– السادسه : اعطيت الغذاء الاساسى بالاضافه الى ٥% من مسحوق بذور العنب.

٧– السابعه : اعطيت الغذاء الاساسى بالاضافه الى ٧,٥% من (خليط من النباتات).

وقد تم اعطاء النباتات السالف ذكرها لمده ٢٨ يوم . وبعد نهايه التجربه تم اخذ عينات الدم من جميع الفئران بكل المجموعات وتم فصل السيرم وذلك لقياس مايلى من المؤشرات :

- انزيمات الكبد (ALT,AST,ALP)
- وظائف الكلي (urea – creatinine – uric acid)
- الكوليسترول الكلى ,الجليسريدات الثلاثيه , الليبوبروتينات (HDL-c, LDL-c,VLDL-c).

وفيما يلى اهم نتائج هذه الدراسه :

١. حدوث ارتفاع بدرجه معنويه فى معدل اكتساب الوزن ,المأخوذ الغذائى ,ومعدل الاستفاده من الطعام للمجموعه الضابطه الموجبه (المصابة) مقارنه بالمجموعه الضابطه السالبه (الطبيعيه) اما المجموعات التى تم إحداث ارتفاع الكوليتسرول لها ثم تغذت على مسحوق النباتات فقد

أظهرت انخفاضا فى المؤشرات بدرجات معنويه بالمقارنه بالمجموعه الضابطه الموجبة وكانت افضل المعاملات للتغير في الوزن وكفاءه الاستفاده من الغذاء هي بذور اللوز والمأخوذ الغذائي بذور العنب .

٢. أدي الكارنيتين الي تحسن في كل العوامل المدروسه ولكن في معظم الاحيان التغذيه علي النباتات والبذور تحت الدراسه كان لها تأثير افضل .

٣. إرتفاع الكوليستيرول أدي الي زياده في وزن الكبد والقلب والكلي ومحتوي السيرم في TC, TG,LDL,AST, ALP,VLDL,ALT, الكرياتنين , اليوريا حامض اليوريك ومستوي الجلوكوز مع الانخفاض في HDL .

٤. أفضل المعاملات لإرتفاع الكرياتنين , U.A , AST , ALT في بذور العنب ولإنخفاض HDL هي ثمار الأفوكادو . بينما كانت أفضل معامله هي خليط الافوكادو مع بذور اللوز والعنب فيما يخص أوزان الاعضاء الداخلية , TC, TG, VLDL , HDL, LDL , AST, ALT , ALP , UREA ومستوي الجلوكوز .

الكلمات المفتاحية :

بذور العنب – الافوكادو – اللوز – كارنتين يساري – الكوليتسرول – دهون الدم – وظائف الكلي – وظائف الكبد – جلوكوز الدم .

INTRODUCTION:

Cholesterol suffix *-ol* as alcohol, is a hydrocarbon organic molecule. It is a sterol (or modified steroid), a lipid molecule and is biosynthesized by all animal cells because it is an essential structural component of animal cell membranes that is required to maintain both membrane structural integrity and fluidity. Cholesterol enables animal cells to protect membrane integrity/cell-viability and animals to move (unlike bacteria and plant cells which are restricted by their cell walls).In addition to its importance within cells, cholesterol also serves as a precursor for the biosynthesis of steroid horm ones. Cholesterol is the principal sterol synthesized by cells of all animals. In vertebrates the hepatic cells typically produce greater amounts than other cells. It is almost completely absent among prokaryotes (i.e., bacteria), although there are some exceptions such as mycoplasma, which require cholesterol for growth. François Poulletier de la Salle first identified cholesterol in solid form in gallstones in 1769. However, it was not until 1815 that chemist Michel Eugène Chevreul named the compound "cholesterine".

Hypercholesterolemia (also spelled hypercholesterolaemia) is the presence of high levels of cholesterol in the blood. It is a form of "hyperlipidemia" (elevated levels of lipids in the blood) and "hyperlipoproteinemia" (elevated levels of lipoproteins in the blood). Plant cells do not manufacture cholesterol. It is also the precursor of the steroid hormones, bile acids and vitamin D.Since cholesterol is insoluble in water, it is transported in the blood plasma within protein particles (lipoproteins). Lipoproteins are classified by their density: Very low density lipoprotein (VLDL), intermediate density lipoprotein (IDL), low density lipoprotein (LDL) and high density lipoprotein (HDL). All the lipoproteins carry cholesterol, but elevated levels of the lipoproteins other than HDL (termed non-HDL cholesterol), particularly LDL-cholesterol are associated with an increased risk of atherosclerosis and coronary heart disease. In contrast higher levels of HDL cholesterol are protective. Elevated levels of LDL in the blood may be a consequence of diet, obesity, inherited (genetic) diseases (such as LDL receptor mutations in familial hypercholesterolemia), or the presence of other diseases such as diabetes and an underactive thyroid.

