Comparative Study of White, Brown and Black Rice Effects on Hypercholesterolemic Rat

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Abstract:
This study was carried out to compare white, brown, black rice, their mixture and biscuits effects on hypercholesterolemic rats. Thirty-five male mature albino rats weighing 150-160g per each, were used in this study and divided into 7 equal groups, the first group was kept as a control -ve group, while the other groups were fed on hypercholesterolemic diet for 3 weeks to induce hypercholesterolemia. The tested plant powder their mixture and biscuits were given to the rats as a percent of 5% from the Basel diet for 28 days. At the end of the experiment, serum total cholesterol (TC), Triglycerides (TG), High density lipoprotein (HDL-c), GOT, GPT, ALP, urea, creatinine, uric acid were determined. Also, low density lipoprotein (LDL-c), very low density lipoprotein (VLDL-c), and (A.I) were calculated. Also, heart was examined histopathologically. The results indicated that tested plants significantly (P<0.05) decreased serum TC, TG, LDL, VLDL and increased HDL and A.I. Moreover, the tested seeds improved liver and kidney functions and prevented some of the adverse histopathological changes in liver. The obtained findings hypothesized that tested plant parts containing several compounds which are able to improve the adverse effects and inhibited hypercholesterolemia. So, the data recommended to take white, brown, black rice by a moderate amount in our diets.

Keywords: T.C, T.G, HDL-c, LDL-c, liver and kidney functions, hypercholesterolemic rats, histopathological examination.
Introduction

Hyperlipidemia is a medical condition characterized by excess of fatty substances such as lipids, cholesterol and triglycerides in the blood. Fatty substances travel in the blood attached to proteins to remain dissolved while in circulation, so hyperlipidemia may be called hyperlipoproteinemia (Haddad et al., 2013). The leading cause of morbidity and mortality in many countries in the world is still cardiovascular disease (CVD), in spite of remarkable improvements in its prevention, diagnosis and therapy. Hypercholesterolemia is caused by increased concentrations of low-density lipoprotein cholesterol (LDL-C) and very low-density lipoprotein cholesterol (VLDL-C). The increase in VLDL caused the increase in triglycerides (TGs). High TG and greater LDL-C are predictors to increase CVD risk. High-density lipoprotein cholesterol (HDL-C) concentrations provide the opposite relationship, with increased blood concentrations of HDL-C predicting reduced risk. To lower serum LDL-C levels by making dietary changes is the well-established way to reduce the risk of developing CVD. In addition to reduce saturated fat and cholesterol intake, and increasing cis-unsaturated fat intake, the importance of other dietary approaches, such as increasing the intake of water-soluble dietary fibers has become increasingly recognized (Tanay et al., 2012). Black rice contains many vitamins and minerals, including iron, vitamin A and vitamin B, which are beneficial for overall health and the prevention of heart disease. These marked health benefits have been attributed to the antioxidant properties of anthocyanin. Anthocyanins are linked with better heart health, cancer prevention, relieving inflammation, and increasing memory. This makes it a stellar addition to the diet in place of other rice (Kushwaha, 2016). Anthocyanins are naturally occurring plant pigments that belong to the flavonoid family and are widely used for their antioxidant and pharmacological properties. Reactive free radicals have been postulated to contribute the development of chronic inflammatory proliferative diseases (CIPDs), particularly arteriosclerosis and cancer by causing oxidative damage to essential enzymes, cells and tissues. The anthocyanins in rice act as antioxidants, which can inhibit inflammation throughout the body, act as anticancer agents, promote blood circulation, slow damage and aging of tissues, reduce cholesterol and blood sugar
levels affect pituitary gland function, inhibit gastric acid secretion and inhibit platelet aggregation (Wipada and Kanlaya, 2015)

**Materials and methods**

**Plant materials:** White, brown and black rice are obtained from the Ministry of Agriculture (black rice in Horticulture Research station, Sakha, Garbia governorate.

**Rats and diets:** Male albino rats weighing 150-160g per each were purchased from Medical Insects Research Institute, Cairo, Egypt. Cholesterol and other Chemicals basal diet constituents were obtained from El-Gomhoria Company for trading Drug Chemicals and Medicals, Cairo, Egypt.

