Effect of Low Fat Diet, Almonds, Green Coffee and Mackerel Fish on Obese Rats

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Authors’ contributions

This work was carried out in collaboration between both authors. Authors FK designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author SA contributed in literature search, questionnaire preparation and finalized the manuscript. Both authors read and approved the final manuscript.

ABSTRACT

The present work was conducted to study the effect of low fat diet (LFD), almonds, green coffee, mackerel fish and the combination of all of them on loss of weight, lipid profile, serum glucose, leptin hormone, liver enzymes and kidney functions of obese rats.

Methods: In this research, researcher used normal male albino rats (n=42). This group of rats was divided into two major groups. The first group (n=6 rats) fed on standard diet and was considered as a group of negative control. The second group (n= 36 rat) fed high fat diet for six weeks on to induce of obesity. Rats in the second group were randomly assigned to six equal subgroups: Subgroup (1) fed on HFD (consist of 20% fat) and used as (control positive) 1; Subgroups (2) fed on LFD containing only (10% fat) and used as (control positive) 2. Subgroup The third subgroup feeds on low fat diet LFD containing (almonds, which provided the diet with 5% oil hydrogenated oils 4% and soy oil 1%). Subgroup (4) fed on LFD and treated each rat daily in this group with 3 ml green coffee. Subgroup (5) fed on LFD containing (mackerel fish, which provided the diet with 5% fat, hydrogenated oils 4% and soy oil 1%). Subgroup (6) fed on LFD containing (almonds which provided the diet with 5% oil and mackerel fish which provided the diet with 5% oil) and treated each rat daily in this group with 3 ml green coffee. The obtained data were tested with one-way...
INTRODUCTION

High fat diets HFDs cause detrimental effects on tissues and organs and leads to endocrine complications in obese human and animals. There are many factors including, genetic inheritance, age, type or lifestyle, physical activity that has influence on body fat [1]. A healthy diet contain almond, coffee have beneficial effect on reducing the body fat. The prevalence of obesity has almost tripled from 1975 to 2016 leading to higher rates of non-communicable diseases like diabetes, the metabolic syndrome, musculo skeletal disturbances, cardiovascular diseases and certain types cancers [2].

In this, respect HFDs lead to changes in the size of adipocytes and stimulate insulin and leptin releases [3].

Nuts are dense nutrients comprising sources which are rich in minerals, unsaturated fatty acids, proteins of high-quality, fibres and certain compounds like tocopherols, phytoesters, and phenolic compounds which are bioactive, nuts have a large total fat content which ranges from 46% to 76%, the content of saturated fatty acids in nuts ranged from (4 to 16%) and the remaining fatty acids represent unsaturated fatty acids, Oleic acid was the major monounsaturated fatty acids in most nuts [4]. Consumption of nuts, at least five times per week lead to protecting against cardiovascular disease, type II diabetes and gallbladder disease [5]. On the other hand, the consumption of peanuts daily led to weight loss when consumed as part of moderate fat diet [6].

A daily fishmeal resulted in weight loss and a better lipid and glucose profile. When overweight patients with high blood pressure eat fishmeal rich in fatty acids of type n-3 possibly a cardiovascular risk reduced substantially. Treating young, overweight men, with either fish oil or fatty fish as part of a diet of restricted energy that led to a weight loss, in comparison with similar diet without them [7]. The researchers further reported that, adding seafood to a balanced, energy-restricted diet can boost weight loss [8].

Green coffee beans contain high rates of caffeine, chlorogenic acid, and its associated, namely p-coumaric acid, caffeic acid and quinic acid as describe by Choudhary P in his study in 2009 [9]. It was found that Caffeine promotes lipolysis in adipocytes of humans as well as experimental animals. In this respect, we aimed in this study to recognize the effects of diet containing low fat, almonds, green coffee and mackerel fish on rats suffering from obesity [10].

2. MATERIALS AND METHODS

This study was a randomized controlled trial. Animals for experiment wer albino male rats (42) of Sprague Dawley Strain obtain from the Laboratory Faculty of Medicine at Hail University, Saudia Arabia. Forty-two albino rats of weight ranging between 140 and 160 grams are kept in cages of good ventilation and hygienic conditions, and fed for one week on standard diet for acclimation [11]. The protocols for experiment was approved and performed in strict
accordance with the Guide for the care and use of laboratory animals [Institute of Laboratory Animal Resources on Life Sciences, US National Research Council,1996] and the Institutional Animal Ethical Committee [IAEC] of Hail University, KSA. All animals for experiment were kept in cages according to standard. The rats were grouped and housed in environmentally controlled room [ambient temperature 24±2°C and relative humidity of 55±5%] in the animal house and acclimatized for 07 days [12,13].