Reducing saturated dietary fat is recommended to reduce total blood cholesterol and LDL in adults. In people with very high cholesterol (e.g. familial hypercholesterolemia), diet control is often insufficient to achieve the desired lowering of LDL and lipid lowering medications which reduce cholesterol production or absorption are usually required. If necessary, other treatments such as LDL apheresis or even surgery (for

particularly severe subtypes of familial hypercholesterolemia) are performed. Hypocholesterolemia is the presence of abnormally low (hypo-) levels of cholesterol in the blood (-emia). Although the presence of high total cholesterol (hyper-cholesterolemia) correlates with cardiovascular disease, a defect in the body's production of cholesterol can lead to adverse consequences as well. Cholesterol is an essential component of mammalian cell membranes and is required to establish proper membrane permeability and fluidity. It is not clear if a lower than average cholesterol level is directly harmful; it is often encountered in particular illnesses. **(Wikipedia, the free encyclopedia, 2014).**

Tavia *et al.*, (1977) said that Lipids values, including fasting triglycerides,high density lipoproteins (HDL), low density llpoproteins (LDL) and total cholesterol levels, were obtained on 2,815 men and women aged 49 to 82 years chiefly between 1969 and 1971 at Framingham. In the approximately four years following the characterization of lipids, coronary heart disease developed in 79 of the 1,025(7.7%) men and 63 of the 1,445(4.4%) women free of coronary heart diseases. At these older ages the major potent lipid risk factor was HDL cholesterol, which had an inverse association with the incidence of coronary heart disease ($p < 0.001$) in either men or women. This lipid was associated with each major manifestation of coronary heart disease. These associations were equally significant even when other lipids and other standard risk factors for coronary heart disease were taken into consideration.

William *et al.*, (1986) reported that the first report from the Framingham Study that demonstrated an inverse relationship between high-density lipoprotein cholesterol (HDL-C) and the incidence of coronary heart disease (CHD) was based on four years of surveillance. These participants, aged 49 to 82 years, have now been followed up for 12 years, and this report shows that the relationship between the fasting HDL-C level and subsequent incidence of CHD does not diminish appreciably with time. It is concluded that nonfasting HDL-C and total cholesterol levels are related to development of CHD in both men and woman aged 49years and older.

MATERIALS AND METHODS

Materials:

A- Used plants and their preparation:

The plants which used in this study; *Grape seeds (Vitis vinifera), avocado (Persea Americana) and* almond *(Prunus dulcis*); were obtained from local market and herb shop, dried at 105c^{o} and milled.

B- Experimental animals: Thirty five (35) (spargue – Dawley strain) male albino rats, weighting (150 ± 10 g) were used in this study. Rats

were housed in wire cages under the normal laboratory condition and fed on basal diet for 4 consecutive days as adaptation period.Tap water was provided to rats by means of glass tubes projecting through wire cages from inverted bottles supported to one side of the cage.

C- Used chemicals: Powdered cholesterol was obtained from El-Gomhoryia Company for Chemical Industries, Cairo, Egypt.

Methods:

A- Biological Experiment

1- Chemical Composition of Basal Diets: The basal diet consisted of casein (12%), corn oil (10%), choline chloride (0.25%), vitamins mixture(1%), cellulose (5%), salt mixture (4%) , corn starch (up to100%) and according to **(Campbell,1963).** The composition of salt and vitamins mixture was according to **(Hegested *et al.*, 1941 and Campbell, 1963).**

2- Preparation of hypercholesterolemic rats: Thirty (30) male albino rats (Spargue –Dawley strain) weighing (150 ± 10 g) were fed by on 10% animal fats(sheep tail) & Powdered cholesterol (1.5%of the basal diet) for two weeks to get hypercholesterolemic rats.

