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Potential Effect Of Peach, Red Grape Fruits And Their Mixture As Powder On Hypercholestrolestrolemic Rats

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Abstract

This study was conducted to investigate the effect of different levels (2.5% and 5%) of peach (*Prunus persica*) and red grape (*Vitis vinfera, L.*) fruits as powder on hypercholesterolemia male albino rats. Forty male albino rats , weighing between (140±10g B.Wt),) were divided into 8 equal group, one was kept as a control (-ve) was fed on basal diet and, while, the other 7 groups were induced hypercholesterolemia by Triton-x-100 (100mg/kg of the weight of the rat) one of them kept as control (+ve) was feed on basal diet only without any addition ,and another groups fed basal diet additionally the powder of investigated fruits for 28 days . Determined the biological parameters as (BWG, FER, and FI), total cholesterol, triglycerides, lipoprotein fraction (HDL-c, LDL-c, VLDL-c, AI), glucose, kidney functions (urea, uric acid and creatinine), liver functions (ALT and AST), have been determined. The obtained results indicated that peach, red grape fruits and their mixture contains enhancement of phenolic compounds, its use as antioxidant. Data also of peach, red grape fruits and their mixture showed significant enhancement in weight gain, food intake, food efficiency ratio, albumin level, TC, TG, HDL-c, LDL-c, VLDL-c, and all other parameters including internal organs weights. **In conclusion**: peach, red grape and mixture of them could be considered powerful nutraceutical therapeutic means for the treatment of hypercholesterolemia rats.

Kcey words: Hypercholesterolemia, Peach, Red grape, Rats, Biochemical analysis.

Introduction

Familial Hypercholesterolemia (FH) is a genetic disorder characterized by high LDL-c cholesterol (LDL-c) plasma concentrations that leads to accelerate arteriosclerotic cardiovascular disease (ASCVD). The prevalence of the heterozygous FH form is about 1/250 individuals **(Roman, and Ramos, 2017) and (Zamora *et al*., 2017).**

Hyperlipidemia has been ranked as one of the greatest risk factors contributing to prevalence of atherosclerosis, it is a condition characterized by very high levels of cholesterol in the blood. (**Kaushik and Saini 2014).**

Hyperlipidemia is a heterogeneous group of disorders characterized by elevation of plasma concentrations of the various lipids and lipoprotein fractions, which is the key risk factor for cardiovascular disorders (CVD) **(Reiner *et al* ., 2010).** These lipids include cholesterol, cholesterol esters, phospholipids, and triglycerides. Lipids are transported in the blood as large 'lipoproteins' and has been reported as the most common cause of death in developed as well as developing nations **(Simons,2002 and Yokozawa *et al* .,2003)**. Hyperlipidemia associated lipid disorders are considered to cause the atherosclerotic cardiovascular disease **(Sundarrajan *et al* .,2010).**

Hypercholesterolemia is defined as excessively high plasma cholesterol levels, and is a strong risk factor for many negative cardiovascular events. Total cholesterol levels above 200 mg/dl have repeatedly been correlated as an independent risk factor for development of peripheral vascular (PVD) and coronary artery disease (CAD), and considerable attention has been directed toward evaluating mechanisms by which hypercholesterolemia may impact vascular outcomes; these include both results of direct cholesterol lowering therapies and alternative interventions for improving vascular function **(Stapleton *et al*.,2010).**

Hypercholesterolemia became the most frequently encountered medical problem worldwide. Among its causes are the bad dietary habits and increased dependence on fast food **(Bipasha, and Goon, 2014).**

The peach is a climateric fruit which has its ripening process controlled by the production of ethylene, a hormone with a series of specific genes which produce changes in the chemical composition and the physical characteristics of the fruit **(Grierson, 1987).**

The peach (Prunus persica L.) is a deciduous tree that is native to South Asia and cultivated worldwide. The world production is about ten million tons per year. Peach is one of the most widely consumed fruits in several European countries, especially those with the Mediterranean diet **(Konopacka *et al.,* 2010).**

Prunus persica is an orchard tree native to China that bears a juicy edible peach. It belongs to the *Rosaceae* family. It is highly useful in treating inflammatory disorders **(Lokesh Deb *et al* .,2011).**

The peach tree, *Prunus persica* (L.) Batsch, which belongsto the family Rosaceae and the genus *Amygdalus* L., is widely cultivated in China and has been commonly used for centuriesto treat different diseases. It has been reported that the seeds have anti-inflammatory **(Shin *et al*.,2010)** and antitumor activity **(Fukuda *et al* .,2003)** and that the nucleus in the seeds can improve blood circulation **(Liu *et al* .,2012).** In high fat diet induce model, oral administration of methanolic extract of leaves of *Prunus persica(*MEPP) (100mg/kg,200 mg/kg and 400mg/kg, p.o.) significantly reduced the serum total cholesterol (TC), triglyceride (TG), low density lipoprotein-cholesterol (LDL-C), VLDL cholesterol levels but significantly increased serum HDL-cholesterol level as compared with positive control group. This study shows serum lipid parameters in animals were significantly reduced ($p<0.001$,) by fourteen days treatment with MEPP at dose levels 100, 200 mg/kg and 400 mg/kg, when compared with control group. 400 mg/kg of MEPP group animals has shown very significant ($p<0.001$) compared with control group **(Chatragadda *et al*., 2014).**

Grapes (*genus Vitis*) are one of the most widely cultivated fruit crops in the world, with uses in the food industry that range from juice, wine, jam, jelly, raisins, and vinegar production to oil extraction from grape seeds. It is estimated that about 80% of the grape harvest is used in the winemaking industry **(Yi *et al* .,2009),** grapes *(Vitis vinfera* L.) are considered the world’s most prevalent fruit crop. Their large amounts of phenolic compounds have made them the focus of extensive studies **(Bozan *et al*., 2008).**

