Selenium supplementation to broiler diets

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The present study was conducted to determine the effect of selenium supplementation on performance of broiler chicks. 300 broiler chicks (Lohmann) were divided into three groups of equal weight and numbers. Group (A) fed on broiler diet, group (B) fed on broilers diet + 3% vegetable oil and group (C) fed on broiler diet + 3% vegetable oil + 0.125 ppm Selenium. Feed intake, body weight, weight gain, feed conversion ratio, respiratory rate, body temperature and some carcass characteristics were examined for the significance of effect of diet treatment using one way analysis of variance. Feed intake was not affected by dietary treatments, however, body weight was significantly (P<0.05) increased in group B and C, compared to group A. Carcasses analysis showed no significant variations among dry matter, ether extract and ash for the three dietary groups. For CP, group C was significantly (P<0.05) higher compared to group A and B. Group (B) had significantly (P<0.05) higher dressing percentage than group (A). Group (C) had significantly (P<0.05) higher blood selenium concentration than group (A) and (B). With the exception of the breast tenderness, sensory evaluation was not affected by the dietary treatment. Group (C) had significantly (P<0.05) tender than group (A) and (B). No mortality was reported during the experimental period. The study concluded that selenium and vegetable oil supplementation in broiler diets significantly improved weight gain, final body weight and meat quality without increase of feeding cost.

Key words: Carcass, feed intake, Lohmann, sensory evaluation

Selenium (Se) is considered to be an essential trace nutrient for animals and humans. The findings of extensive research strongly indicate that some of its functions are intimately related to vitamin E in normal metabolism, i.e., most clinical signs of Se deficiency occur in association with vitamin E deficiency and some symptoms can be alleviated or even prevented by supplementation with either Se or vitamin E (Hoekstra, 1975). Both Se and vitamin E are important components of the antioxidant defense system that helps protect cell membranes from peroxidative damage (Hoekstra, 1975). Therefore, nutritional Se deficiency and its physiologic effect must be considered in terms of Se and vitamin E status.

Rotruck et al. (1973) reported that Se is required for proper function of the glutathione peroxidase enzyme, which are antioxidant enzymes. Cantor et al. (1975a,b) reported that Se is necessary in the diets of poultry to protect them from oxidative diathesis and pancreatic fibrosis. The Se requirement for broilers throughout the growth period is 0.15 ppm (NRC, 1994)

Diets low in Se and vitamin E cause serious Se-vitamin E deficiency disorders in many species. But in animals receiving normal allowances of vitamin E, there was little evidence of Se-responsive disease. However, Nesheim and Scott (1958) provided strong evidence for the indispensability of Se when they found that chicks required Se for growth and survival even when their diet contained high amounts of vitamin E.

Bunk and Combs (1980) stated that administration of 5 microgram selenium as seleno-DL-methionine increased voluntary feed consumption within 2-3 hours, whereas selenite did not have a significant effect until 3-4 hours. Spontaneous activity, body weight gain and plasma glucose concentration increased 6-8 hours after selenium administration.
Sahin and Kucuk (2001) showed that a combination of 250 mg of vitamin E and 0.2 mg of Se provides the greatest performance in Japanese quails reared under heat stress. This combination can be considered as a protective management practice in reducing the negative effects of heat stress. The same authors reported that, 250mg vitamin E/kg of diet compared with that of 125 mg/kg of diet and higher dietary Se inclusions (0.1 vs. 0.2 mg/kg) resulted in a better performance. The interaction between vitamin E and Se for feed intake, weight change and feed efficiency was not detected. Carcass characteristics were not affected. Breast muscle and other parts of viscera (heart, liver, intestine and stomach) were weighed individually. The main parts of viscera (heart, liver, intestine and stomach) were weighed individually. The carcass weight was recorded before and after chilling (5°C, for 24 hour). The left halves of the carcasses had been de-boned and homogenously minced, and then it is analyzed (proximate analysis) to investigate the following: Dry matter, crude protein, crude fiber, ether extract and ash.