3- Experimental designs: Thirty five (35) (Spargue – Dawley strain) male albino rats were distributed into 7 groups each of 5 rats in which means of rats weight for all groups were nearly equal. All the groups of rats were housed in wire cages and fed on the experimental diet for 4 weeks according to the following groups:

- Group (1): Control negative group (-ve), in which normal rats were fed on basal diet for 28 days.
- Group (2): Control positive (+ve), in which hypercholesterolemic rats were fed on hypercholesterolemic basal diet for 28 days.
- Group (3): Hypercholesterolemic rats were fed on basal diet containing 7.5 % l_carnitine for 28 days.
- Group (4): Hypercholesterolemic rats were fed on basal diet containing 7.5 % avocado for 28 days.
- Group (5): Hypercholesterolemic rats were fed on basal diet containing 7.5 % almond for 28 days.
- Group (6): Hypercholesterolemic rats were fed on basal diet containing 5 % grape seeds for 28 days.
- Group (7): Hypercholesterolemic rats were fed on basal diet containing 7.5% combination of all plants for 28 days.

4- Biological evaluation: During the experimental period, the diet consumed was recorded every day, and body weight recorded every week. The body weight gain (BWG %) and feed efficiency ratio (FER) were

calculated according to **Chapman *et al.*, (1959).**using the following equations :

Body Weight Gain = Final weight (g) - Initial Weight (g) ×100 / Initial Weight (g)

Feed efficiency ratio (FER) = Daily gain in body weight (g) Feed intake (g/day).

5-Biochemical analysis of serum

5.1) Determination of Serum Lipids profile:

5.1.1) Determination of serum total triglycride

Enzymatic colorimetric determination of triglycrides was carried out according to **Fassati and Prencipe (1982).**

5.1.2) Determination of serum total cholesterol **(lopez , 1977)**

The principle use of total cholesterol determination according to **Allain (1974).**

5.1.3) Determination of Serum HDL-Cholesterol **(Allain , 1974)**

5.1.4) Calculation of serum VLDL and LDL -Cholesterol:

The calculation of serum VLDL (very low density lipoprotein) and LDL were carried out according to the method of **Lee and Nieman (1996**) as follows.

VLDL (mg/dl) = TG (mg/dl) / 5

LDL (mg/dl) = Total Cholesterol - [(VLDL-C) + (HDL-C)].

5.2. Determination of Liver enzymes:

5.2.1. Determination of GPT (ALT):

Determination of GPT was carried out according to the method of **Henry (1974) and Yound (1975).**

5.2.2) Determination of GOT (AST):

Determination of GOT was carried out according to the method of **Henry (1974) and Yound (1975).**

5.2. 3) Determination of (ALP):

Determination of Alkaline Phosphatase (ALP): Kits were obtained from Biosystems S.A.Kits, Barcelona (Spain). Serum ALP was determined according to **IFCC methods (1983).**

6-Statical Analysis: The data were statically analysed using a computerized costat program by one way ANOVA. The results are presented as mean ± SD. Differences between treatments at $p \leq 0.05$ were considered significant.

RESULTS AND DISSCUSION

Table (1) results show the mean value of body weight gain % of hypercholesterolemic rats fed on various diets. It could be noticed that the mean value of BWG% of control (+) group was higher than control (-) group, being 37.47±1.5&20.29±1.9% respectively, showing significant difference with percent of decrease (-45.58%)of control (-) group as compared to control (+).All treatment indicate significant decreases as compared to control (+) group at ($p<0.05$). The best BWG % was recorded for group 7 (the mixture of all plants and seeds) when compared to control (-) group.

Table (2) Result According to **Abd Elwahab, maswa (2012)** hypercholesterolemia raised BWG, FI & FER.on the contrary almond seeds recorded the reverse. Indicate the mean value of feed intake (g/day) of hypercholesterolemic rats fed on variable diets. Data revealed that the mean value of (F.I) of control (+) group was higher than control (-) group, being 13.31± .04 &12.12± .04 respectively, showing significant difference with percent of decrease(-8.94) of control (-) group as compared to control (+).All treatment indicated significant decreases as compared to control (+) group at ($p<0.05$). The best F.I was recorded for group6(hypercholesterolemic rats fed grape seeds) even when compared to control (-) group.

Data of table (3) illustrate the mean value of FER of hypercholesterolemic rats fed on different diets. The result showed that the mean value of FER of control (+) group was higher than control (-) group, being.028±.001&.016±.0015 respectively, showing significant increase with percent of decrease(-42.86) of control (-) group as compared to control (+).All treatment indicate significant decreases as compared to control (+) group at ($p<0.05$). The Lowest FER was recorded for group 5(hypercholesterolemic rats fed on almond seeds diet when compared to control (-) or control (+) group.