Casein as source of protein, vitamins mixture, minerals mixture, cellulose, Cystine and choline chloride were obtained from the Supplier company from Al-Khobar, Eastern Province, Saudi Arabia.

Hydrogenated oils, soy oil, starch, sucrose, coffee, almonds and mackerel fish were purchased from Pistachio, almond from Othiam market in Hail.

2.1 Preparation Cooking Mackerel Fish

2.1.1 Cooking of mackerel fish

Mackerel was roasted in electrical oven at 250°C for 15 – 20 minutes, after cleaning them and washing well. Then, mackerel fish was minced and mixed well, and then the mackerel fish was dried in oven at 40 - 50°C and grind.

2.1.2 Preparation of green coffee

Green coffee beans (2.5 g) were extracted in 100 ml boiled water for 5 min, then filtrate.

2.1.3 The chemical analysis of mackerel fish and almonds

Ash, moisture, protein, fat, and fiber were identified in almonds and mackerel fish.

2.1.4 Fatty acid composition

Fatty acid compositions of oils extracted from almonds and mackerel fish were determined accordingly [11].

2.2 Biological Study Accordingly

Researcher divided the (42) rats into two main groups: The first group consisted of (n = 6) rats fed on standard diet, and was used as the group for negative control. The second one consisted of (n = 36) rats fed for 6 weeks on HFD consisted of (20% casein, 20% fat "19% hydrogenated oils and 1% soy oil to provide necessary fatty acids", 1% vitamin mixture, 0.25% choline chloride, 3.5% salt mixture, 5% cellulose, 10% sucrose, , and the rest is corn starch) to induction obesity in this group of rats.

After these periods, the percentage of the gained body weight was estimated in these groups (group for negative control, which fed on basal diet and obese group fed on HFD). Also, blood samples were collected from each rat to estimate cholesterol, triglycerides and leptin to insure the induction of obesity, the second main group was divided into six equal subgroups (6 rats each): The first subgroup : Six rats were fed on a diet of high fat, and used as (positive control)1. The second one fed on diet of low fat having (hydrogenated oils 9%, 1% soybean oil which provided the diet with essential fatty acids) and used as control positive group2 (control +ve)2. The third subgroup was feeding on low fat diet containing (hydrogenated oils 4%, soy oil 1% and almonds which provided the diet with 5% oil. The fourth subgroup was feeding on low fat diet and treated each rat daily with 3 ml green coffee. The fifth subgroup: fed on low fat diet containing (hydrogenated oils 4%, soy oil 1% and mackerel fish, which provided the diet with 5% oil. The sixth subgroup fed on low fat diet containing (almonds, which provided the diet with 5% oil, mackerel fish that provided the diet with 5% oil and Soybean oil 1%) and treated each rats with 3 ml green coffee.

Gained body weights in rats as well as intake of feed were recorded. The rats were fasted overnight at the end of the experimental time (6 weeks), then the rats were anesthetized and sacrificed, and blood samples were obtained from the centrifuged and the aorta to obtain the serum. Serum was isolated to determine certain biochemical parameters such as lipid profile including (lipoprotein of low density, triglycerides, cholesterol, lipoprotein of high density, and lipoprotein of very low density), glucose, serum leptin hormone, liver enzymes including (ALP, ALT, and AST activities) and kidney function including (urea nitrogen, uric acid and creatinine). Liver weight / body weight % of each group was calculated [13].

Statistically Analysis; All nutritional and biological results analysed statistically by using one way ANOVA test, by using statistical analysis software (SAS) program Results of biological evaluation of each group were statistically analyzed (mean ± standard deviation and one-way ANOVA test) using SAS package and
compared with each other followed by LSD analysis (least significant differences at \( P < 0.05 \) [13].

3. RESULTS AND DISCUSSION

3.1 Chemical Composition of Dried Almonds and Mackerel Fish (g/100 g)

The chemical analysis of almonds and mackerel fish is shown in Table 1. The amounts of moisture, protein, lipid, ash, fiber and carbohydrates of almonds and mackerel fish were (5.00, 22.033, 50.180, 2.133, 10.752 and 9.902 g/100g) and (7.022, 60.810, 28.065, 4.103, 00 and 00 g/100g), respectively. The amount of moisture, protein and ash increased in mackerel fish than that of almonds, while lipids in the almonds increased in almonds than mackerel fish.