Grapes (*Vitis* sp.) are one of the most cultivated fruit crops in the world, with more than 60 million tons produced annually. Winemaking is an important agricultural activity in several countries of southern Europe, such as Spain, Italy and France, and it produces huge amounts of grape pomace; this by-product mainly consists of skin, seeds and some stalks **(Rondeau *et al*., 2013).**

Red grapes are one of the richest sources of flavonoids. Research suggests that pigments called polyphenols are responsible for explaining the French paradox. Polyphenols, found in red grape skins, are believed to act as antioxidants, control blood pressure, and reduce blood clots **(Stoclet *et al* .,2004).**

The grape was one of the first fruits to be cultivated by man. Since the dawn of civilization, the fermented product of grapes, wine, has probably been an important way of consuming grapes **(Cheng *et al*.,2012),**grape was known for its high nutritional value and was mentioned in AL-Quran AL-Kariem many times **(Badwilan, and Ben Salem, 2005.)**

Al Ansary *et al* ., (2017), said that red grapes juices exerted effective reduction of lipid profile in rat model of hypercholesteremia which seemed to have impact on the protection of the aorta and coronaries against high cholesterol induced atherosclerosis.

Del Bas, *et al*.,(2005) found that Resveratrol's antioxidant activity may play an important role in its possible cardio protective action, Above, was mentioned its ability to inhibit the oxidation of LDL, Resveratrol also has been found to exert a strong inhibitory effect on superoxide anion and hydrogen peroxide production by macrophages stimulated by lipopolysaccharides or phorbol esters. It also has been demonstrated to decrease arachidonic acid release induced by lipopolysaccharides or phorbol esters, or by exposure to superoxide or hydrogen peroxide. It has hydroxyl-radical scavenging activity and has recently been found to possess glutathione sparing activity.

This study was conducted to investigate the effect of different levels (2.5% and 5%) of peach and red grape fruits as powder and their mix on hypercholesterolemia male albino rats.

Material and Methods

Materials

- Fresh fruits samples of peach (*Prunus persica*) and red grape (*Vitis vinfera, L.*) fruits were purchased from a local market, Shebin El-Kom City, Menoufia Governorate, Egypt.
- **Triton- X-100**

  The chemical Triton X-100 used to induce the hypercholesterolemia obtained from SIGMA Chemical Co.
- **Casein, cellulose, choline, chloride, and DL Methionine:**

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

A total of 40 adult normal male albino rats strain weighing 140± 10g were obtained from Vaccine and Immunity Organization, Ministry of Health, Helwan Farm, Cairo, Egypt.

Methods

Preparations of fruits

Fresh fruits samples of peach and red grape were washed with running water, then cut into small slices. Slices were dried by Solar Dreier (Drying Vazl) to save the phenol compounds as they are until constant moisture level as described by the method of **AOAC, (1995)**. The dried samples were pounded using electric stainless still mill, and kept in polyethylene bags at freezing temperature until using.

Basal diet (Standard diet):

The basal diet was prepared according to **AIN, (1993)** as illustrated in table (a). The compositions of salt and vitamin mixtures are shown in tables (b&c).

Table (a): The ingredients of the basal diet (g/100 g diet).

Ingredients	g/100 g
*Casein	12
Sunflower oil	10.0
Mineral mixture	4
Vitamins mixture	1
Fibers (cellulose)	4
Sugar (sucrose)	10
DL- methionin	0.3
Choline chloride	0.2
Corn starch	56.55
Total	**100 (g)**

* 12 g casein yielded 10.32 g protein.

Table (b): Composition of vitamin mixture (AOAC, 1990).

Compounds	Quantity
Vitamin A	2000UL
Vitamin D	200 UL
Vitamin K	10 UL
Inositol	10 UL
Niacin	4 mg
Ca-Pantothenate	4 mg
Riboflavin (B2)	0.08 mg
Thiamine (B1)	0.5 mg
Pyridoxine	0.5 mg
Folic acid	0.2 mg
Biotin	0.04 mg
Cyanocobalamin (B12)	0.03 mg
Choline chloride	200 mg
P-amino benzoic acid	10 mg

Table (c): Composition of the salt mixture (AOAC, 1990)

Compounds	Quantity (g)
$CaCO_3$	300
$kH2PO_4$	322
$CaPO_4 2H_2O$	75
$MgSO47\ H_2O$	102
NaCl	167
$FeC_6H_6O_7\text{-}6H_2O$	27.5
KI	0.9
$MnSO_4\ 4H_2O$	5
$ZnCl_2$	0.25
$CuSO_4\ 5H_2O$	0.35
Total	**1000g**

Experimental design

Forty male albino rats, 6 weeks age, weighing (140) ± 10g, were used in this experiment. All rats were fed on basal diet (casein diet) prepared according to **AIN, (1993)** for 7 consecutive days. After this adaptation period, rats are divided into 8 groups, (n=5) rats as follows: **group (1):** rats fed on basal diet as negative control(-ve). **Group (2):** A group injected by single dose of freshly prepared solution of Triton-X-100 (100 mg/kg) and used as a positive control group (+ve). **Group (3):** A group infected by hypercholesterolemia fed on basal diet and 2.5% peach as powder. **Group (4):**A group infected by hypercholesterolemia fed on basal diet and 5% peach as powder. **Group (5):** A group infected by hypercholesterolemia fed on basal diet and 2.5% red grape as powder. **Group (6):** A group infected by hypercholesterolemia fed on basal diet and 5% red grape as powder. **Group (7):** A group infected by hypercholesterolemia fed on basal diet and 2.5% mixture as powder. **Group (8):** A group infected by hypercholesterolemia fed on basal diet and 5% mixture as powder. The experiment period was taken 28 days.