Table (4) Results show the mean value of Internal organs weights liver, heart, kidneys weights (g) of hypercholesterolemic rats fed on various diets. It could be noticed that the mean value of Internal organs (g) of control (+) group were higher than control (-) group, being 3.75±.58&2.52±.44 .067±0.7&,0.67±0.7&0.087±0.108 and 0.77±0.1&0.48±0.03 respectively. showing significant increases control (+) compared to control (-) group .All hypercholesterolemic rats fed on various diets showed significant decreases in mean values of Internal organs weights as compared to control (+) group. The best of the Internal organs weights weight was revealed for group7 (hypercholesterolemic rats fed on mixture diet) when compared to control (+) group.

B- Biochemical parametrs.

1- lipids profile

table (5) Data presented in tables (5-10)show the levels of TC,TG,VLDL,HDL,LDL of hypercholesterolemic rats no effected by addition of L- carnitine and sourses of L- carnitine , being avocado fruit, almond seeds , grape seed and mixture of all phytogenic sources of the L-carnitine . It is evident that hypercholesterolemia raised TC , TG , VLDL, LDL while lowered the HDL. Nevertheless L- carnitine and its natural vegetable sources reverled these changes . Except for LDL the best value of lipids parameters was even better than that recorded for the control (-) group . Best treatment for all lipids profile parameters (TC ,TG, VLDL,LDL) was that of the mixture of all plants , while for HDL was that of avocado diet . Many authors **Abbey etal; Dianne etal; (2002)and Olivia etal; (2009)** Found that hypercholesterolemia raised TC , TG , VLDL, LDL while reduced HDL,and feeding with almond seeds or oil reversed such changes revealing hypocholesterolemia (Eman **etal;** 2013).

2- Liver function enzymes

Data of table (11) illustrate the mean value of serum (GOT) (U/L) of hypercholesterolemic rats fed on different diets. It could be noticed that the mean value of (GOT)of control (+) group was higher than control (-) group,being137±.8 &78±1 respectively, showing significant difference with percent of decrease -43.6 % of control (-) group when compared to control (+)group. All hypercholesterolemic rats fed on different diets revealed significant decreases in mean values as compared to control (+) group. Grape seeds (group6) revealed the best treatment when compared to control (-) group considering (AST) activity.

Table (12) Show the mean value of serum (GPT) (U/L) of hypercholesterolemic rats fed on different diets. . It could be observed that the mean value of (GPT) of control (+) group was higher than control (-) group, being 50±.5 &35±.7 respectively, showing significant difference with percent of decrease -30% of control (-) group when compared to control (+) group. All hypercholesterolemic rats fed on different diets revealed significant decreases in mean values as compared to control (+)group. Group7 (Mixture of all plants and seeds) was the best treatment considering the GPT (ALT).

Table (13) Results illustrate the mean value of serum (ALP) (U/L) of hypercholesterolemic rats fed on different diets.It could be noticed that the mean value of (ALP)of control (+) group was higher than control (-) group,being 189±.27 & 151±.8 respectively, indicated significant difference with percent of decrease -20.11% of control (-) group when compared to control (+)group. All hypercholesterolemic rats fed on

different diets revealed significant decreases in mean values as compared to control (+)group. Mixture of all plants diet recorded the better treatment of serum ALP.

table (14) That as for AST**,** the best result for AST / ALT ratio was that recorded for grape seeds diet .

3- Kidneys function

table (15) Results indicated the mean value of serum creatinine (mg/dl) of hypercholesterolemic rats fed on different diets. It could be observed that the mean value of creatinine of control (+) group was higher than control (-) group, being 1.12±.09 &.64±.05 respectively, showing significant difference with percent of decrease -42.85% of control (-) group when compared to control (+) group. All hypercholesterolemic rats fed on different diets revealed significant decreases in mean values as compared to control (+) group. The best treatment considering serum creatinine recorded for group6(rats fed on diet containing grape seeds).

Data of table(16) illustrate the mean value of serum urea (mg/dl) of hypercholesterolemic rats fed on different diets. It could be noticed that the mean value of urea of control (+) group was higher than control (-) group,being 34.02±1.02 &22±.6 mg/dl respectively indicating significant difference with percent of decrease -35.33% of control (-) group when compared to control (+)group. All hypercholesterolemic rats fed on different diets revealed significant decreases in mean values as compared to control (+) group. The best treatment considering serum urea recorded for group7(rats fed on diet containing mixture of all plants and seeds).