The right-halves of the carcasses were stored in a deep freezer (-20°C) for 7 days. Then they were thawed for (24 hours) in a refrigerator (4°C), then the breasts, thighs and drumsticks were wrapped individually in hundred, four weeks old, broiler chicks (Lohmann) were divided into three diet groups on live body weight basis (hundred birds per treatment). Experimental birds were fortified with sufficient level super vitamin to meet requirements and decrease heat stress. Table (1) showed the determined analysis of the experimental diets for group A, B and C. A control, diet B contained 3% vegetable oil and diet C contained 3% vegetable oil and 0.125ppm selenium. Diet C supplemented with 0.125 ppm selenium as sodium selenite.

Table (1): The determined analysis of the experimental diets for group (A) control, (B) 3% vegetable oil and (C) 3% vegetable oil+ 0.125ppm Se

<table>
<thead>
<tr>
<th>Components</th>
<th>Dietary Treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>ME (Kcal/Kg)</td>
<td>3204</td>
</tr>
<tr>
<td>CP (%/N x 6.25)</td>
<td>21.2</td>
</tr>
<tr>
<td>Ca (%)</td>
<td>1.1</td>
</tr>
<tr>
<td>Av. P (%)</td>
<td>0.45</td>
</tr>
<tr>
<td>L-Lysine (%)</td>
<td>1.21</td>
</tr>
<tr>
<td>DL-Methionine (%)</td>
<td>0.51</td>
</tr>
<tr>
<td>Added selenium (ppm)</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Values are means of duplicate samples.

Feed intake, body weight and feed conversion ratio (F.C.R), were determined weekly. Mortality was recorded when it occurred. Respiration rate and body temperature for each group were daily recorded.

The live weight was recorded for the whole flock then the birds were fasted for 12 hours before being slaughtered, then blood samples were taken randomly from birds of each group. Then evisceration had been done and weighing as whole unit. The right-halves of the carcasses had been de-boned and homogenously minced, and then it is analyzed (proximate analysis) to investigate the following: Dry matter, crude protein, crude fiber, ether extract and ash.

The right-halves of the carcasses were stored in a deep freezer (-20°C) for 7 days. Then they were thawed for (24 hours) in a refrigerator (4°C), then the breasts, thighs and drumsticks were wrapped individually in

MATERIALS AND METHODS
This experiment was carried out in an open-sided deep litter poultry house. Three
from the experiment was subjected to A (control). B (Supplemented by 3%
treatment means as described by Gomez
three weeks (finishing period). The results
vegetable oil) and
feed intake
FCR for 7 week old broiler chicks fed on diet

RESULTS
Table (2) showed the results of total
feed intake (gm/day), total weight gain and
FCR for 7 week old broiler chicks fed on diet
A (control), B (Supplemented by 3%
vegetable oil) and C (Supplemented by 3%
vegetable oil+ Se 0.125 ppm) during the last
three weeks (finishing period). The results
showed that there were no significant
differences in the feed intake.

Table (3) presented the result of total
weight gain of birds in group (A), (B) and (C)
in the finishing period (5-7 weeks). The total
weight gain during the finishing period (5-7
weeks) of group C and group B was
significantly (P<0.05) higher compared to
the control treatment (A). While FCR was
resulted in no significant differences among
dietary treatments but it tended to be better
for group B and C.

The respiration rate observed in the
present study showed that birds fed on diet
B had significantly higher respiration rate
than both C followed by A (table, 4). Blood
selenium concentration results, presented in
table (4), showed that group C had the
highest significant concentration (p<0.05).

Table (5) illustrates the (hot weight,
cold weight and dressing percentage of the
three groups A, B and C). Group (B)
showed the highest weight (hot) which was
1211.0 g followed by group C and A which
account 1153 and 1064 g respectively. Cold
weight of group B showed the highest value,
which was followed by group C then group
A. The results showed no significant
differences in hot and cold weight. Dressing
percentage showed significant variation
between (B) and (C) (P<0.05). Carcasses
analysis showed no significant variations
among dietary treatments in dry matter, ether extract and ash, but there was
significant variation (P<0.05) in crude
protein of group C which was found to be
significantly (P<0.05) higher compared to
that of group A and B. (Table, 5).