Blood sampling:

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

Body weight gain (BWG), feed intake (FI), and feed efficiency ratio(FER):

During the experimental period (28 days) the net feed intake was daily recorded, while body weight was weekly recorded. The net feed intake and gained body weight were used for the calculation of feed efficiency ratios (FER) according to **Chapman *et al.*, (1959)** as follow:

$$\textbf{B.W.G.} = \frac{\text{(Final weight - Initial weight)}}{\text{Initial weight}}$$

$$\textbf{FER \%} = \frac{\textbf{Body weight gain (g)}}{\textbf{Food intake (g)}} \times 100$$

Biochemical analysis

Lipids profile

Determination of total cholesterol

Colorimetric method for cholesterol was determined according to **Richmond, (1973)**.

Determination of serum triglycerides

Serum triglyceride was determined by enzymatic colorimetric method used to determine triglycerides according to **Young and Pestaner, (1975)**.

Determination of high density lipoprotein (HDL-c):

HDL-c was determined according to the method described by**Friedewaid (1972) and Grodon and Amer (1977)**.

Calculation of very low density lipoproteincholesterol (VLDL-c)

VLDL-c was calculated in mg/dl according to **Lee and Nieman (1996)** using the following equation:

VLDL-c (mg/dl) = Triglycerides / 5

Calculation of low density lipoprotein cholesterol (LDL-c)

LDL-c was calculated in mg/dl according to **Lee and Nieman (1996)** as follows:

LDL-c (mg/dl) = Total cholesterol – HDL-c – VLDL-c.

Calculation of atherogenic index (AI):

Calculation of atherogenic index = (VLDL-c+ LDL-c) / HDL-c

This index was calculated as the (VLDL-c+ LDL-c/HDL-c ratio according to the formula of **Kikuchi-Hayakawa *et al.*, (1998).**

Liver functions:

Determination of serum alanine amino transferase (ALT), serum asparatate amino transferase (AST), according to the method of **Chawla (2003) and Srivastava *et al.*, (2002).**

Kidney functions*:*

1. Determination of serum urea:

Urea was determination by enzymatic method according to **Patton and Crouch (1977).**

2. Determination of serum creatinine:

Serum creatinine was determined according to the method described by **Henry (1974).**

3. Determination of serum uric acid:

Serum uric acid was determined calorimetrically according to the method of **Barham and trinder (1972).**

4. Determination of blood glucose:

Enzymatic determination of plasma glucose was carried out calorimetrically according to the method of **Tinder (1969).**

Statistical analysis:

Data were analyzed using a completely randomized design **(SPSS, 2010)** 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 **Wolfinger and Chang,(1995)**.

Results And Discussion

Effect of Peach, red grape and their mixtures as powder on serum total cholesterol and triglycerides of hypercholesterolemic rats

Data tabulated in Table (1) showed that the mean value of serum triglycerides and total cholesterol of hypercholestrolemic rats fed on various diets. It could be observed that the TG value of control (+) group was Significantly higher than control (-) group, being 183.66 and 94 mg/dl, respectively.

All hypercholestrolemic rats fed on different diets revealed significant decrease in TG mean values as compared to control (+) group .The values were 134.33,126.7,118.32,110.67,101.3 and 96 mg/dl for 3,4,5,6,7, and 8, respectively . Numerically, the best serum Triglycerides was observed for group 8 (5% mixture powder, 96 mg/dl) when compared to (control positive group, 183.66 mg/dl).

On the other hand, the mean value of serum total cholesterol of hypercholestrolemic rats fed on various diets. It could be observed that the mean value of control (+) group was higher than control (-) group, being 246.65 and 99.66 mg/dl, respectively, showing significant difference as compared to control (+) group.

All hypercholestrolemic rats fed on different diets revealed significant decrease in mean values as compared to control (+) group .The values were 164.35,134.31,142.33,119.33,133.66 and 107.66 mg/dl for 3,4,5,6,7, and 8, respectively. Numerically, the best serum total cholesterol was observed for group 8 (5% mixture powder, 107.66 mg/dl) when compared to (control positive group, 246.65 mg/dl). These result are in agreement with the study by **Song *et al*., (2014)** they reported that 28 days of administration of grape seed powder was found to be capable of reducing the levels of serum lipids (TC, TG and LDL-c) and preventing occurrences of fatty liver among rats. In confirmation of this study, by **Song *et al*., (2014)** demonstrated that Red Grape Seed Extract (RGSE) had the capacity to significantly increase the concentration of HDL-c apo-AI and lead to decreased TC, TG and LDL-c levels, in relation to the pre-treatment values.

Effect of Peach, red grape and their mixtures as powder on serum lipid profiles of hypercholesterolemic rats

Data presented in Table (2) showed that the mean value of serum high density lipoprotein of hypercholestrolemic rats fed on various diets. It could be concluded that the mean value of control (+) group was lower than control (-) group, being 30.33 and 44.65 mg/dl, respectively, showing a significant difference as compared to control (+) group.

All hypercholestrolemic rats fed on different diets revealed a significant increase in mean values as compared to control (+) group. The values were 33.33, 34,37.6,39.33, 41.63 and 43 mg/dl for 3,4,5,6,7, and 8, ,respectively . Rats fed on groups 2,3,4,5,6,7 and 8 showed very high significant differences ($p \leq 0.005$). Rats fed on group 2 showed very high significant difference ($p \leq 0.005$). Finally, the best serum high density lipoprotein was observed for group 8 (5% mixture powder, 43 mg/dl) when compared to (control negative group, 44.65 mg/dl

On the other hand, the mean value of serum low density lipoprotein of hypercholestrolemic rats fed on various diets. It could be indicated that the mean value of control (+) group was higher than control (-) group, being 179.53 and 36.21 mg/dl, respectively, showing significant difference as compared to control (+) group.

