Effects of Feeding Olive Cake and Barley Radicle as fiber sources on lipids, cholesterol and fatty acids in Hen Eggs
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Abstract
A total of 98 Lohman laying hens 54 weeks old were used in a 3 month experiment in 9
treatment groups and 7 replicates. The diets formulated by inclusion of olive cake (OC, 5 and
10%) and barley radicle (BRP, 10 and 20%) substituting parts of yellow corn and soybean
meal protein respectively of a control diet. Both (OC and BRP) were tested each level alone
along with the 4 possible combinations of the two materials using the same levels.
Results indicated that inclusion of the two levels of OC or BRP either alone or in
combinations in hen diets resulted in decreases in plasma and egg yolk cholesterol, TG and
LDL relative to the control.

Introduction
The effects of dietary components on hypercholesterolemia and atherosclerosis have
received much attention. Polyunsaturated fatty acids and dietary fiber appeared to lower the
blood cholesterol level and events of atherogenic progress (Carroll and Hamilton, 1975 and
Levy et al., 1976). Moreover, it has been hypothesized that fiber play a role in cholesterol
metabolism my possible combination of its ability to decrease absorption of cholesterol, bind
with bile salts in the intestinal tract, shorten the intestinal transit time and increase fecal sterol
excretion (Kelley and Tsai, 1978). Several dietary fiber sources have been suggested to
reduce egg cholesterol content (Mente et al., 1974 and Weiss and Scott, 1979).

Material and Methods
Nine experimental diets were formulated using olive cake or barley radicle as sources of fiber
either alone or in combinations. The experimental diets were (1) The control diet which
contained zero level of olive cake or barely radicle. (2) The same as the control but 5% of
yellow corn (YC) was substituted by olive cake (OC). (3) The same as the control but 10% of
YC was substituted by OC. (4) The same as the control but 10% of soybean meal protein
(SBMP) was substituted by barely radicle protein (BRP). (5) The same as the control but 20%
SBMP was substituted by BRP. (6) The same as the control but 5% of YC and 10% SBMP
were substituted by OC and BRP, respectively. (7) The same as the control but 5% of YC
and 20% SBMP were substituted by OC and BRP, respectively. (8) The same as the control
but 10% of YC and 10% of SBMP were substituted by OC and BRP, respectively. (9) The
same as the control but 10% of YC and 20% of SBMP were substituted by OC and BRP,
respectively. All diets were iso-caloric (2779 Kcal ME/kg) and iso-nitrogenous.
At the end of the experiment, four hens from each treatment were selected at random to
collect blood samples via the wing vein using heparin as an anticoagulant and plasma was
separated by centrifugation to determine cholesterol, triglycerides (TG), high density
lipoprotein (HDL) cholesterol and low density lipoprotein.
Twelve eggs were collected from each group during the last 3 days of the experiment,
weighted, cracked and the yolks were mixed in 3 pooled yolk samples (4 pooled yolks in each
sample). Yolk samples were analyzed for total cholesterol, triglycerides (Lowell et al., 1973), high density lipoprotein (HDL) cholesterol (Eckel, 1977), low density lipoprotein (LDL), phospholipids (Kates, 1972, Kaur et al., 1973) and total lipids (Bigh and Dyer, 1959). The extracted total lipids of each of the 3 pooled yolk samples (of each treatment) were then pooled again in one sample/treatment which used for isolation of fatty acids (Farag et al., 1990).

The data was analyzed as one way analysis of variance while differences among means were evaluated using Duncan’s multiple range test (Duncan, 1955).

Results and Discussion
Inclusion of the two levels of OC or BRP in hen diets either alone or in combinations resulted in decreases in plasma cholesterol (Table1) relative to the control, ranging from 23.4% (10%OC + 10%BRP) to 67.1% (5% OC).

Table(1) Effect of fiber level in laying hen diets on cholesterol, TG, HDL, concentration of blood plasma.