Table (6) showed the results of panel
test. Which include the color, flavor,
juiciness and tenderness of the breast, thigh
and drum stick. All the differences between
the roaster meat in respect to color, flavor,
juiciness and tenderness were statistically
not significant, except for tenderness of the
breast significant at (P<0.05)

DISCUSSION
Diets are assumed to be safe for poultry in
term of either selenium deficiency or
selenium toxicity when they contain 0.15 –
4.0 mg/ kg selenium (NRC, 1994). Weekly
feed intake (Table 2) showed no significant
differences between dietary groups,
however the feed intake increased slightly in
the group fed on high energy supplemented
with Se. This might be due to nutritional
balance (Ensminger et al., 1990).

The results showed that the mean
weight gain was significantly increased for
birds fed diet B(3% vegetable oil) and C
(3% vegetable oil+ 0.125 ppm Se). This
improvement might be due to the balanced
finishing diet with adequate metabolizable
energy (Lesson and Summer, 2001), beside
the good nutrient utilization due to the
positive effects of Se as an antioxidant
agent which protect nutrient from oxidation
particularly vitamin A and D3 (Church and
Pond, 1988; Hurley and Done 1989; Elnour
et al, 1998) and Joshi et al. (1999). Feed
conversion ratio resulted in no significant
differences but it tended to be improved for
diets B and C. This improvement might be
related to the significant improvement in the
mean total weight gain. These results were
in agreement with those reported by Elnour
et al. (1998). Many studies have reported
beneficial influences of selenium
supplementation on feed consumption, body
weight, weight gain and the prevention of
selenium deficiency symptoms and mortality
in poultry (Cantor et al., 1975) (Jianhua et
al., 2000). Combs and Scott (1979) stated
that the supplementation of 0.1 mg Se/ Kg
diet as sodium selenite significantly
increased feed intake of hens. Christine et
al. (2002) reported that body weight
increased significantly with age in all groups
fed diets supplemented with selenium.
Table (2): Feed intake, weight gain and FCR as affected by dietary treatments during the finishing period (5-6 weeks of age)

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Feed intake (g/day/bird)</th>
<th>Weight gain (g/week/bird)</th>
<th>FCR (g feed/g gain)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>5th week</td>
<td>79.3±17</td>
<td>84.4±14</td>
<td>83.1±16</td>
</tr>
<tr>
<td>6th week</td>
<td>80.1±21</td>
<td>106.0±22</td>
<td>109.2±18</td>
</tr>
<tr>
<td>7th week</td>
<td>109.5±26</td>
<td>109.5±19</td>
<td>106.7±20</td>
</tr>
<tr>
<td>Overall</td>
<td>89.5±17</td>
<td>99.9±15</td>
<td>107.5±15</td>
</tr>
<tr>
<td>米兰</td>
<td>89.6±17</td>
<td>241.7±42</td>
<td>283.3±39</td>
</tr>
<tr>
<td>米粒</td>
<td>99.9±13</td>
<td>2097.9±68</td>
<td>2114.0±65</td>
</tr>
<tr>
<td>米粒</td>
<td>975.1±94</td>
<td>225.0±34</td>
<td>328.3±71</td>
</tr>
<tr>
<td>米粒</td>
<td>301.7±51</td>
<td>237.5±34</td>
<td>325.0±72</td>
</tr>
<tr>
<td>米粒</td>
<td>2.3±1</td>
<td>2.2±1</td>
<td>2.2±1</td>
</tr>
<tr>
<td>米粒</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>

Table (3): Total feed intake (g/day), weight gain (g/bird) and FCR as affected by the dietary treatments during the finishing period (5-7 weeks)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Dietary treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Total feed intake (g/day)</td>
<td>1881.6±68</td>
</tr>
<tr>
<td>Total weight gain (g/bird)</td>
<td>848.4±63</td>
</tr>
<tr>
<td>FCR (g feed/g gain)</td>
<td>2.29±0.6</td>
</tr>
</tbody>
</table>

Values within the row with different superscript are significantly different (p<0.05)

Table (4): Respiratory rate and body temperature for group (A) (control), (B) 3% vegetable oil and (C) 3% vegetable oil+ 0.125 Se