All hypercholestrolemic rats fed on different diets revealed significant decrease in mean values as compared to control (+) group. The values were 104.15, 74.97, 81.07, 57.87, 71.77 ,and45.46 mg/dl for 3, 4, 5, 6, 7, and 8, respectively.

Rats fed on group 8 (5 % mixture powder, 45.42 mg/dl) recorded the best serum low density lipoprotein was observed for group 8 (5% mixture powder, 44.65 mg/dl) (LDL-c) when compared to (control negative group, 36.21 mg/dl).

In case of VLDL-c, the mean value of serum very low density lipoprotein of hypercholestrolemic rats fed on various diets. It could be observed that the mean value of control (+) group was higher than control (-) group, being 36.73 and 18.80 mg/dl, respectively, showing significant difference as compared to control (+) group.

All hypercholestrolemic rats fed on different diets revealed significant decrease in mean values as compared to control (+) group .The values were 26.87, 25.34, 23.66, 22.13, 20.26 and19.24 mg/dl for 3,4,5,6,7, and 8, ,respectively.

Numerically, the better serum very low density lipoprotein (VLDL-c) was observed for group 8 (5% mixture powder, 19.24 mg/dl) when compared to (control positive group, 36.79 mg/dl). These results agreement with **narayanasamy *et al* ., (2017).**who observed that Beta-carotene in peaches showed positive cardio protective effect by improving HDL value and reducing VLDL ratio, atherogenic index and LDL cholesterol. It also exhibits anti-oxidant property. Also in agreement with **Sudhahar *et al* ., (2008)**who observed that the levels of triglycerides, total cholesterol, LDL cholesterol, and VLDL cholesterol of high cholesterol dite rats were increased, whereas serum HDL-cholesterol level was decreased, Rat which received red grape juice (RGJ) showed significant decrease in levels of these lipids ,LDL cholesterol, VLDL cholesterol and increase in HDL level. RGJ are rich in phenolic compounds which significantly ameliorated plasma lipid levels.

Also in agreement with **Kaesancini and Krauss , (1994**) who reported that there is significant decrease in the serum total cholesterol, triglycerides, LDL, VLDL and a significant increase in the HDL levels was observed with 400mg/kg .The methanolic extract of our *Prunus persica* (MEPP), 200mg/kg and 100mg/kg when compared with the hyperlipidemia control. This study shows serum lipid parameters in animals were significantly reduced ($p<0.001$,) by fourteen days treatment with MEPP at dose levels 100, 200 mg/kg and 400 mg/kg, when compared with control group. 400 mg/kg of MEPP group animals has shown very significant ($p<0.001$) compared with control group.

Effect of peach, red grape and its mixtures on liver functions of hypercholestrolestrolemic rats:

Data in Table (3) revealed that the mean value of serum ALT of hypercholestrolemic rats fed on various diets. It could be noticed that the mean value of control (+) group was higher than control (-) group, being 92.88 and 30.08 U/L, respectively. Showing significant difference as compared to control (+) group. All hypercholestrolemic rats fed on different diets revealed significant decrease in mean values as compared to control (+) group .The values were 61.51,57.21,71.71,62.82,61.28 and 54.65 mg /dl for 3,4,5,6,7, and 8, ,respectively .Rats fed on groupn2,3,4,5,6,7 and 8 showed very high significant differences ($p \leq 0.005$) . Numerically, the best serum ALT was observed for group 8 (5%

mixture powder, 54.65 U/L) when compared to (control positive group, 92.88 U/L).

Data in Table (3) revealed that the mean value of serum GOT of hypercholestrolemic rats fed on various diets. It could be noticed that the mean value of control (+) group was higher than control (-) group, being 74.28 and 19.98 U/L, respectively. Showing significant difference as compared to control (+) group. All hypercholestrolemic rats fed on different diets revealed significant decrease in mean values as compared to control (+) group .The values were 44.58,33.18,41.53,38.21,32.11 and 26.21 U/L for 3,4,5,6,7, and 8, ,respectively .Rats fed on groupn2,3,4,5,6,7 and 8 showed very high significant differences ($p \leq 0.005$) . Numerically, the best serum GOT was observed for group 8 (5% mixture powder, 26.21U/L) when compared to (control positive group, 74.28 U/L).

Data given in Table (3) showed that the mean value of serum ALP of hypercholestrolemic rats fed on various diets.

It could be noticed that the mean value of control (+) group was higher than control (-) group, being 71.72 and 29.11 mg/dl, respectively, showing significant difference as compared to control (+) group.

All hypercholestrolemic rats fed on different diets revealed significant decrease in mean values as compared to control (+) group. The values were 49.43,40.22,48.58,42.33,38.31 and 33.70 mg/dl, for 3,4,5,6,7, and 8, ,respectively .Rats fed on groupn2,3,4,5,6,7 and 8 showed very high significant differences ($p \leq 0.005$) . Numerically, the best serum ALP was observed for group 8 (5% mixture powder, 33.70 mg/dl,) when compared to (control positive group, 71.72 mg/dl,).

These result are in agreement with **Al Zunaidy *et al*.,(2015)** who reported that feeding syrup of pears and peaches (pulp & peel) and green tea increased the antioxidant capacity and can scavenge reactive oxygen species which resulted+ in reduced Hypercholesterolemia, hypertriglyceridemia, lipid peroxidation (MDA), i-mproved the activities of antioxidant enzymes (SOD, GSH-Px) and Catalase and blood reduced glutathione and plasma aminotransferases (ALT, AST) and plasma urea. Moreover, histopathological examination of the heart tissue showed signs of recovery from separation of cardiac muscle fibers, diffuse haemorrhage and congestion. Thus it can be concluded that administration of pears, peaches and green tea can protect from oxidative stress generated by feeding high sucrose diet and in this respect green tea produced the higher improvement followed by peels of pears and peaches.