Protein, fat, moisture and ash contents of fresh mackerel fish ranged between (21.46% - 22.75%), (2.24% - 8.23%), (69.7% - 74.9%), and (1.25% - 1.63%), respectively [14,15]. While, the amounts of nutrients of almonds analysed by 3, which reported that, water content of almonds ranged from 5.93 to 7.27%, oil from 53.67 to 54.26%, protein from 23.03 to 23.98%, sugar from 4.15 to 5.29%, K from 1546 to 1685 mg%, P from 253 to 259 mg%, Ca from 640 to 678 mg%, Mg from 447 to 494 mg%, Cu from 24.30 to 25.80 ppm, Zn from 76.33 to 80.50 ppm, Fe from 54.83 to 65.33 ppm and Mn from 37.67 to 37.83 ppm.

Table 2 shows the analysis of fatty acids of almonds and mackerel fish oils. The amount of saturated fatty acids SFAs of mackerel fish oil was 35.51%, the highest amount of SFAs in mackerel fish oil recorded for palmitic acid (C16:0) (28.85%), followed by stearic acid C18:0. Total amounts of monounsaturated fatty acid MUFA was (34.40%), the highest amount of MUFAs in mackerel fish oil recorded for oleic acid (C18:1), while the eicosadienoic acid C20:1 was (2.17%). Polyunsaturated fatty acid was 10.12% in mackerel fish oil, linoleic acid C18:2 was (9.35%). Mackerel fish oil contains more SFAs and MUFAs, than PUFA.

Concerning the fatty acids composition of almonds, the results in this table revealed that, total saturated fatty acids of almond oil were 8.71%, palmitic acid C16:0 was the major SFA presented in almond oil (6.84%), followed by stearic acid C18:0 (1.87%). Monounsaturated fatty acid MUFA was (71.01%), the oleic acid C18:1 was the predominant MUFA presented in almond oil (70.15%), while the palmitoleic Acid C16:1 was (0.81). Polyunsaturated fatty acid was 17.11% in almond oil, linoleic acid C18:2 was (16.86%). Almond oil contains more mono-unsaturated fatty acids than mono-unsaturated fatty acids and saturated fatty acids, respectively.

![Table 1. Chemical composition of dried almonds and mackerel fish (g/100 g)](data:image/png;base64,iVBORw0KGgoAAAANSUhEUgAAAgAAAAAHCAYAAAB...)

![Table 1. Fatty Acids Composition of oil extracted from almonds and mackerel fish (g/100 g)](data:image/png;base64,iVBORw0KGgoAAAANSUhEUgAAAgAAAAAHCAYAAAB...)

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Values of food consumption (gram per day for each rat), gained body weight and liver weight/body weight% in obese rats which treated with low fat diet LFD; LFD containing half amount of fat from almonds, LFD and treated daily with 3ml green coffee extract, LFD containing mackerel fish which provided the diet with half amount of fat and LFD containing (the same amounts of almonds and mackerel fish which provided the diet with all amount of fat) and treated with 3ml green coffee are found in Table 3.

Diet of high fat increased the feed intake mean in obese rat group, in comparison with to healthy rats which fed on standard diet. While feed intake decreased in obese rats group which fed on LFD (control +ve)2, in comparison with (the control +ve)1 which fed on HFD. All groups treated with almonds, green coffee, mackerel fish and their combinations showed significant decrease in feed intake p ≤ 0.05, in comparison with (control +ve)1, while coffee group and the group which treated with all tested materials led to decrease the mean value of feed intake significantly, in comparison with (control +ve) 2.

High fat diet increased the percentage of the gained body weight and liver weight/body weight percentage in obese rats, in comparison with the group of (negative control) which was fed on basal diet. Body and liver weights increased by approximately 120.921% and 102.209% than that of healthy rats in the group of negative control, respectively. Data in this Table revealed that, low fat diet LFD decreased BWG% and liver weight/body weight% significantly, as compared to HFD group. Treated obese groups with almonds, green coffee, mackerel fish and all of them led to significant decrease (P≤0.05) in BWG% and liver weight/body weight%, in comparison with (+ve control group). The highest decrease in BWG% and liver weight/body weight% found in the group which treated with LFD containing (almond & mackerel fish) and treated with green coffee, this treatment led to decrease the mean values of BWG% and liver weight/body weight % by about 56.205% and 48.918% than that of obese rats fed on HFD, respectively.