Table(17) show the mean value of serum(U. A) (mg/dl) of hypercholesterolemic rats fed on different diets. It could be observed that the mean value of uric acid of control (+) group was higher than control (-) group, being 2.5±.7 &1.09±.09 mg/dl respectively, indicating significant difference with percent of decrease-56.4% of control (-) group when compared to control (+)group. All hypercholesterolemic rats fed on different diets revealed significant decreases in mean values as compared to control (+) group. The best treatment was recorded for group6 (grape seeds) when compared to control (+) group.

4- Serum glucose

Table(18)results illustrate the mean value of serum glucose(mg/dl) of hypercholesterolemic rats fed on different diets. It could be noticed that the mean value of urea of control (+) group was higher than control (-) group, being105±2 &82±1.9 6 mg/dl respectively,indicating significant difference with percent of decrease -21.90% of control (-) group when compared to control (+)group. All hypercholesterolemic rats fed on different diets revealed significant decreases in mean values as compared to

control (+) group .the best treatment was recorded for group 7(Mixture of all plants and seeds) when compared to control (-) group.

RECOMMENDATIONS:

1- The plant materials and seeds may be ground and used orally in capsules or as extracts.
2- Powders or extracts may be added in bread or in cooked foods.
3- Data indicated that plants (avocado, almond, grape seeds) of present work may be suggested to correct disorders of liver function, renal function, lipids profile and hyperglycemia.

Table (1): Effect of L- carnitine ,avocado, almond ,grape seeds &mixture of all plants and seeds on body weight gain % in hypercholesterolemic rats

Parameter / Groups	BWG% (Mean±SD)	% change of (+Ve) group
Control – ve(G1)	20.29 ± 1.9^{b}	-45.58
Control + ve(G2)	37.47 ± 1.5^{a}	00.00
7.5% L- carnitine (G3)	$31.56\pm.9^{a}$	-15.77
7.5% Avocado (G4)	10.58 ± 1.4^{c}	-71.76
7.5% Almond (G5)	7.17 ± 1.7^{c}	-80.86
5% Grape seeds (G6)	23.58 ± 9.04^{b}	-37.07
7.5% Mixture of all plants(G7)	19.38 ± 1.8^{b}	-48.28
LSD	6.505	

Values denote arithmetic means ± standard deviation of the mean.

Means with different letters (a,b, c, d, etc ,) in the same column differ significantly at

$p \leq 0.05$ using ANOVA test , while those with similar letters are non-significantly different.

Table (2): Effect of L- carnitine ,avocado, almond ,grape seeds &mixture of all plants and seeds on feed intake (FI) in hypercholesterolemic rats

Parameter / Groups	Feed Intake (g/day/rat) (Mean±SD)	% change of (+Ve) group
Control – ve(G1)	$12.12\pm .04^{b}$	-8.94
Control + ve(G2)	$13.31\pm .04^{a}$	00.00
7.5% L- carnitine (G3)	$11.69\pm .035^{c}$	-12.17
7.5% Avocado (G4)	$11.59\pm .04^{d}$	-12.92
7.5% Almond (G5)	$11.37\pm .04^{f}$	-14.58
5% Grape seeds (G6)	$11.35\pm .04^{g}$	-14.73
7.5% Mixture of all plants(G7)	$11.47\pm.04^{e}$	-13.82
LSD	.0057	

Values denote arithmetic means ± standard deviation of the mean .
Means with different letters (a,b, c, d, etc ,) in the same column differ significantly at p ≤0.05 using ANOVA test , while those with similar letters are non-significantly different .

Table (3): Effect of L- carnitine ,avocado, almond ,grape seeds &mixture of all plants and seeds on Feed efficiency ratio (FER) in hypercholesterolemic rats

Parameter / Groups	FER (Mean±SD)	% change of (+Ve) group
Control – ve(G1)	.016±.0015^{cd}	-42.86
Control + ve(G2)	.028±.001^{a}	00.00
7.5% L- carnitine (G3)	.026±5.77^{b}	-7.14
7.5% Avocado (G4)	.009±.001^{e}	-67.86
7.5% Almond (G5)	.006±.0015^{f}	-78.57
5% Grape seeds (G6)	.017±.003^{c}	-39.29
7.5% Mixture of all plants(G7)	.016±.001^{d}	-42.86
LSD	7.087	

Values denote arithmetic means ± standard deviation of the mean .
Means with different letters (a,b, c, d, etc ,) in the same column differ significantly at p ≤0.05 using ANOVA test , while those with similar letters are non-significantly different .