Also in agreement with **Dulundu *et al* .,(2009)** who indicated that the antioxidant effect has been described for grap seed extract (GSE) proanthocyanidins in diabetic rats and has been shown to lead to a decrease in the oxidant generation and lipid peroxidation. Also, a protective effect of GSE has been reported on reperfusion-induced injury in rats. GSE could reverse ALT, AST and histological alterations induced by the injury. The therapeutic effect of GSE was established against bile duct ligation-induced hepatic fibrosis, where oxidative stress takes place; while a 28-day administration of 50 mg/day of GSE successfully decreased ALT and AST after the damage.

Effect of peach, red grape fruit and their mixtures as powder on kidney functions of hypercholestrolestrolemic rats

The mean value of serum creatinine of hypercholestrolemic rats fed on various diets as shown in Table (4). It could be observed that the mean value of creatinine of control (+) group was higher than control (-) group, being 1.42 and 0.72 mg/dl, respectively, showing significant difference as compared to control (+) group.

All hypercholestrolemic rats fed on different diets revealed significant decrease in mean values as compared to control (+) group .The values were 1.15,1.02,1.11,0.95,0.99 and 0.84 mg/dl for 3,4,5,6,7, and 8, ,respectively.

Rats fed on groups 3, 4, 5, 6, 7 showed no significant difference. The best treatment of serum creatinine was recorded for group 8 (5% mixture powder, 0.84 mg/dl) when compared to (control positive group, 1.42 mg/dl).

On the other hand, the mean value of serum uric acid of hypercholestrolemic rats fed on various diets. It could be noticed that the mean value of control (+) group was higher than control (-) group, being 9.9 and 6 mg/dl, respectively, showing significant difference as compared to control (+) group.

All hypercholestrolemic rats fed on different diets indicated significant decrease in mean values as compared to control (+) group .The values were 8.8,7.88,7.5,7.2,7.8 and 6.7 mg/dl for 3,4,5,6,7, and 8 ,respectively .

Rats fed on groups 2, 3, 4, 5, 6, 7 and 8 showed very high significant differences ($p \leq 0.05$). While, the highest uric acid level of treated group 3 recorded for group fed on 2.5 % peach but, the lowest value recorded for group fed on 5% plant mixture with significant difference ($P \leq 0.05$). The mean values were 8.8 and 6.7 mg/dl, respectively.

In case of serum urea, data revealed that the mean value of serum urea of hypercholestrolemic rats fed on various diets. It could be noticed that the mean value of control (+) group was higher than control (-) group, being 32.6 and 20.4 mg/dl, respectively, showing significant difference as compared to control (+) group.

All hypercholestrolemic rats fed on different diets indicated significant decrease in mean values as compared to control (+) group .The values were 28.4,24.7,30.4,28.2,27.68 and 25.2 mg/dl for 3,4,5,6,7, and 8, ,respectively .Rats fed on groupn2,3,4,5,6,7 and 8 showed very high significant differences (P ≤0.05). While, the highest uric acid level of treated group 5 recorded for group fed on 2.5% grape but, the lowest value recorded for group fed on 5% plant mixture with significant difference (P≤0.05). The mean values were 30.4 and 25.2 mg/dl, respectively.

These results in agreement with **Abdelbaky *et al*., (2016)** who revealed that, significant decreased in urea were found for rats fed on hypercholesterolemic diet supplemented with NGS 2% &4% and non-significant decreased for rats fed on hypercholesterolemic diet supplemented with grape seeds powder (GSP) 5%&10%, when compared with positive control group. Moreover, it could be observed that, significant decreased was found in uric acid for rats fed on hypercholesterolemic diet supplemented with Nanoparticles of grape seeds NGS and its powder GSP by different levels compared with control positive. Also, significant decreased was found in creatinine for rats fed on hypercholesterolemic diet supplemented with GSP 5%and 10% compared with control positive .On the other hand , it could be observed that markedly and significant increase in creatinine were recorded for rats fed on hypercholesterolemic diet supplemented with NGS 2% and 4% compared with control positive.

Effect of peach, red grape fruit and their mixture on atherogenic index of hypercholestrolestrolemic rats:

Data given in table (5) revealed that the mean value of atherogenic index ratio of hypercholestrolemic rats fed on various diets.

It could be observed that the mean value of control (+) group was higher than control (-) group, being 6.99 and 1.79 mg/dl, respectively, showing significant difference as compared to control (+) group.

All hypercholestrolemic rats fed on different diets revealed significant decrease in mean values as compared to control (+) group .The values were 3.93,2.93,3.55,2.93,2.28 and 2.28 (mg/dl) for 3,4,5,6,7, and 8, respectively .Rats fed on groupn2,3,4,5,6,7 and 8 showed very high significant differences (p ≤ 0.05). The better serum (AI) ratio was observed for group 8 (5% mixture powder, 2.28 mg/dl) when compared to (control negative group, 1.79 **(mg/dl)**

These results agreement with **Mulvihill *et al*., (2009)** who reported that Atherosclerotic index (A.I) is believed to be an important risk factor for diagnosis of atherosclerosis. The metabolic extract of our *Prunus persica* reduced atherogenic index which is one of the most important risk factors of atherosclerotic plaques, naringenin ability to inhibit the secretion of very-low density lipoprotein by the cells.

Also in agreement with **Lim, (2013)** who reported that proanthocyanidins as one of the many phenols available in grape led to a significant decrease in cholesterol, atherogenic index and triglycerides in the blood serum of rats that dealt with meals high in cholesterol content has added 100 mg Proanthocyanidins grape seed / kg body weight compared to mice that dealt with meals high in cholesterol content.