There is an inverse relationship between consumption of nuts and body weight, due to a change in energy expenditure, incomplete absorption of energy and the increased satiety [15,16]. The thermogenesis by caffeine was synergistically enhanced with catechins in rat adipose tissues [17].

Some study demonstrated that marine omega 3 fatty-acid-enriched diet led to decrease adipose growth and increase b-oxidation [18].

Table 4 illustrates the effect of almonds, green coffee, mackerel fish and all of them on the profile of lipid which includes (triglycerides, cholesterol, HDL-c, LDL-c and VLDL-c) of obese rats fed on a diet of low fat. All parameters, except HDL-c, have significant increased mean values (P≤ 0.05) in obese group fed on HFD, in comparison with (the control –ve group). On the other hand, obese rats fed on LFD (control +ve)2 decreased all lipid parameters except HDL-c which showed significant increase P≤0.05, in comparison with the group of positive control which fed on HFD (control +ve)2.

Treating obese groups with LFD containing almonds, LFD and treated daily with 3ml green coffee, LFD containing mackerel fish and LFD containing (the same amounts of almonds and mackerel fish) and treated daily with 3ml green coffee improved the lipid profile, as compared with the groups of positive control. The highest improvement in lipid profile showed in the group fed on LFD containing (almonds and mackerel fish) and treated daily with 3ml green coffee, because the treatment reduced all parameters, except HDL-c; in comparison with the other groups.

The antioxidant activity which extracted from green coffee ability to scavenge free radicals in vitro and increased the antioxidant capacity of plasma in vivo. The Relationship between the consumption of nut and reduced risk factors associated with heart disease has been well documented [19]. It is thought that the vitamin E (alpha-tocopherol) in nuts assists in reducing cardiovascular disease by some mechanisms e.g. prevention of oxidation of LDL cholesterol, prevention of platelet aggregation, and the inhibition of proliferation of smooth muscle cells. There was a 37% decrease in the risk of heart disease (CVD) for the ones whose consumption of nuts was more than four times weekly in comparison with those who rarely consumed nuts or consumed no nuts [14]. Consumption of nut improved the risk factors of cardiovascular disease, including improvements in LDL cholesterol, triglycerides, and total cholesterol [19]. There is lower chance of having coronary artery disease in populations consuming more n-3 fatty acids obtained from fish [20].
The effect of almonds, green coffee, mackerel fish and all of them on serum glucose, leptin, AST, ALT and ALP enzymes of obese rats fed on low fat diet are shown in Table 5. Serum glucose increased significantly (P≤ 0.05) in positive group fed on HFD (obese rats), in comparison with the group of negative control fed on standard diet (healthy rats). Serum glucose increased by about 75.83% in obese rats fed on HFD, than that of normal rats fed on standard diet. Feeding obese rats on LFD (control +ve)2 decreased significantly (P≤0.05) in this parameter, in comparison with the control positive group fed on HFD (control +ve)1.

There was a significant decrease (P≤ 0.05) in serum glucose among the obese rats which were fed on LFD with almonds, mackerel fish, green coffee and all of them decreased, as compared to (control +ve)1 &2. The results indicated that, feeding obese rats on LFD containing (almonds, mackerel fish and treated with green coffee) showed the best results in serum glucose. This treatment decreased this parameter significantly P≤0.05 in comparison with the other treated groups. Serum glucose in this group decreased by 37.153% approximately, than that of the positive control group (control +ve)1 which fed on HFD only.

Serum leptin increased in obese rats (the group of +ve control fed on HFD) significantly, in comparison with healthy rats (group of -ve control). Feeding rats in HFD increased serum leptin by 508.9% approximately, than that of the group of -ive control fed on standard diet. There was a significant decrease (p ≤ 0.05) among obese rats fed on LFD, in comparison with the group of +ve control fed on HFD.

Feeding obese rats on LFD containing almonds, LFD containing mackerel fish, LFD and treated with green coffee and LFD containing (almonds and mackerel fish) and treated with green coffee improved serum leptin, as compared to the (control +ve)1&2. The mean value of serum leptin decreased significantly under these treatments, in comparison with the group of positive control fed on HFD (control +ve)1. Group of rats fed on LFD containing (almonds and mackerel fish) and treated with green coffee recorded the best results in serum leptin, this treatment decreased serum leptin by 68.424% approximately, than that of the group of +ve control fed on HFD.

