Research Article

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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) was 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 exudative 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, final body weight change and feed efficiency was detected. Carcass yield increased significantly with increasing both dietary vitamin E and Se. The interactions on carcass characteristics were all non-significant. Digestibility of nutrients (DM, OM, CP and ether extract) was higher significantly with higher dietary vitamin E, and DM digestibility was also higher with higher dietary Se. There were no interactions detected for digestibility of nutrients.

Christine *et al* (2002) stated that hens depleted of Se tended to lay lighter eggs. The Se-depleted hens produced less egg mass compared with non depleted hens. Even when calculated per unit body weight, these hens tended to produce comparatively less egg mass. Feed efficiency was not affected by treatment during the study, indicating that the hens previously depleted of Se ate more of the diet containing more of the essential trace elements.

Payne and Southern (2005) conducted an experiment to compare the effects of organic and inorganic sources of Se on growth performance, carcass traits, breast and plasma Se concentrations, and plasma glutathione peroxidase activity in broilers. Daily gain, gain: feed and mortality were not affected by Se source or level of supplementation. Similarly, carcass traits were not affected. Breast muscle and plasma Se concentrations were increased, and plasma glutathione peroxidase activity was not affected.

The objectives of this study were: to investigate the effect of supplementary selenium in broiler diets on feed intake, body weight gain, feed conversion ratio, respiratory rate, body temperature, carcass characteristics and composition and blood selenium concentration.

MATERIALS AND METHODS

This experiment was carried out in an open-sided deep litter poultry house. Three 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 (I): The determined analysis of the experimental diets for group (A) control, (B) 3% vegetable oil and (C) 3% vegetable oil+ 0.125ppm Se

Components	Dietary Treatments		
	A	B	C
ME (Kcal/Kg)	3204	3460	3464
CP (%) (N%X6.25)	21.2	21.3	21.2
Ca (%)	1.1	1.1	1.1
Av. P (%)	0.45	0.46	0.46
L-Lysine (%)	1.21	1.21	1.22
DL-Methionine (%)	0.51	0.52	0.53
Added selenium (ppm)	0.00	0.00	0.125

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 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

aluminum foil and roasted at (80°C) for 90 mints. They were cut into pieces and served warm. The sensory panel sessions were conducted to determine the effect of selenium according to Stone *et al.* (1974) and Cross *et al.* (1978).

The blood samples were first freeze-dried and then analyzed using the technique of X-Ray fluorescence (XRF) techniques according to Cesareo (1976). Standard reference materials, animal blood, supplied by the International Atomic Energy Agency (IAEA) of Vienna, were used for the analysis.

A complete randomized design was used in the experiment. The data generated from the experiment was subjected to analysis of variance. L. S. D. test was used to assess significance of differences among treatment means as described by Gomez and Gomez (1984).

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 broiler 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 D_3 (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)

Parameters	Feed intake (g/day/bird)			Weight gain (g/week/bird)			FCR		
	A	B	C	A	B	C	A	B	C
5th week	79.3±17	84.4±14	83.1±15	241.7±42	283.3±39	266.7±43	2.3±1	2.1±1	2.2±1
6th week	80.1±21	106.0±22	109.2±18	331.7±37	346.7±54	406.7±67	1.7±1	2.1±1	1.9±1
7th week	109.5±26	109.3±19	109.7±20	275.0±34	328.3±71	301.7±51	2.8±1	2.3±1	2.5±1
Overall mean	89.6±17	99.9±13	100.7±15	382.8±45	319.4±32	325.0±72	2.3±0.6	2.2±0.1	2.2±0.3
Significance		NS			*			NS	

NS= Not Significant
* = Significant at (P<0.05)

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

Treatment	Dietary treatments		
	A	B	C
Total feed intake (g/day)	1881.6±68	2097.9±57	2114.0±65
Total weight gain (g/bird)	848.4±63[b]	958.3±45[a]	975.1±94[a]
FCR (g feed/g gain)	2.29±0.6	2.19±0.1	2.21±0.3

Values within the row with different superscript are significantly (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

Treatment	Blood selenium concentration ppm	Respiratory rate	Body temperature (°C)
A	34.67±5.9[b]	48.7±7.1[b]	41.7±0.9
B	28.0±1.9[c]	72.0±15.46[a]	42.0±0.3
C	50.23±1.8[a]	57.0±6.3[b]	41.9±0.5
Significance	*	*	NS

a,b = Means within 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

Treatment	Final live weight (g)	Hot weight (g)	Cold weight (g)	Dressing (%)	DM (%)	CP (%)	EE (%)	Ash (%)
A	1516.0±170.4[b]	1064±150.3	1028.0±158.8	70.2±4.0	33.2±2.7	16.4+6.7b	11.8±1.3	2.18±0.8
B	1554.0±68.8[b]	1211±80.96	1186.0±82.9	78.4±6.8[a]	34.1±1.3	15.7+0.7b	13.7±0.9	1.3±0.7
C	1742.0±171.5[a]	1153±133.6	1036.0±140.6	66.2±6[b]	32.2±1.3	18.7+0.7a	13.7±2.8	1.3±0.07
Significance	*	NS	NS	*	NS	*	NS	NS

a,b = Means 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

Treatment	A	B	C	Significance
Colour of breast	6.3±1.2	6.6±1.5	6.7±1.1	NS
Colour of thigh	6.7±0.9	5.8±2.4	6.0±2.4	NS
Colour of drum stick	6.3±1.4	6.2±1.9	6.1±1.1	NS
Flavor of breast	6.1±1.6	5.8±1.8	6.6±1.3	NS
Flavor of thigh	6.0±1.3	5.4±2.4	5.7±2.4	NS
Flavor of drum stick	5.5±1.2	6.0±2.1	5.4±1.2	NS
Juiciness of breast	6.9±1.2	6.2±1.2	7.2±1.1	NS
Juiciness of thigh	6.3±1.4	5.6±2.5	5.7±2.6	NS
Juiciness of drum stick	6.1±1.6	5.8±2	6.1±1.1	NS
Tenderness of breast	6.9 ± 1.2^{b}	6.2 ± 1.2^{b}	7.2 ± 1.1^{a}	*
Tenderness of thigh	6.3±1.2	5.8±2.6	6.3±2.4	NS
Tenderness of drum stick	5.7±1.5	6.3±2.0	6.2±1.2	NS

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 antioxidanat agent and improving nutrient utilization as general (Elnour *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 gm/kg and 3% (se and oil) respectively.

3- Selenium supplementation in broiler diets resulted in a significant improvement in meat content of protein.

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