Table (4): Effect of L- carnitine ,avocado, almond ,grape seeds &mixture of all plants and seeds on organs weight (g) of hypercholesterolemic rats

Parameter Groups	Liver (g) (Mean±SD)	Heart (g) (Mean±SD)	Kidneys (g) (Mean±SD)
Control – ve(G1)	2.52±.44^{b}	.087±.106^{c}	.48±.03^{d}
Control + ve(G2)	3.75±.58^{a}	.67±.07^{a}	.77±.01^{a}
7.5% L- carnitine (G3)	2.85±.65^{b}	.33±.04^{b}	.48±.079^{d}
7.5% Avocado (G4)	2.75±.28^{b}	.3±.05^{b}	.49±.07^{d}
7.5% Almond (G5)	2.83±.53^{b}	.3±.08^{b}	.59±.015^{bc}
5% Grape seeds (G6)	2.71±.42^{b}	.26±.09^{b}	.62±.05^{b}
7.5% Mixture of all plants(G7)	2.69±.45^{b}	.27±.03^{b}	.52±.02^{cd}
LSD	.86	.125	.081

Values denote arithmetic means ± standard deviation of the mean .

Means with different letters (a,b, c, d, etc ,) in the same column differ significantly at p ≤0.05 using ANOVA test , while those with similar letters are non-significantly different .

Table (5): Effect of of L- carnitine ,avocado, almond ,grape seeds &mixture of all plants and seeds on on serum cholesterol in hypercholesterolemic rats

Parameter / Groups	Serum cholesterol (mg/dl) (Mean±SD)	% Change of (+ve) group
Control – ve(G1)	74.9±.6^{f}	-41.85
Control + ve(G2)	128.8±1^{a}	00.00
7.5% L- carnitine (G3)	83.7±.8^{c}	-35.01
7.5% Avocado (G4)	78.2±.4^{e}	-39.29
7.5% Almond (G5)	82.4±.9^{d}	-36.02
5% Grape seeds (G6)	86.1±.7^{b}	-33.15
7.5% Mixture of all plants(G7)	75±.5^{f}	-41.77
LSD	1.274	

Values denote arithmetic means ± standard deviation of the mean . Means with different letters (a,b, c, d, etc ,) in the same column differ significantly at p ≤0.05 using ANOVA test , while those with similar letters are non-significantly different .

Table (6): Effect of of L- carnitine, avocado, almond ,grape seeds &mixture of all plants and seeds on serum triglycerides in hypercholesterolemic rats

Parameter / Groups	Serum triglycerides (mg/dl (Mean±SD)	% Change of (+ve) group
Control – ve(G1)	44±.5^{f}	-43.81
Control + ve(G2)	78.3±.9^{a}	00.00
7.5% L- carnitine (G3)	55.2±.7^{b}	-29.51
7.5% Avocado (G4)	52.1±.95^{c}	-33.46
7.5% Almond (G5)	47.5±.8^{e}	-39.33
5% Grape seeds (G6)	50.5±.6^{d}	-35.50
7.5% Mixture of all plants(G7)	44±.4^{f}	-43.80
LSD	1.258	

Values denote arithmetic means ± standard deviation of the mean . Means with different letters (a,b, c, d, etc ,) in the same column differ

significantly at p ≤0.05 using ANOVA test , while those with similar letters are non-significantly different .

Table (7): Effect of of L- carnitine, avocado, almond ,grape seeds &mixture of all plants and seeds on serum high density lipoprotein-cholesterol in hypercholesterolemic rats

Parameter / Groups	Serum HDL-c (mg/dl) (Mean±SD)	% Change of (+ve) group
Control – ve(G1)	49±.9[a]	41.37
Control + ve(G2)	34.66±.7[e]	00.00
7.5% L- carnitine (G3)	42.01±.5[c]	21.21
7.5% Avocado (G4)	48±.8[a]	38.49
7.5% Almond (G5)	35.4±.6[e]	2.14
5% Grape seeds (G6)	39.46±.95[d]	13.94
7.5% Mixture of all plants(G7)	44.89±.4[b]	29.52
LSD	1.258	

Values denote arithmetic means ± standard deviation of the mean . Means with different letters (a,b, c, d, etc ,) in the same column differ significantly at p ≤0.05 using ANOVA test , while those with similar letters are non-significantly different .