**Basal diet:** The basal diet was prepared according to the following: protein (10%), corn oil (10%), vitamin mixture (1%), mineral mixture (4%), choline chloride (0.2%), methionine (0.3%), cellulose (5%), and the remained is corn starch (69.5%) according to Campbell (1963). The vitamin mixture component was recommended by Hegstedet et al., (1941), while the salt mixture was formulated according to Drury and Wallington, (1980). Cholesterol containing diet was prepared by adding 1.5% cholesterol to the basal diet according to Hegsted et al., (1941)

**Experimental Design:**
Thirty five male albino rats were housed in healthy condition (21-23°C) and fed on basal diet for one week before starting the experiment for acclimatization. After this, rats were divided into two main groups, the first group (5 rats) fed on basal diet as a negative control (ve-) and the other main group (30 rats) was fed on 1.5% cholesterol for 3 weeks to induce hypercholesterolemia, then classified into six sub groups as follow:

Sub group (2): Control positive group (+ve), hypercholesterolemic rats fed on basal diet.
Sub group (3): Hypercholesterolemic rats fed on basal diet + 5% white rice powder.
Sub group (4): Hypercholesterolemic rats fed on basal diet + 5% brown rice powder.
Sub group (5): Hypercholesterolemic rats fed on basal diet + 5% Black rice powder.
Sub group (6): Hypercholesterolemic rats fed on basal diet 5% mixture of white, brown and black rice powder.

Sub group (7): Hypercholesterolemic rats fed on biscuits made from the three kinds of rice powder 5%.

At the end of the experimental (4 weeks), rats were fasted for 12-h then scarificed. Blood samples were collected from the portal vein into dry clean centrifuge tubes for serum separation, blood samples centrifuged for 10 minutes at 3000 rpm to separate the serum according to Drury and Wallington, (1980). Liver of sacrificed rats were kept in 10% formalin solution till processed for histopathological examination.

**Serum lipid profile assay**

Cholesterol, TG, H.D.L-c, L.D.L-c and V.L.D.L-c were determined according to Allain et al., (1974), Fassati and Prencipe, (1982), Lopez, (1977) and Lee and Nieman, (1996), respectively. Low density lipoprotein cholesterol and very low-density lipoprotein cholesterol were calculated according to the following equation:

\[
LDL\text{-}c = \text{Total cholesterol} - (\text{HDL\text{-}c} + \frac{\text{TG}}{5})
\]

\[
VLDL\text{-}c = \frac{\text{TG}}{5}
\]

Atherogenic index (AI) was calculated as \((\text{LDL}\text{-}c + \text{VLDL}\text{-}c)/\text{HDL}\text{-}c\) according to (Kikuchi et al., 1998).

**Liver functions assay:**

Glotamic oxalic transaminase (GOT), Glotamic pyrofic transaminase (GPT) and alkaline phosphatase (ALP) were determined according to the methods described by Bergmeyer and Harder, (1986), Kachmar and Moss, (1976) and Varley et al., (1980), respectively.

**Kidney functions assay**

Urea, Creatinine and uric acid were determined according to the methods of Patton and Crouch (1977), Henry (1974), and Schultz, (1984), respectively.

**Histopathological Examination:**

Small specimens from liver was collected from all experimental groups, fixed in 10% neutral buffered formalin, dehydrated in ascending concentration of ethanol (70, 80, and 90%), cleared in xylene and embedded in paraffin. Sections of (4 - 6) μm thickness were prepared
and stained with Hematoxylin and Eosin according to Bancroft et al., (1996).

**Statistical Analysis:**

Data were expressed as mean ± standard deviation. In order to compare the groups, analysis of variance (ANOVA) test was used. Values at (P≤0.05) were considered to be statistically significant according to SAS, (2006).