Effect of peach and red grape and their mixture as powder on glucose level of hypercholestrolestrolemic rats

Data presented in Table (6) showed that the mean value of serum glucose of hypercholestrolemic rats fed on various diets. It could be observed that the mean value of control (+) group was higher than control (-) group, being 176.23 and 97.95 mg /dl, respectively, showing a significant difference as compared to control (+) group.

All hypercholestrolemic rats fed on different diets revealed a significant decrease in mean values as compared to control (+) group. The mean values were 163.3,160.6,162.45,152.83,142.25 and 135 mg /dl for 3,4,5,6,7, and 8, respectively .

Rats fed on groups 2, 3, 4, 5, 6, 7 and 8 showed very high significant differences ($p \leq 0.05$). Numerically, the best serum glucose was observed for group 8 (5% mixture powder, 135 mg /dl) when compared to (control positive group, 179.23 mg/dl). These result are in agreement with **Zuanazzi *et al*., (2019)** who reported that the ingestion on 7 ml/Kg/d for 30 d. does not alter blood glucose or insulin levels but decreases(body mass index) and waist and abdominal circumference. No differences were observed in NO levels or markers of oxidative damage.

Also **Yugarani *et al*., (1992)** who observed that the blood glucose and insulin levels of high cholesterol diet (HCD)-fed rats at the end of the experiment were significantly increased. RGJ significantly decreased them at the end of the experiment compared to those received HCD alone.

Similarly, previous study, found that of RGJ had hypoglycemic effect on HCD-fed rats. This due to flavonoids content and these constituents can preserve the insulin-secreting capacity and viability of pancreatic β cells. Therefore, the presence of these constituents in RGJ may explain the hypoglycemic activity. In agreement to our observations a previous study, reported increase level of glucose and insulin in hamsters received HCD which decreased by grape seed at the end of the study.

Also in agreement with **Sharma *et al.*, (2018)** who reported that *Prunus persica* ethylacetate fraction (PP-EtOA) possesses potent free radical scavenging property. It's antihyperglycemic and anti-adipogenic activities may be due to quercetin (flavonoid) and may prove to be effective in the treatment of diabetes mellitus and diabetes driven dyslipidemic conditions. Although the present findings suggest the presence of hypoglycemic and insulinogenic compounds in the fraction, the precise mechanism of its hypoglycaemic action is still speculative and requires further studies for appropriate elucidation. *P. persica* and the pure compound(s) there in could be further explored to reveal a natural drug candidate to be useful in diabetes mellitus treatment.

Effect of peach and red grape fruits on body weight gain (BWG),food intake (FI) and feed efficiency ratio (FER) hypercholestrolemic rats rats .

Data presented in Table (7) show the effect of peach and red grape fruits on body weight gain (BWG),food intake (FI) and feed efficiency ratio (FER) hypercholestrolemic rats. It could be indicated that the mean value of control (+) group was lower than control(-) group, being 2.14 and 3.49 g, respectively. Showing no significant difference as compared to control (-) group. All hypercholestrolemic rats fed on different diets revealed significant increase in mean values as compared to control (+) group .The values were 2.90,2.64,3.18,2.92,2.87, and 2.71 g for 3,4,5,6,7, and 8, ,respectively . Rats fed on group1,2, 3,4,5,6,7 and 8 showed no significant differences . Finally the highest level of (BWG)g was observed for group 5 (2.5% grape ,3.18 %) while the lowest level of (BWG)g was observed for group 4 (5% grape ,2.64 g) when compared to (control negative group ,3.49%).

In case of feed intake (FI), It could be indicated that feed intake of control (+) group was lower than control (-) group, being 16.87 and 18.49 %, respectively. Showing no significant difference as compared to control (-) group. All hypercholestrolemic rats fed on different diets revealed significant increase in mean values as compared to control (+) group .The values were 18.15,17.35,17.18,17.49,17.88, and 17.46 % for 3,4,5,6,7, and 8, ,respectively . Rats fed on group3, 4, 6,7 and 8 showed no significant differences. Finally the highest level of (FI)% was observed for group 3 (2.5% peach, 18.15 %) while the lowest level of (FI)% was observed for group 5 (2.5% grape ,17.18 %) when compared to (control positive group , 16.87 %).

The obtained results indicated feed efficiency ratio (FER), It could be indicated that feed intake of control (+) group was lower than control (-) group, being 0.186and 0.127 %, respectively. Showing no significant difference as compared to control (-) group. All hypercholestrolemic rats fed on different diets revealed significant increase in mean values as compared to control (+) group .The values were 0.159,0.152,0.185,0.166,0.164, and 0.153 % for 3,4,5,6,7, and 8, ,respectively . Rats fed on group2,3, 4,5, 6,7 and 8 showed no significant differences. Finally the highest level of (FER)% was observed for group 5 (2.5% grape, 0.185 %) while the lowest level of (FER)% was observed for group 4 (5%peach ,0.152 %) when compared to (control positive group , 0.127 %).

These results are agreement with **Thiruchenduran *et al.*, (2011)** who reported that high cholesterol diet (HCD) induced significant increase in the weight of the rats. Supplementation HCD with red grape juice (RGJ) could significantly reduce this weight gain. It was observed that the relative weight of kidney in HCD-fed rats was significantly lowered compared to both control and HCD-fed rats plus RGJ.

Also in agreement with results **Abdelbaky *et al.*, (2014**) revealed that, rats fed on experimental diet containing 10% grape seeds powder had reduced food intake compared to the positive control group. In addition rats fed on experimental diet containing 2% , 4% nanoparticles of grape seeds,and 5% grape seeds powder had reduced food intake compared to the positive control . Regarding body weight gain (BWG), it was significantly lowered ($P \leq 0.05$) for the positive control group when compared with the negative control group. . **In conclusion**: peach, red grape and mixture of them could be considered powerful nutraceutical therapeutic means for the treatment of hypercholesterolemia rats.