Table (8): Effect of L- carnitine, avocado, almond ,grape seeds &mixture of all plants and seeds on serum low density lipoprotein-cholesterol in hypercholesterolemic rats

Parameter / Groups	Serum LDL-c (mg/dl) (Mean±SD)	% Change of (+ve) group
Control – ve(G1)	17.1±.8[f]	-77.93
Control + ve(G2)	77.48±1.24[a]	00.00
7.5% L- carnitine (G3)	30.65±.9[c]	-60.44
7.5% Avocado (G4)	19.76±.5[e]	-74.50
7.5% Almond (G5)	37.5±.7[b]	-.516
5% Grape seeds (G6)	36.46±.95[b]	-52.94
7.5% Mixture of all plants(G7)	19.76±.4[e]	-74.50
LSD	1.452	

Values denote arithmetic means ± standard deviation of the mean. Means with different letters (a,b, c, d, etc ,) in the same column differ

significantly at p ≤0.05 using ANOVA test , while those with similar letters are non-significantly different .

Table (9): Effect of L- carnitine, avocado, almond ,grape seeds &mixture of all plants and seeds on serum very low density lipoprotein-cholesterol in hypercholesterolemic rats

Parameter / Groups	Serum VLDL-c (mg/dl)* (Mean±SD)	% Change of (+ve) group
Control – ve(G1)	8.8±.9^{d}	-43.81
Control + ve(G2)	15.66±.5^{a}	00.00
7.5% L- carnitine (G3)	11.03±.99^{b}	-29.57
7.5% Avocado (G4)	10.44±.6^{bc}	-33,33
7.5% Almond (G5)	9.5±.4^{cd}	-39.33
5% Grape seeds (G6)	10.1±.9^{bcd}	-35.50
7.5% Mixture of all plants(G7)	8.8±.9^{d}	-43.81
LSD	1.302	

Values denote arithmetic means ± standard deviation of the mean . Means with different letters (a,b, c, d, etc ,) in the same column differ significantly at p ≤0.05 using ANOVA test , while those with similar letters are non-significantly different .

Table (10): Effect of L- carnitine, avocado, almond ,grape seeds &mixture of all plants and seeds on GOT(AST) in hypercholesterolemic rats

Parameter / Groups	AST (U/L) (Mean±SD)	% Change of (+ve) group
Control – ve(G1)	78±1^{g}	-43.6
Control + ve(G2)	137±.8^{a}	00.00
7.5% L- carnitine (G3)	102.2±.6^{b}	-25.40
7.5% Avocado (G4)	98±.7^{c}	-28.47
7.5% Almond (G5)	91±.5^{d}	-33.58
5% Grape seeds (G6)	80±.4^{f}	-41.61
7.5% Mixture of all plants(G7)	82±.9^{e}	-40.15
LSD	1.274	

Values denote arithmetic means ± standard deviation of the mean . Means with different letters (a,b, c, d, etc ,) in the same column differ

significantly at p ≤0.05 using ANOVA test , while those with similar letters are non-significantly different .

Table (11): Effect of L- carnitine, avocado, almond ,grape seeds &mixture of all plants and seeds on GPT (ALT) in hypercholesterolemic rats

Parameter / Groups	ALT (U/L) (Mean±SD)	% Change of (+ve) group
Control – ve(G1)	35±.7^{g}	-30
Control + ve(G2)	50±.5^{a}	00.00
7.5% L- carnitine (G3)	44.5±1^{d}	-11
7.5% Avocado (G4)	48.4±.6^{b}	-3.2
7.5% Almond (G5)	46±.4^{c}	-8
5% Grape seeds (G6)	43±.9^{e}	-14
7.5% Mixture of all plants(G7)	40.5±.8^{f}	-19
LSD	1.274	

Values denote arithmetic means ± standard deviation of the mean . Means with different letters (a,b, c, d, etc ,) in the same column differ significantly at p ≤0.05 using ANOVA test , while those with similar letters are non-significantly different .