**Results and Discussion**

Effect of white, brown, black rice, their mixture and biscuits on serum total cholesterol and triglycerides (mg/dl) of hypercholesterolemic rats

Serum TC and TG in normal and hypercholesterolemic rats fed on diets with or without white, brown, black rice, their mixture and biscuits were recorded in table (1). Rats fed on high cholesterol diet (control +ve) had a significant increase in serum concentration of T.C and T.G which recorded 195±2 and 180 ± 2mg/dl, respectively compared to control (–ve) group which recorded 131±1 and 90 ± 1mg/dl, respectively. Rats fed on high cholesterol diets with white, brown, black rice and their mixture had significant decreases in serum concentration of TC and TG. The best serum TC and TG results were recorded for groups (5 and 6) (mixture 5%) and (biscuits 5%). These results in the same line carried out by Wang et al., (2006), Soheir et al., (2016) and Thanuja and Parimalavalli, (2018), they indicated that animals (Wistar male rats) fed with black rice showed lower levels of T.C. Also, data agree with Jocelem et al., (2010) and Soheir et al., (2016) as they found that black rice feeding of hypercholesterolemic rats reduced the TG.
Table (1). Serum total cholesterol and triglycerides (mg/dl) of hypercholesterolemic rats fed on white, brown, black rice and their mixture

<table>
<thead>
<tr>
<th>Groups</th>
<th>TC (mg/dl)</th>
<th>% change of positive control</th>
<th>LSD (p≤0.05)</th>
<th>TG (mg/dl)</th>
<th>% change of positive control</th>
<th>LSD (p≤0.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (-)</td>
<td>131±1</td>
<td>-32.82</td>
<td></td>
<td>90±1</td>
<td>-50</td>
<td></td>
</tr>
<tr>
<td>Control (+)</td>
<td>195±2</td>
<td>-</td>
<td></td>
<td>180±2</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>White Rice 5%</td>
<td>186.02±0.505</td>
<td>-4.61</td>
<td>1.787</td>
<td>120±0.5</td>
<td>-33.33</td>
<td>0.965</td>
</tr>
<tr>
<td>Brown Rice 5%</td>
<td>153±1.305</td>
<td>-21.53</td>
<td></td>
<td>110±0.4</td>
<td>-38.89</td>
<td></td>
</tr>
<tr>
<td>Black Rice 5%</td>
<td>120±1</td>
<td>-38.46</td>
<td></td>
<td>70±1</td>
<td>-61.11</td>
<td></td>
</tr>
<tr>
<td>Mixture 5%</td>
<td>110±0.5</td>
<td>-43.89</td>
<td></td>
<td>58±0.6</td>
<td>-67.77</td>
<td></td>
</tr>
<tr>
<td>Biscuits 5%</td>
<td>114.889±0.994</td>
<td>-41.08</td>
<td></td>
<td>80±0.7</td>
<td>-55.56</td>
<td></td>
</tr>
</tbody>
</table>

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

Effect of white, brown, black, their mixture and biscuitson serum HDL-c, LDL-c, and VLDL-c (mg/dl) of hypercholesterolemic rats

Data in table (2) indicate that rats fed on high-cholesterol diet had observed reduction in serum level of HDL-c (18 ± 0.5 mg/dl) when compared with rats fed on basal diet (40 ± 1 mg/dl). Rats fed on white, brown, black rice and their mixture showed higher values in serum level of HDL-c as compared to the positive control group. With regard to serum levels of VLDL-c and LDL-c, results revealed that positive control group had observed increases in serum LDL-c and VLDL-c (141 ± 0.5 and 36.01 ± 0.395 mg/dl), respectively comparing with negative control group (73 ± 0.4 and 18 ± 0.21 mg/dl). Rats fed on high cholesterol diets with white, brown, black rice and their mixture had significant decreases in serum concentration of VLDL-c and LDL-c as compared to the positive control group. The best serum HDL, LDL, and VLDL were recorded for group 6 (mixture 5%). Murata et al., (2007) used experimental diets with rice for Japanese people 20% black rice from the diet and found a significant decline in levels of blood.
cholesterol. However, Lee et al., (2007) observed an increase in HDL-C levels in rats that received germinated black rice. This trend was also found by Jocelem et al., (2010) and Soheir et al., (2016) they found that the serum HDL-C levels were significantly increased when rats received 20% black rice from the diet and decreased serum LDL-c levels. The reduction of the VLDL levels was also observed by Nan et al., (2008) they found that rats fed a diet rich in black rice bran oil showed a significant decrease in cholesterol and VLDL-C concentrations. Also, in the same line of Lobo et al., (2010) they reported that black rice helps to increase high-density lipoprotein (HDL) cholesterol. In present work, however the mixture diet was the best (tables (1&2). This indicated a synergistic action different types of rice considering serum lipids fractions.