The diet of high fat induced significant increase (P≤0.05) in liver enzymes in obese rats, in comparison with healthy rats fed on standard diet. Low fat diet LFD decreased AST, ALT and ALP significantly in obese rats, as compared to obese group fed on HFD. There was a significant decrease in these parameters (P≤0.05) in all treated obese groups with almonds, green coffee, mackerel fish (all of them), in comparison with obese rats fed on HFD or LFD (only).

The highest improvement in (AST, ALT and ALP) found in obese group fed on LFD containing (almonds and mackerel fish) & treated with green coffee. This treatment decreased AST, ALT and ALP by about 43.957%, 56.842% and 35.982%, respectively than of the positive control (control +ve)1.

There was a significant reduction (p<0.01) in almond fasting as well as in levels of post-prandial blood glucose in female subjects suffering from Type 2 DM. On the other hand, the almond soluble fiber decreased cholesterol and adjusted levels of sugar of blood in diabetic persons. Almond is rich in phytochemicals and nutrients including vitamin (E), also polyphenols that is known as antioxidants and had strong free radical scavenging. The almond extract treatment (150 mg / kg and 300 mg / kg) returned levels of the biochemical markers to almost normal levels in a dose-dependent manner [21].

It has been found that coffee contributed significantly to the overall potential of vitro antioxidant of diet, as oxidative stress could lead to type 2 diabetes development [22]. Larger coffee consumption was associated with lower risk of cirrhosis as population studies indicated, and Chronic hepatic disease among people with unknown liver disease diagnosis. The liver fat was improved by omega-3 PUFAs, and gamma-glutamyl transferase GGT which protect the liver from the damage in non-alcoholic fatty liver disease patients / non-alcoholic steatohepatitis NAFLD / NASH. Thus, n-3 PUFAs could be a new NAFLD treatment option [23].

The effect of treated obese rats with low fat diet LFD, almonds, green coffee, mackerel fish and their combination on uric acid, urea nitrogen and creatinine are shown in Table 6. The treatment of obese rats with a diet of high fat in (control +ve)1 resulted in significant reduction P≤0.05 in all parameters, in comparison with the group of negative control fed on standard diet, on the other hand feeding obese rats on low fat diet LFD in (control +ve)2 reduced the
parameters’ mean values, in comparison with the obese group fed on HFD (control +ve) [1]. Treated obese groups which fed on LFD with almonds, green coffee, mackerel fish and all of them, improved functions of kidney, when compared to the (group of +ve) fed on HFD. The lowest values of these parameters were found in the group treated with green coffee, while the highest values were found in the obese group treated with all tested materials (almonds, green coffee, mackerel fish).

Almonds provided the hypercholesterolemic diet with 5% and 10% oil improved kidney function of hypercholesterolemic rats [23]. The improvement in kidney functions in treated diabetic rats with some nuts may be related to the antioxidant properties of these nuts which have scavenge free radicals and thereby may protect cells from oxidative stress. Almonds are a rich source of vitamin E and polyphenols that is known as antioxidants and had strong free radical scavenging [13].

CGA is a phenolic compound consisting of a set of organic compounds which occur naturally in plants [24], and found in high amount in coffee (Coffea canephora) [24]. It is an ester consisting of cinnamon acid and quinic acid, denoted by (5-CQA). Glucose-6-phosphate-translocase inhibition has been found to delay absorption of glucose in the intestine.

**Table 2. Effect of almonds, green coffee, mackerel fish and all of them on nutritional parameters on obese rats fed on low fat diet**

<table>
<thead>
<tr>
<th>Groups</th>
<th>Feed intake g/day/rat</th>
<th>BWG%</th>
<th>Liver weight/b body weight%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basal diet (control –ve)</td>
<td>19.952 ± 0.596</td>
<td>8.986 ± 0.518</td>
<td>2.896 ± 0.188</td>
</tr>
<tr>
<td>High fat diet (control +ve)</td>
<td>21.237 ± 0.849</td>
<td>19.852 ± 1.034</td>
<td>5.920 ± 0.300</td>
</tr>
<tr>
<td>Low fat diet LFD (control +ve)</td>
<td>19.326 ± 0.362</td>
<td>15.106 ± 0.881</td>
<td>4.270 ± 0.181</td>
</tr>
<tr>
<td>Containing almonds</td>
<td>19.376 ± 0.429</td>
<td>11.866 ± 0.616</td>
<td>3.440 ± 0.218</td>
</tr>
<tr>
<td>and treated with green coffee</td>
<td>17.709 ± 0.493</td>
<td>10.738 ± 0.399</td>
<td>3.166 ± 0.124</td>
</tr>
<tr>
<td>containing mackerel fish</td>
<td>19.258 ± 0.367</td>
<td>10.520 ± 0.396</td>
<td>3.570 ± 0.130</td>
</tr>
<tr>
<td>containing almonds, mackerel fish and treated with green coffee</td>
<td>18.204 ± 0.212</td>
<td>8.694 ± 0.384</td>
<td>3.024 ± 0.183</td>
</tr>
</tbody>
</table>