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Blood selenium concentration ppm</th>
<th>Respiratory rate</th>
<th>Body temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>34.6±5.9</td>
<td>48.7±7.1</td>
<td>41.7±0.9</td>
</tr>
<tr>
<td>B</td>
<td>28.0±1.0</td>
<td>72.0±15.46</td>
<td>42.0±0.3</td>
</tr>
<tr>
<td>C</td>
<td>50.23±1.8</td>
<td>57.0±6.3</td>
<td>41.9±0.5</td>
</tr>
</tbody>
</table>

Significance: NS

_value in the same column followed by different superscripts are significantly different (p<0.05)_

Significant at (P<0.05)

NS: Not significant

Table (5): Carcass characteristics and composition of broilers fed on treatment (A) (control), (B) 3% vegetable oil and (C) 3% vegetable oil+ 0.125 Se

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Final live weight (g)</th>
<th>Hot weight (g)</th>
<th>Cold weight (g)</th>
<th>Dressing (%)</th>
<th>DM (%)</th>
<th>CP (%)</th>
<th>EE (%)</th>
<th>Ash (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1516.0±170.4</td>
<td>1064±150.3</td>
<td>1028.0±158.8</td>
<td>70.2±24.0</td>
<td>33.2±2.7</td>
<td>16.4±6.7</td>
<td>11.8±1.3</td>
<td>2.18±0.8</td>
</tr>
<tr>
<td>B</td>
<td>1554.0±170.8</td>
<td>1211±280.9</td>
<td>1186.0±282.9</td>
<td>78.4±18.8</td>
<td>34.1±1.3</td>
<td>16.7±0.7</td>
<td>13.7±0.9</td>
<td>1.32±0.7</td>
</tr>
<tr>
<td>C</td>
<td>1742.0±171.5</td>
<td>1153±133.6</td>
<td>1036.0±140.6</td>
<td>66.2±26.6</td>
<td>32.2±1.3</td>
<td>18.7±0.7</td>
<td>13.7±2.8</td>
<td>1.32±0.7</td>
</tr>
</tbody>
</table>

Significance: NS

_value followed by different superscripts in the same column were significantly different (p<0.05)_

Significant at (P<0.05)

NS: Not significant

The results showed that there was a significant variation in respiratory rate (P<0.05). With significant higher rate in group (B), compared with group (A) and (C) and this might be due to the body condition (fatness). The results showed that there was no significant variation in post slaughter weight and cold weight. The dressing percentage showed significant variation between (C) and (B) (P<0.05). But there was no significant variation in group (C) compared with (A).

The results showed that no significant variation among dry matter, ether extract and ash of experimental carcasses, but there was a significant (P<0.05) increase in CP of carcasses of birds fed diet C (Supplemented by 3% vegetable oil+ Se)
Table (6): Sensory evaluation of broiler's meat fed on treatment (A)(control), (B) 3% vegetable oil and (C) 3% vegetable oil+ 0.125 Se

<table>
<thead>
<tr>
<th>Treatment</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colour of breast</td>
<td>6.3±1.2</td>
<td>6.6±1.5</td>
<td>6.7±1.1</td>
<td>NS</td>
</tr>
<tr>
<td>Colour of thigh</td>
<td>6.7±0.9</td>
<td>5.8±2.4</td>
<td>6.0±2.4</td>
<td>NS</td>
</tr>
<tr>
<td>Colour of drum stick</td>
<td>6.3±1.4</td>
<td>6.2±1.9</td>
<td>6.1±1.1</td>
<td>NS</td>
</tr>
<tr>
<td>Flavor of breast</td>
<td>6.1±1.6</td>
<td>5.8±1.8</td>
<td>6.6±1.3</td>
<td>NS</td>
</tr>
<tr>
<td>Flavor of thigh</td>
<td>6.0±1.3</td>
<td>5.4±2.4</td>
<td>5.7±2.4</td>
<td>NS</td>
</tr>
<tr>
<td>Flavor of drum stick</td>
<td>5.5±1.2</td>
<td>6.0±2.1</td>
<td>5.4±1.2</td>
<td>NS</td>
</tr>
<tr>
<td>Juiciness of breast</td>
<td>6.9±1.2</td>
<td>6.2±1.2</td>
<td>7.2±1.1</td>
<td>NS</td>
</tr>
<tr>
<td>Juiciness of thigh</td>
<td>6.3±1.4</td>
<td>5.6±2.5</td>
<td>5.7±2.6</td>
<td>NS</td>
</tr>
<tr>
<td>Juiciness of drum stick</td>
<td>6.1±1.6</td>
<td>5.8±2</td>
<td>6.1±1.1</td>
<td>NS</td>
</tr>
<tr>
<td>Tenderness of breast</td>
<td>6.0±1.2</td>
<td>6.2±1.2</td>
<td>7.2±1.2</td>
<td>*</td>
</tr>
<tr>
<td>Tenderness of thigh</td>
<td>6.3±1.2</td>
<td>5.8±2.6</td>
<td>6.3±2.4</td>
<td>NS</td>
</tr>
<tr>
<td>Tenderness of drum stick</td>
<td>5.7±1.5</td>
<td>6.3±2.0</td>
<td>6.2±1.2</td>
<td>NS</td>
</tr>
</tbody>
</table>