Table 2. Serum HDL-c, LDL-c and VLDL-c (mg/dl) of hypercholesterolemic rats fed on white, brown, black and mixture rice

<table>
<thead>
<tr>
<th>Groups/ Variable</th>
<th>HDL-c (mg/dl)</th>
<th>% change of positive control</th>
<th>LSD (p&lt;0.05)</th>
<th>LDL-c (mg/dl)</th>
<th>% change of positive control</th>
<th>LSD (p&lt;0.05)</th>
<th>VLDL-c (mg/dl)</th>
<th>% change of positive control</th>
<th>LSD (p&lt;0.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (-)</td>
<td>40 ± 1</td>
<td>122</td>
<td></td>
<td>73 ± 0.4</td>
<td>-48.22</td>
<td></td>
<td>18d ± 0.21</td>
<td>-50.01</td>
<td></td>
</tr>
<tr>
<td>Control (+)</td>
<td>18 ± 0.5</td>
<td>-</td>
<td></td>
<td>141 ± 0.5</td>
<td>-</td>
<td></td>
<td>36.01a ± 0.395</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>White Rice 5%</td>
<td>29 ± 0.3</td>
<td>61.11</td>
<td>0.904</td>
<td>133 ± 0.3</td>
<td>-5.67</td>
<td>0.257</td>
<td>24b ± 0.3</td>
<td>-33.35</td>
<td></td>
</tr>
<tr>
<td>Brown Rice 5%</td>
<td>38 ± 1</td>
<td>111.11</td>
<td></td>
<td>93 ± 0.5</td>
<td>-34.04</td>
<td></td>
<td>22c ± 0.2</td>
<td>-38.90</td>
<td></td>
</tr>
<tr>
<td>Black Rice 5%</td>
<td>43 ± 0.3</td>
<td>138.88</td>
<td></td>
<td>62.97 ± 0.276</td>
<td>-55.34</td>
<td></td>
<td>14f ± 0.295</td>
<td>-61.12</td>
<td></td>
</tr>
<tr>
<td>Mixture 5%</td>
<td>46 ± 0.51</td>
<td>155.55</td>
<td></td>
<td>52 ± 0.4</td>
<td>-63.12</td>
<td></td>
<td>12g ± 0.5</td>
<td>-66.69</td>
<td></td>
</tr>
<tr>
<td>Biscuits 5%</td>
<td>44 ± 0.31</td>
<td>144.44</td>
<td></td>
<td>55 ± 0.7</td>
<td>-60.99</td>
<td></td>
<td>16e ± 0.4</td>
<td>-55.56</td>
<td></td>
</tr>
</tbody>
</table>

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

Effect of white, brown, black and mixture rice on atherogenic index (AI) (mg/dl) of hypercholesterolemic rats

Data in table (3) revealed that rats fed on high-cholesterol diet had a higher value of atherogenic index (9.823 ± 0.099) when compared
with negative control group (2.28 ± 0.02). Groups treated with white, brown, black rice and their mixtures showed lower values in AI index as compared to positive control group. The best AI (LDL+VLDL/HDL) index was recorded for group 6 (mixture 5%).

Table (3). Atherogenic Index (mg dl) of hypercholesterolemic rats fed on white, brown, black, mixture rice and biscuits

<table>
<thead>
<tr>
<th>Groups Variables</th>
<th>A.I</th>
<th>%change of positive control</th>
<th>LSD (p≤0.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (-)</td>
<td>2.28± 0.02</td>
<td>-77.60</td>
<td></td>
</tr>
<tr>
<td>Control (+)</td>
<td>9.82± 0.099</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>White Rice 5%</td>
<td>5.41± 0.02</td>
<td>-44.93</td>
<td></td>
</tr>
<tr>
<td>Brown Rice 5%</td>
<td>3.03± 0.013</td>
<td>-69.14</td>
<td></td>
</tr>
<tr>
<td>Black Rice 5%</td>
<td>1.79± 0.01</td>
<td>-81.78</td>
<td></td>
</tr>
<tr>
<td>Mixture 5%</td>
<td>1.39± 0.03</td>
<td>-85.85</td>
<td></td>
</tr>
<tr>
<td>Biscuits 5%</td>
<td>1.61± 0.01</td>
<td>-83.61</td>
<td></td>
</tr>
</tbody>
</table>