Table (1): Effect of Peach, red grape and their mixtures as powder on serum total cholesterol and triglycerides of hypercholesterolemic rats

Groups / Parameters	TG (mg/dl)	TC (mg/dl)
G_1Control (-)	$94^{h}\pm1.88$	$99.66^{h}\pm1.58$
G_2Control (+)	$183.66^{a} \pm 1.01$	$246.65^{a} \pm 2.45$
G_3(2.5 %peach)	$134.33^{b}\pm1.59$	$164.35^{b}\pm1.41$
G_4 (5 %peach)	$126.7^{c} \pm1.69$	$134.31^{d} \pm1.37$
G_5 (2.5 % Red grape)	$118.32^{d} \pm 2.91$	$142.33^{c} \pm 1.41$
G_6 (5 %Red grape)	$110.67^{e}\pm0.656$	119.33 e±0.939
G_7(2.5 % Mixture)	$101.3^{f} \pm1.09$	133.66 f ±2.65
G_8 (5 % Mixture)	$96^{g} \pm0.589$	107.66 g ±1.42
LSD	**1.006**	**2.25**

Values denote arithmetic ± standard deviation of the mean (*n* = 5).TC= Total Cholesterol. TG= Triglyceride.

Mean under the same column bearing different superscript letters are different significantly ($p \leq 0.05$).

Table (2): Effect of Peach, red grape and their mixtures as powder on serum lipid profiles of hypercholesterolemic rats

Groups / Parameters	HDL-C mg/dl	LDL- C mg/dl	VLDL- C mg/dl
G_1 Control (-)	44.65^{a} ± 2.45	36.21^{h}± 2.48	18.8^{a}± 2.001
G_2 Control (+)	30.33^{g} ± 1.91	179.59^{a} ± 1.65	36.73^{f} ±0.318
G_3 (2.5 %Peach)	33.33^{f} ±1.67	104.15^{b} ±1.92	26.87^{e}± 0.343
G_4 (5 %peach)	34 ^{f}±1.16	74.97^{e}±2.41	25.34^{c}± 0.514
G_5 (2.5 % Red grape)	37.60^{e}± 1.55	81.07^{d}± 0.302	23.66^{d}±1.59
G_6 (5 %Red grape)	39.33^{d} ±1.59	57.87^{c}±2.08	22.13^{bc} ±1.42
G_7(2.5 % Mixture)	41.63^{c} ±1.51	71.77^{f}±0.882	20.26^{d}±1.88
G_8 (5 % Mixture)	43^{b} ±2.45	45.46^{g} ±0.425	19.2^{a}± 2.001
LSD	0.706	1.29	1.68

Values denote arithmetic ± standard deviation of the mean (*n* = 5). HDL-C= High density lipoprotein Cholesterol. LDL =Low density lipoprotein Cholesterol. High significant differences, Mean under the same column bearing different superscript letters are different significantly (p ≤ 0.05).

Table (3): Effect of peach, red grape and its mixtures on liver functions of hypercholestrolestrolemic rats.

parameter / Groups	(ALT) U/L	(GOT) U/L	(ALP) U/L
G1 Control (-)	30.08 ^{f} ±1.94	19.98^{g} ± 1.42	29.11^{f}± 2.86
G2control(+)	92.88^{a} ± 3.14	74.28^{a} ± 4.29	71.72^{a}± 3.51
G3(2.5% Peach)	61.51^{c}±1.89	44.58^{b} ± 1.76	49.43^{b} ± 0.727
G4 (5% Peach)	57.21^{d} ±0.82	33.18^{e}± 1.92	40.22^{cd}± 2.69
G5 (2.5% Grape)	71.71^{b} ± 1.41	41.53^{c} ± 2.25	48.58^{b} ± 3.39
G6 (5% Grape)	62.82^{c} ±1.69	38.21^{d} ± 1.27	42.33^{c} ± 1.89
G7 (2.5% Mixture)	61.28^{c} ±3.14	32.11^{e} ± 1.69	38.31^{d} ± 1.88
G8 (5% Mixture)	54.65^{e} ±2.37	26.21^{f} ± 0.942	33.70^{e} ± 1.41
LSD (p ≤ 0.05)	**2.39**	**2.66**	**2.21**

Each value is represented as mean ± standard deviation (*n* = 5).
Mean under the same column bearing different superscript letters are different significantly (p ≤ 0.05).

Table (4): Effect of peach, red grape fruit and their mixtures as powder on kidney functions of hypercholestrolestrolemic rats

Parameter / Groups	Creatinine	Uric acid mg/dl	Urea mg/dl
G1 Control (-)	$0.72^{b} \pm 0.065$	$6.0^{f} \pm 0.81$	$20.4^{f} \pm 0.77$
G2control(+)	$1.42^{a} \pm 0.727$	$9.9^{a} \pm 0.78$	$32.6\ ^{a} \pm 1.18$
G3(2.5% Peach)	$1.15a^{b} \pm 0.057$	$8.8^{b} \pm 0.098$	$28.4^{c} \pm 1.62$
G4 (5% Peach)	$1.02a^{b} \pm 0.082$	$7.88^{c} \pm 0.088$	$24.7^{e} \pm 0.91$
G5 (2.5% Grape)	$1.11^{ab} \pm 0.03$	$7.5^{cd} \pm 0.29$	$30.4^{b} \pm 1.87$
G6 (5% Grape)	$0.95^{ab} \pm 0.049$	$7.2^{cd} \pm 0.81$	$28.2^{c} \pm 1.06$
G7 (2.5% Mixture)	$0.99^{ab} \pm 0.201$	$7.8^{c} \pm 0.229$	$27.68^{d} \pm 1.10$
G8 (5% Mixture)	$0.84^{b} \pm 0.008$	$6.7^{e} \pm 0.016$	$25.2^{e} \pm 0.81$
LSD	**0.355**	**0.590**	**0.591**

Each value is represented as mean ± standard deviation (n = 5).
Mean under the same column bearing different superscript letters are different significantly ($p \leq 0.05$).