Samples were rated on an 8-point structured scale for the three tested attributes.

a,b = Means followed by different superscripts in the same row were significantly different (p<0.05)

• Significant at (P<0.05)
• NS = Not significant

0.125 ppm). This increase in crude protein might be due to improving of crude protein digestibility and utilization caused by Se, which known to be part of specific selenoprotein that plays a role in RNA by its incorporation into purines and pyrimidines bases (Church and Pond, 1988). In addition selenium can carry out some functions of vitamin E as an antioxidant agent and improving nutrient utilization as general (Elnoun et al., 1998).

CONCLUSIONS
Based on the results of this study, the following conclusion can be drawn:
1- Selenium supplementation in broiler diets resulted in no significant differences in feed intake.
2- Using of selenium and vegetable oil for broiler chicks resulted in a significant improvement in weight gain and final body weight when the rate of inclusion was 0.125 g/ml/kg and 3% (se and oil) respectively.
3- Selenium supplementation in broiler diets resulted in a significant improvement in meat content of protein.

REFERENCES
Church DC, Pond WG, 1988 Basic animal nutrition and feeding. 3rd edn. John Wiley and sons. NY.
Nutr. Metab. 42(6):341-349.
Ensminger EM, Old-field EJ, Heinemann
WW, 1990. Feeds and Nutrition, 2nd
edn, press by the Ensminger publishing
company in U. S. A.
Gomez KA, Gomez AA, 1984. Statistical
procedures for agricultural research.
2nd edn. Wiley and sons, Inc.
Hoekstra WG, 1975. Biochemical function
of selenium and its relation to vitamin E.
Hurley WL, Done RM, 1989. Recent
development in the roles of vitamins
and minerals in reproduction. J. Dairy
selenium influences growth via thyroid
hormones status in broiler chickens. Br.
Joshi BN, Sainani MN, Bastawade KB,
Deshpande VV, Gupta VS, Ranjekar
PK, 1999. pearl millet cysteine protease
inhibitor: evidence for presence of two
distinct sites responsible for antifungal
Lesson S, Summer JD, 2001. Nutrition of
chickens. 4th edn. University book,
Guelph, Ontario, Canada. N1H6N8.
Nesheim MC, Scott ML, 1958 Studies on
the nutritive effects of selenium for
edn National Academy press,
Washington, D.C. U.S.A.
of inorganic and organic selenium
sources for broiler. J. Poult. Sci.,
84:898-902.
Rortuck JT, Pope AL, Ganther HE, Swason
Selenium: biochemical role as a
component of glutathione peroxidase.
Science, 179:588-590.
and selenium on performance,
digestibility of nutrients and carcass
characteristics of Japanese quails
Stone H, Sidel J, Woolsey A, Singleton RC,
1974. Sensory evaluation by
quantitative description analysis, food
Technol.28:24-35.
Thompson JN, Scott ML, 1969 Role of
selenium in the nutrition of the chick. J.
Nutr. 97:335-342.
Thompson JN, Scott ML, 1970. Impaired
lipid and vitamin E absorption related to
atrophy of the pancreas in selenium-