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

Effect of white, brown, black and mixture rice on serum GOT, GPT, and ALP (u/l) of hypercholesterolemic rats

Data in table (4) showed that control negative group was significantly lower in serum level of GOT which was 139.04 ± 0.941u/l when compared with control positive group 266.92 ± 1.891 u/l. Rats treated with white, brown, black rice and their mixtures showed lower values in serum level of GOT as compared to the positive control group. With regard to serum levels of GPT and ALP, results revealed that positive control group had observed an increase in serum GPT and ALP which were 193.89 ± 1.613 and 321.89 ± 0.5 u/l, respectively comparing with negative control group (97.079 ± 1.666 and 309 ± 0.401u/l). Groups
which treated with white, brown, black rice and their mixture decreased serum levels of GPT and ALP as compared to positive group. The best serum GOT, GPT, and ALP were recorded for group 5 and 6 (5% black rice) and (5% mixture). This trend was also found by Soheir et al., (2016), they found that feeding mice on black rice decreased serum AST or GOT levels. Similarly, Jang et al., (2015), found that feeding rats on black rice decreased levels of serum asparate amine transaminase (AST) or (GOT) and decreased levels of serum alanine transaminase (ALT) or (GPT). The data of above mention tables are in agreement with that obtained by Jang et al., (2012), they indicated that the rats fed on black rice decreased levels of serum alkaline phosphatase (ALP) enzyme. For serum (GOT), (GPT) synergistic action was not found. Never theless biscuits with rice were useful for the rats health, based of liver enzymes levels.

Table (4). Serum GOT, GPT, and ALP (U/L) of hypercholesterolemic rats fed on white, brown, black, mixture rice and biscuits

<table>
<thead>
<tr>
<th>Groups Variables</th>
<th>GOT (μL)</th>
<th>%change of positive control</th>
<th>LSD (p&lt;0.05)</th>
<th>GPT (μL)</th>
<th>%change of positive control</th>
<th>LSD (p&lt;0.05)</th>
<th>ALP (μL)</th>
<th>%change of positive control</th>
<th>LSD (p&lt;0.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (+)</td>
<td>139.04±0.94</td>
<td>-47.91</td>
<td></td>
<td>97.079±1.666</td>
<td>-49.93</td>
<td></td>
<td>309±0.401</td>
<td>-4.0</td>
<td></td>
</tr>
<tr>
<td>Control (+)</td>
<td>266.92±1.891</td>
<td>-47.91</td>
<td></td>
<td>193.893±1.613</td>
<td>-49.93</td>
<td></td>
<td>321.89±0.5</td>
<td>-49.93</td>
<td></td>
</tr>
<tr>
<td>White Rice 5%</td>
<td>249.99±1.55</td>
<td>-6.43</td>
<td>2.471</td>
<td>149±1.44</td>
<td>-12.84</td>
<td>2.785</td>
<td>320.76±0.463</td>
<td>0.35</td>
<td>1.435</td>
</tr>
<tr>
<td>Brown Rice 5%</td>
<td>211.24±1.154</td>
<td>-20.86</td>
<td></td>
<td>162±1.89</td>
<td>-16.45</td>
<td></td>
<td>318±1</td>
<td>-1.21</td>
<td></td>
</tr>
<tr>
<td>Black Rice 5%</td>
<td>169.29±1.4</td>
<td>-36.57</td>
<td></td>
<td>121.616±0.907</td>
<td>-37.28</td>
<td></td>
<td>268.176±0.957</td>
<td>-16.69</td>
<td></td>
</tr>
<tr>
<td>Mixture 5%</td>
<td>194.236±1.05</td>
<td>-27.22</td>
<td></td>
<td>127.233±0.775</td>
<td>-34.48</td>
<td></td>
<td>268.176±0.957</td>
<td>-16.68</td>
<td></td>
</tr>
<tr>
<td>Biscuits 5%</td>
<td>196.63±0.709</td>
<td>-26.33</td>
<td></td>
<td>846.583±1.507</td>
<td>-24.40</td>
<td></td>
<td>286.04±0.94</td>
<td>-11.13</td>
<td></td>
</tr>
</tbody>
</table>