Table (5): Effect of peach, red grape fruit and their mixture on atherogenic index of hypercholestrolestrolemic rats

Parameters / Groups	Atherogenic index (mg/dl)
G1 Control (-)	$1.79^{c} \pm 0.049$
G2control(+)	$6.99^{a} \pm 1.27$
G3(2.5% Peach)	$3.93^{b} \pm 0.817$
G4 (5% Peach)	$2.93^{bc} \pm 1.43$
G5 (2.5% Grape)	$3.55^{bc} \pm 1.43$
G6 (5% Grape)	$2.93^{bc} \pm 0.089$
G7 (2.5% Mixture)	$2.88^{bc} \pm 1.27$
G8 (5% Mixture)	$2.28^{bc} \pm 2.28$
LSD ($P \leq 0.05$)	**1.25**

Each value is represented as mean ± standard deviation (n = 5).
Mean under the same column bearing different superscript letters are different significantly ($p \leq 0.05$).

Table (6): Effect of peach and red grape and their mixture as powder on glucose level of hypercholestrolestrolemic rats

Parameters / Groups	Glucose mg/dl
G1 Control (-)	$97.95^{f} \pm 2.50$
G2 Control (+)	$176.23^{a} \pm 2.47$
G3(2.5% Peach)	$163.30^{b} \pm 1.31$
G4 (5% Peach)	$160.6^{b} \pm 1.46$
G5 (2.5% Grape)	$162.45^{b} \pm 2.04$
G6 (5% Grape)	$152.83^{c} \pm 2.41$
G7 (2.5% Mixture)	$142.25^{d} \pm 2.06$
G8 (5% Mixture)	$135^{e} \pm 3.27$
LSD (P≤ 0.05)	**2.980**

Each value is represented as mean ± standard deviation (n = 5).
Mean under the same column bearing different superscript letters are different significantly (P ≤ 0.05).

Table (7): effect of peach and red grape fruits on body weight gain (BWG),food intake (FI) and feed efficiency ratio (FER) hypercholestrolemic rats rats .

Groups/Parameter	BWG (g)	FI (g/day)	FER (%)
G1 Control (-)	3.49a± 0.0.79	18.49a± 0.56	0.189a± 0.26
G2control(+)	2.14a± 0.37	16.87a± 0.98	0.127a± 0.033
G3(2.5% Peach)	2.90a± 0.55	18.15ab± 0.84	0.159a± 0.04
G4 (5% Peach)	2.64a±0.29	17.35ab±0.49	0.152a±0.016
G5 (2.5% Grape)	3.18a±0.12	17.18b±0.63	0.185a±0.015
G6 (5% Grape)	2.92a±0.53	17.49ab±0.53	0.166a±0.027
G7 (2.5% Mixture)	2.87a±0.49	17.48ab±0.57	0.164 a±0.018
G8 (5% Mixture)	2.71a±0.29	17.46ab±0.79	0.155a±0.03
LSD	**0.58**	**0.86**	**0.86**

Each value is represented as mean ± standard deviation (n = 5).
Mean under the same column bearing different superscript letters are different significantly (P ≤ 0.05)

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التأثير المحتمل لثمار الخوخ والعنب الأحمر علي الفئران المصابة بإرتفاع الكوليسترول

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قسم التغذية وعلوم الأطعمةـ كلية الأقتصاد المنزلى ـ جامعة المنوفية

الملخص العربي

اجريت هذه الدراسه لمعرفه تأثيرمسحوق ثمار فاكهه الخوخ والعنب الاحمر بالتركيزات المختلفه 2.5-5% علي الفئران المصابه بارتفاع الكوليستيرول . تم استخدام 40 فأر من النوع الالبينو تتراوح اوزانهم بين 140+- 10 جم تم تقسيميهم الي 8 مجموعات واعتبرت واحده منهم مجموعه ضابطه سالبه سليمه . وال 7 مجاميع الاخري تم حقنهم بماده تريتون إكس 100(100 مجم/ كجم من وزن الجسم) وذلك للاحداث الاصابه بارتفاع الكوليستيرول واحده منهم تغذت علي الغذاء القياسي دون اي اضافات (المجموعه الضابطه الموجبه) وبقيه المجاميع تغذت علي الغذاء الاساسي مضاف له التركيزات المختلفه من مسحوق ثمار الفاكهه وخليطهما ايضا . وبعد انتهاء مده التجربه (28 يوم) تم تشريح الفئران وتجميع عينات الدم وتم عمل التحاليل االلازمه من تحاليل بيولوجيه (BWG-FER-FI) كذلك تم تقدير دهون الدم وانزيمات الكبد واليوريا والكرياتنين ومستوي الجلوكوز و أشارت النتائج المتحصل عليها إلى أن الخوخ والعنب الأحمر ومخلوطهما يحتويان على كميات مختلفة من المركبات الفينولية واستخدامها كمضادات للأكسدة. أظهرت بيانات الخوخ ، ثمار العنب الأحمر وخليطها تحسن معنوياً في زيادة الوزن ، وتناول الطعام ، ونسبة كفاءة الغذاء و TC ، و TG ، و HDL-c ، و LDL-c ، و VLDL-c ، وجميع المعاملات الأخرى.

في الختام: يمكن اعتبار الخوخ والعنب الأحمر ومزيجهم من الوسائل العلاجية القوية للتغذية في علاج الفئران المصابة بارتفاع كوليسترول الدم.

الكلمات الكاشفة : الخوخ ، العنب الاحمر ، الكوليسترول الكلي ، ارتفاع دهون الدم ، التحاليل البيوكيميائيه.