**Table 4. Effect of almonds, green coffee, mackerel fish and all of them on lipid fractions of obese rats fed on low fat diet**

<table>
<thead>
<tr>
<th>Groups</th>
<th>Cholesterol mg/dl</th>
<th>Triglyceride</th>
<th>HDL-c</th>
<th>LDL-c</th>
<th>VLDL-c</th>
</tr>
</thead>
<tbody>
<tr>
<td>High fat diet (control +ve)</td>
<td>157.374 a ± 3.827</td>
<td>98.695 a ± 3.638</td>
<td>17.867 f ± 1.597</td>
<td>119.768 a ± 3.061</td>
<td>19.738 a ± 0.727</td>
</tr>
<tr>
<td>Low fat diet LFD (control +ve)</td>
<td>137.946 b ± 3.958</td>
<td>75.750 b ± 2.085</td>
<td>27.349 e ± 1.933</td>
<td>95.477 b ± 3.220</td>
<td>15.149 b ± 0.417</td>
</tr>
<tr>
<td>Containing almonds</td>
<td>122.815 c d ± 2.892</td>
<td>63.242 d ± 3.027</td>
<td>35.837 cd ± 2.578</td>
<td>74.328 d ± 3.201</td>
<td>12.650 d ± 0.604</td>
</tr>
<tr>
<td>and treated with green coffee</td>
<td>127.654 c ± 3.958</td>
<td>67.249 c ± 1.917</td>
<td>33.167 d ± 1.933</td>
<td>81.037 c ± 2.220</td>
<td>13.449 c ± 0.417</td>
</tr>
<tr>
<td>containing mackerel fish</td>
<td>118.490 d ± 4.322</td>
<td>62.562 d ± 1.997</td>
<td>36.718 c ± 1.330</td>
<td>69.259 e ± 3.880</td>
<td>12.512 d ± 0.399</td>
</tr>
<tr>
<td>containing almonds, mackerel fish and treated with green coffee</td>
<td>101.280 e ± 5.104</td>
<td>55.036 e ± 2.502</td>
<td>42.925 b ± 1.753</td>
<td>47.348 f ± 3.402</td>
<td>11.007 e ± 0.500</td>
</tr>
</tbody>
</table>

**LFD: Low fat diet. Least significant differences at P<0.05. Means with the same letter are insignificantly difference.**
blood urea nitrogen BUN levels were significantly increased while clearance of creatinine in untreated diabetic rats was significantly reduced. Nevertheless, ten weeks of CGA administration significantly improved the GFR in diabetic rats, implying its nephro-protective action. We propose that GFR was improved by CGA through downregulation of TGF-β induced expression of extracellular matrix protein in the glomerular matrix [25].

Blood pressure is reduced by omega-3 polyunsaturated fatty acids, a known accelerator of the progression of renal disease [26]. Clinical trials which are well planned, properly operated, randomized and controlled need additional research of the possible advantages of omega-3 poly-unsaturated fatty acids on kidney disease progression and patient survival. Omega-3 fatty acids may have clinical benefits; formal recommendations that promote omega-3 dialysis supplementation are premature before long-run and antagonistic impacts are better characterized by Fassett R.G in his study 1910 [25,27].

4. CONCLUSION

In conclusion, treatment of obese rats with low fat diet LFD; almond; mackerel fish; green coffee and all of them improved body weight gain%,
liver weight, lipid profile, glucose, Leptin hormone, liver enzymes and kidney functions, especially the group which treated with “almond; mackerel fish and green coffee” together. Therefore, obese people are advised to reduce the intake of fat and also use mackerel fish, almond and green coffee as part of their daily meals.

CONSENT

It is not applicable.

ETHICAL APPROVAL

The study was approved by the institutional ethical committee, University Of Hail, dated: 28/2/2018 and approved by university president letter number No. 85456/3/21 dated 23/06/1439H.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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