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Effect of white, brown, black, mixture rice and biscuits on serum urea, creatinine, and uric acid (mg/dl) of hypercholesterolemic rats

Data in table (5) indicated that control negative group was significantly lower in serum levels of urea, creatinine, and uric acid which were 30 ± 1, 0.64 ± 0.09, and 1.91 ± .085 mg/dl, respectively when compared with control positive group which were 58 ± 0.8, 1.24 ± 0.02, and 3.71 ± 0.1 mg/dl, respectively. Rats treated with white, brown, black rice, their mixture and biscuits showed significantly lower values in serum levels of urea, creatinine, and uric acid compared to the positive control group. The best serum urea, creatinine, and uric acid were recorded for group 5 (black rice 5%) considering when uric acid, while the best group was the 6 group for creatinine. Similarly trends were given by Missoune et al., (2010) they found also that the black rice reduced levels of serum urea. This trend was also found by Soheir et al., (2016) they found that the black rice reduced levels of serum urea, creatinine, and uric acid.

Table (5). Serum urea, creatinine, and uric acid (mg/dl) of hypercholesterolemic rats fed on white, brown, black and mixture rice

<table>
<thead>
<tr>
<th>Groups</th>
<th>Variables</th>
<th>Urea % change of positive control</th>
<th>LSD p≤0.05</th>
<th>Creatinine % change of positive control</th>
<th>LSD p≤0.05</th>
<th>Uric Acid % change of positive control</th>
<th>LSD p≤0.05</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (-)</td>
<td>30 ± 1</td>
<td>-48.28</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control (+)</td>
<td>58 ± 0.8</td>
<td>-48.38</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White Rice 5%</td>
<td>49.01 ± 0.495</td>
<td>-15.5</td>
<td>1.161</td>
<td>1.041 ± 0.011</td>
<td>-16.04</td>
<td>3.5 ± 0.04</td>
<td>-5.39</td>
</tr>
<tr>
<td>Brown Rice 5%</td>
<td>33.136 ± 1.01</td>
<td>-42.83</td>
<td></td>
<td>0.541 ± 0.019</td>
<td>-56.37</td>
<td>2.597 ± 0.024</td>
<td>-30</td>
</tr>
<tr>
<td>Black Rice 5%</td>
<td>31.19 ± 0.195</td>
<td>-46.55</td>
<td></td>
<td>0.295 ± 0.012</td>
<td>-76.21</td>
<td>1.906 ± 0.040</td>
<td>-48.63</td>
</tr>
<tr>
<td>Mixture 5%</td>
<td>32.02 ± 0.2</td>
<td>-44.79</td>
<td></td>
<td>0.212 ± 0.009</td>
<td>-82.90</td>
<td>2.031 ± 0.017</td>
<td>-45.28</td>
</tr>
<tr>
<td>Biscuits 5%</td>
<td>32.02 ± 0.495</td>
<td>-44.82</td>
<td></td>
<td>0.23 ± 0.019</td>
<td>-81.45</td>
<td>2.066 ± 0.085</td>
<td>-44.31</td>
</tr>
</tbody>
</table>