<table>
<thead>
<tr>
<th>Item</th>
<th>3% Control</th>
<th>5% OC</th>
<th>5%OC &amp; 10% radicle</th>
<th>5%OC &amp; 20% radicle</th>
<th>Overall mean of 5% fiber</th>
<th>10%OC</th>
<th>10%OC &amp; 10% radicle</th>
<th>10%OC &amp; 20% radicle</th>
<th>Overall mean of 6% fiber</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cholesterol, mg/dl</td>
<td>91.8abA</td>
<td>42.5a</td>
<td>129.3ab</td>
<td>77.5ab</td>
<td>83.1A</td>
<td>60.3a</td>
<td>99.0ab</td>
<td>83.3ab</td>
<td>80.8A</td>
</tr>
<tr>
<td>Triglycerides, mg/dl</td>
<td>762aA</td>
<td>190b</td>
<td>509ab</td>
<td>403bc</td>
<td>367B</td>
<td>554ac</td>
<td>386bc</td>
<td>424bc</td>
<td>455B</td>
</tr>
<tr>
<td>HDL, mg/dl</td>
<td>67.0aA</td>
<td>61.3a</td>
<td>21.5b</td>
<td>25.8b</td>
<td>39.1B</td>
<td>54.0a</td>
<td>25.5b</td>
<td>12.8b</td>
<td>26.1B</td>
</tr>
</tbody>
</table>

a,b,c,d Means in the same row with different small letters are significantly different (P<0.05)
A,B Means in the same row with different capital letters are significantly different (P<0.05)

Results also indicated insignificant decreases in plasma triglycerides due to inclusion of OC or BRP either alone or in combinations except 5% OC or 20% BRP which resulted in significant decreases. The great decrease in hen plasma cholesterol due to BRP or OC feeding may be a result of increasing CF level due to barley radicle and olive cake feeding and more particularly may be due to the residual unextracted olive oil still present in the cake of the diets containing OC. Olive oil characterises by high proportions of useful components such as Omega groups (9 or 6 or 3). The inspection of the overall mean data indicated that increasing dietary crude fiber from 3 to 5 or 6%, using OC or OC +BRP as fiber sources, decreased plasma cholesterol concentration by 10.5 and 13.7% respectively. The data of egg yolk lipids (Table2) concentrations resulted in significant (P<0.05) decreases in egg yolk concentrations of total lipids, cholesterol, TG, LDL and phospholipids compared to the control. This decrease may be due to inclusion of olive cake which contains Omega groups (9 or 6 or 3). Laying hens fed barley were reported to produce eggs with less cholesterol than a corn fed control group (Qureshi et al., 1984). Others proposed that hypocholesterolemic effect of barley is the result of its β-glucan content, which may increase intestinal viscosity (Davidson et al., 1991).
**Table (2) Effect of fiber level in laying hens diets on cholesterol, TG, LDL, HDL, Pholspholipid and Total lipids of egg yolk lipid concentration.**

<table>
<thead>
<tr>
<th>Item</th>
<th>3 Control</th>
<th>5% OC</th>
<th>5%OC &amp; 10% radicle</th>
<th>5%OC &amp; 20% radicle</th>
<th>Overall mean of 5% fiber</th>
<th>10%OC &amp; 10% radicle</th>
<th>10%OC &amp; 20% radicle</th>
<th>Overall mean of 6% fiber</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cholesterol, g/100g yolk</td>
<td>1.35aA</td>
<td>0.74b</td>
<td>1.19c</td>
<td>1.01d</td>
<td>0.98B</td>
<td>1.15c</td>
<td>1.01d</td>
<td>0.88e</td>
</tr>
<tr>
<td>TG, g/100g yolk</td>
<td>9.8aA</td>
<td>5.3b</td>
<td>8.6c</td>
<td>7.3d</td>
<td>7.1B</td>
<td>8.4c</td>
<td>7.3d</td>
<td>6.3e</td>
</tr>
<tr>
<td>LDL, mg/100g yolk</td>
<td>0.18aA</td>
<td>0.10b</td>
<td>0.16c</td>
<td>0.13d</td>
<td>0.13B</td>
<td>0.15c</td>
<td>0.13d</td>
<td>0.12e</td>
</tr>
<tr>
<td>HDL, mg/100g yolk</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Phospholipid, g/100g yolk</td>
<td>3.0aA</td>
<td>1.6b</td>
<td>2.7c</td>
<td>2.2d</td>
<td>2.2B</td>
<td>2.6c</td>
<td>2.2d</td>
<td>2.00e</td>
</tr>
<tr>
<td>Total lipids, g/100g yolk</td>
<td>15.0aA</td>
<td>8.2b</td>
<td>13.3c</td>
<td>11.2d</td>
<td>10.9B</td>
<td>12.9c</td>
<td>11.2d</td>
<td>9.8e</td>
</tr>
</tbody>
</table>

a,b,c,d,e Means in the same row with different small letters are significantly different (P<0.05)
A,B Means in the same row with different capital letters are significantly different (P<0.05)

**References**