Table (12): Effect of L- carnitine, avocado, almond ,grape seeds &mixture of all plants and seeds on ALp in hypercholesterolemic rats

Parameter / Groups	Alkaline phosphates (U/L) (Mean±SD)	% Change of (+ve) group
Control – ve(G1)	151±.8^{g}	-20.11
Control + ve(G2)	189±.27^{a}	00.00
7.5% L- carnitine (G3)	153±.9^{f}	-19.05
7.5% Avocado (G4)	158±.5^{d}	-16.40
7.5% Almond (G5)	167±.7^{c}	-11.64
5% Grape seeds (G6)	169±1^{b}	-10.58
7.5% Mixture of all plants(G7)	156±.4^{e}	-17.46
LSD	1.93	

Values denote arithmetic means ± standard deviation of the mean . Means with different letters (a,b, c, d, etc ,) in the same column differ

significantly at p ≤0.05 using ANOVA test , while those with similar letters are non-significantly different .

Table (13): Effect of L- carnitine, avocado, almond , grape seeds &mixture of all plants and seeds on creatinine (mg/dl) in hypercholesterolemic rats

Parameter / Groups	Creatinine (mg/dl) (Mean±SD)	% Change of (+ve) group
Control – ve(G1)	.64±.05^{e}	-42.85
Control + ve(G2)	1.12±.09^{a}	00.00
7.5% L- carnitine (G3)	.86±.07^{bc}	-23.21
7.5% Avocado (G4)	.92±.1^{b}	-17.86
7.5% Almond (G5)	.78±.08^{cd}	-30.36
5% Grape seeds (G6)	.7±.06de	-37.5
7.5% Mixture of all plants(G7)	.85±.04^{bc}	-24.11
LSD	.127	

Values denote arithmetic means ± standard deviation of the mean . Means with different letters (a,b, c, d, etc ,) in the same column differ significantly at p ≤0.05 using ANOVA test , while those with similar letters are non-significantly different .

Table (14): Effect of L- carnitine, avocado, almond, grape seeds &mixture of all plants and seeds on Urea (mg/dl) in hypercholesterolemic rats

Parameter / Groups	Urea (mg/dl) (Mean±SD)	% Change of (+ve) group
Control – ve(G1)	22±.6^{e}	-35.33
Control + ve(G2)	34.02±1.02^{a}	00.00
7.5% L- carnitine (G3)	29±.8^{b}	-14.76
7.5% Avocado (G4)	27±.4^{c}	-20.63
7.5% Almond (G5)	26±.9^{c}	-23.57
5% Grape seeds (G6)	28.5±.7^{b}	-16.22
7.5% Mixture of all plants(G7)	24±.5^{d}	-29.45
LSD	1.281	

Values denote arithmetic means ± standard deviation of the mean . Means with different letters (a,b, c, d, etc ,) in the same column differ significantly at p ≤0.05 using ANOVA test , while those with similar letters are non-significantly different .

Table (15): Effect of L- carnitine, avocado, almond ,grape seeds &mixture of all plants and seeds on uric acid (mg/dl) in hypercholesterolemic rats

Parameter / Groups	Uric Acid (mg/dl) (Mean±SD)	% Change of (+ve) group
Control – ve(G1)	1.09±.09^{c}	-56.4
Control + ve(G2)	2.5±.7^{a}	00.00
7.5% L- carnitine (G3)	1.58±.05^{bc}	-36.8
7.5% Avocado (G4)	1.8±.08^{b}	-28
7.5% Almond (G5)	1.67±.06^{b}	-33.2
5% Grape seeds (G6)	1.56±.1^{bc}	-37.6
7.5% Mixture of all plants(G7)	1.69±.04^{b}	-32.4
LSD	.478	

Values denote arithmetic means ± standard deviation of the mean . Means with different letters (a,b, c, d, etc ,) in the same column differ significantly at p ≤0.05 using ANOVA test , while those with similar letters are non-significantly different .

Table (16): Effect of L- carnitine, avocado, almond ,grape seeds &mixture of all plants and seeds on glucose (mg/dl) in hypercholesterolemic rats

Parameter / Groups	glucose (mg/dl) (Mean±SD)	% Change of (+ve) group
Control – ve(G1)	82±1.9^{d}	-21.90
Control + ve(G2)	105±2^{a}	00.00
7.5% L- carnitine (G3)	97±1.3^{b}	-7.62
7.5% Avocado (G4)	90.66±7.65^{c}	-13.66
7.5% Almond (G5)	93±1.6^{bc}	-11.43
5% Grape seeds (G6)	90±1.8^{c}	-14.29
7.5% Mixture of all plants(G7)	83±1.1^{d}	-20.29
LSD	5.728	

Values denote arithmetic means ± standard deviation of the mean . Means with different letters (a,b, c, d, etc ,) in the same column differ significantly at p ≤0.05 using ANOVA test , while those with similar letters are non-significantly different.

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