Values denote arithmetic means I standard deviation of the mean. Means with different letter(a,b,c,d,etc.) in the same column differ significantly at (p≤0.05) ,using ANOVAA test, while those with similar letter are non-significantly different
Histopathological examination of Liver
Liver of rats from group 1 (negative control group) revealed the normal histological structure of hepatic lobule (Photos 1-a). On the other hand, liver of rats from group 2 hypercholesterolemic rats (positive group) showed cytoplasmic vacuolization of hepatocytes (Photo 1-b). Meanwhile, liver of rats from group 3 hypercholesterolemic rats treated with white rice revealed no histopathological changes (Photo 1-c) except congestion of central vein. Moreover, slight congestion of hepatic sinusoids and slight Kupffer cells activation were noticed in liver from group 4 (hypercholesterolemic rats fed on brown rice) (Photos D). Examined sections from group 5 (hypercholesterolemic rats fed on black rice) showed congestion of central vein and hepatic sinusoids as well as slight Kupffer cells activation (Photo e). However, liver from group 6 (hypercholesterolemic rats fed on mixture) revealed slight cytoplasmic vacuolization of hepatocytes (Photo f). Moreover, liver from group 7 (hypercholesterolemic rats hypercholesterolemic rats fed on biscuit) showed only slight Kupffer cells activation (Photo g). These results in the same line with Bosello et al., (1984); Rumessenet al., (1990), and Nawras (2009) they revealed that the soluble fibers in rice decreased the absorption of lipids in the proximal intestine and increased the absorption in the mid-intestine, which might alter the size and composition of lipoproteins secreted by the intestine, so it protect the organs from bad changes in hypercholesterolemic induced rats. It seems possible that restoring the original structure needs more time of feeding.
Photo(1): Effect of tested rice diets on histopathological changes of liver of hypercholesterolemic rats. (a) a normal (control diet); b control diet often inducing by hypercholesterolemia. (c,d,f and g) fed on diet containing rice diets 5% for 28 day after induction of hypercholesterolemia; (H&E, X 400).

Conclusion

The selected rice in the present study were effective in protecting rats against hypercholesterolemia. These results supported our hypothesis that tested rice contained several important compounds such as fibers, minerals, polyphenols, flavonoids and carotenoids which are able to inhibit hypercholesterolemic process. Therefore, data recommended the selected rice by a moderate amount to be included in our daily diets.

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دراسة مقارنة للأرز الأبيض والبني والأسود لدى الفناث المصابين بارتفاع الكوليسترول بالدم

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المنصوص العربي:

أجريت هذه الدراسة للمقارنة بين أنواع الأرز الأبيض والبني والأسود ومخلوطها والبسكويتنية 5% على الفناث المصاب بالكوليسترول. لذلك تم استخدام 35 فار من ذكر فناث الألباني والتي تزن 150±160 جم تم تقسيمها بالتساوي إلى 7 مجموعات، أهادهم استخدمت كجومعة ضابطا سالبا، بينما باقي المجموعات المختبرة (30) فأر تم تغذيتهم على الوجبة المرتبعة بالكوليسترول لمدة ثلاثة أسابيع، لحاجات ارتفاع في الكوليسترول الفناث. ثم تم إضافة مساحيق الأرز والبسكويت محل الدراسة إلى الوجبة الأساسية الفناث بنسبة 5% وذلك لمدة 28 يوم. وفي نهاية التجربة تم عمل التحاليل التالية: تقييم الكوليسترول الكلي، الجليكدية الثلاثية، الليبيروتينات مرتفعة الكثافة، الليبيروتينات منخفضة الكثافة، والليبيروتينات المنخفضة جدًا في الكثافة، ومعامل تصلب الشرايين. كما تم أيضا تشريح كل من وظائف الكبد والكلي، وعمل فحص هيستوباثولوجي للكبد. وقد أوضح النتائج المتحصل عليها وجود انخفاض معنوي (p≤0.05) في مستويات دهون الدم ووظائف الكبد والكلي. وعمول لوحظ وجود ارتفاع معنوي (p≤0.05) في مستوى الليبيروتينات مرتفعة الكثافة ومعامل تصلب الشرايين، كما أظهرت الفحص هيستوباثولوجي للكبد ما تم الحصول عليه من التحاليل البيوكيميائية. ويرجع هذا التحسن إلى احتواء مساحيق الأرز بالكولسترول على العديد من المكونات الطبيعية الفعالة التي تحسن من صورة دهون الدم ووظائف الكبد والكلي، وذلك منوصي بالاهتمام باستخدام هذه المكونات بكميات معتدلة في وجبات اليوم.

الكلمات المفتاحية: الكوليسترول الكلي، الجليبيدات الثلاثية، الليبيروتينات مرتفعة الكثافة، الليبيروتينات منخفضة الكثافة، وظائف الكبد والكلي، الفناث المصابين بارتفاع الكوليسترول والفحوصات البيستوباثولوجية.