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Effect of dietary supplementation of organic selenium and vitamin E on growth performance, carcass characteristics and meat quality of broiler chickens

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ABSTRACT

Present study was conducted in a 3 × 2 factorial arrangement of 3 levels of organic selenium (0, 0.1, and 0.2 ppm) and 2 levels of vitamin E (0 and 300 mg/kg) to determine the effect of organic selenium and vitamin E on growth performance, carcass characteristics and meat quality in broiler chickens. Day-old Vencobb broiler chicks (180) were randomly divided into 6 treatments (3 replicates of 10 birds/treatment). The diets were formulated according to BIS (1992). The diet was based on corn soybean meal. Study revealed significant interaction in between organic selenium and vitamin E for feed intake, body weight, FCR, dressing percentage and protein and lipid content of muscle. The broilers receiving 0.1 ppm organic selenium with 300 mg/kg vitamin E (T_4) displayed heavier final weight and improved FCR. The highest dressing percentage was determined in the similar group (T_4). As the level of vitamin E increased in the broilers diet, protein percentage of breast and thigh muscle significantly increased whereas, lipid percentage significantly decreased. Lowest muscle lipid and highest protein percentage obtained in broilers receiving 0.1 ppm organic selenium with 300 mg/kg vitamin E (T_4). It can be concluded that dietary organic selenium with vitamin E in broiler feed improved the growth performance and gave the possibility for achievement of better quality meat and higher meat yield.

Key words: Broiler chickens, Carcass characteristics, Growth performance, Meat quality

Dietary supplementation of minerals and vitamins is essential to increase birds performance as the chicks from day of hatching are exposed to variety of high stress producing environment such as stocking density, nutritional and other environmental factors which adversely affect the health of the birds and economy of poultry sector. Presently, problem also associated with increased consumer interest towards beneficial effects of broilers meat added with natural antioxidants. Deficiency of selenium and vitamin E impairs the growth (Marsh *et al*. 1981) and immune function in chicks (Swain *et al*. 2000). The objective of the experiment was to study effect of dietary organic selenium and vitamin E on growth performance, carcass characteristics and meat quality of broiler chickens.

MATERIALS AND METHODS

The study was conducted at Department of Animal Nutrition, College of Veterinary Science and Animal Husbandry, Anjora, Durg, Chhattisgarh.

Experimental design and housing: This study was a 3 × 2 factorial arrangement of three levels of organic selenium (0, 0.1, and 0.2 ppm) and 2 levels of vitamin E (0 and 300 mg/kg). In this experiment, day-old Vencobb broiler chicks (180) were randomly assigned into 6 treatments (3 replicates of 10 birds/treatment). The trial lasted 5 weeks. Broilers

Table 1. Ingredient composition of broiler starter and finisher diet

Feed ingredients	Broiler starter (%)	Broiler finisher (%)
Yellow maize	58.5	63.38
Soya DOC	35.74	31
Maize gluten	-	0.3
Deoiled rice bran	0.12	-
Soybean oil	1	3
Dicalcium phosphate	2.18	1.05
Limestone powder	0.94	0.21
DL-methionine	0.34	0.22
Lysine	0.08	0.11
Soda-bi-carb	0.11	0.05
Choline chloride	0.07	0.03
Salt	0.33	0.26
Premix*	0.49	0.39

* Trace mineral premix mg/kg diet: Mg 300, Mn 55, Fe 56, Zn 30, Cu 4; vitamin premix per kg diet: vit. A 8250IU, vit. K 1mg, vit. E 26.84 mg, vit. B_1 2 mg, vit. B_2 4 mg, vit. B_{12} 100mg, Niacin 60 mg, pantothenic acid 10 mg; choline 500 mg and 30 ppm salinomycin (Coxistac 12%), 55 ppm bacitracin methylene di salicyclate (BMD110).

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Table 2. Proximate composition of broiler starter and finisher rations (% on DM basis)

Particulars	Broiler starter	Broiler finisher
Crude protein	23.01	19.90
Crude fibre	3.76	3.27
Ether extract	5.36	8.50
Total ash	6.54	7.39
Acid insoluble ash	1.05	1.38
Nitrogen free extract**	61.33	60.94
Calcium	0.92	0.94
Phosphorus	0.61	0.70
ME (kcal/kg)**	2800	2900

**Calculated value

were raised in deep litter system. Weighed amount of diet was offered to chicks to ensure *ad lib.* feeding. Fresh and clean drinking water was always made available for birds. Birds were vaccinated against Ranikhet disease and Infectious Bursal disease on day 7 and day 14, respectively. A booster dose for Ranikhet disease was also given on day 28.

Treatments and additives: The diets were isonitrogenic in control and treatment groups and formulated according to BIS (1992). The diet was based on corn-soybean meal. The ingredients composition and chemical compositions of the experimental feed are given in Tables 1 and 2, respectively. The 6 different dietary treatments were: T_1-control diet without organic selenium and vitamin E; T_2, control diet with 300 mg/kg vitamin E; T_3, control diet with 0.1ppm organic selenium; T_4, control diet with 0.1ppm organic selenium and 300 mg/kg vitamin E; T_5, control diet with 0.2 ppm organic selenium and T_6 Control diet with 0.2 ppm organic selenium and 300 mg/kg vitamin E.

Measurements: The body weight of individual bird, feed intake and feed conversion ratio (FCR) was recorded weekly. On 35th day, 3 birds of identical body weight from each replicate were sacrificed. The birds were fasted overnight, bled, defeathered and eviscerated with sufficient care. Different carcass parameters like defeathered weight, eviscerated weight, and weight of different carcass components were recorded. Protein present in the muscles was estimated as per AOAC (2000). Total lipid in breast and thigh muscles was determined as per Bligh and Dyer (1959).

Statistical analysis: The data obtained were subjected to statistical analysis by the software SPSS 10 (SPSS 1997). Levels of significance were calculated as per the standard method described by Duncan (1955) whenever any effect was found significant.

RESULTS AND DISCUSSION

Result of growth performance listed in Table 3. Significant ($P < 0.01$) interactions were observed in between dietary organic selenium and vitamin E for feed intake, body weight and FCR. At the end of the experimental trial, feed intake of broilers fed organic selenium and vitamin E was higher than the control group. As the level of organic selenium and vitamin E increased in the diet, feed intake significantly ($P < 0.01$) increased. Highest feed intake was observed in birds fed 0.2 ppm organic selenium with 300 mg/kg vitamin E (T_6) in the diet and it was 4.78% more than control group (T_1). The broilers receiving 0.1 ppm organic selenium with 300 mg/kg vitamin E displayed the heavier final weight (T_4) and it was 8.40% more than control (T_1). The addition of organic selenium and vitamin E tended to increase weight gain throughout the experimenal period. Mortality was within the normal range and not affected by dietary treatments. The improved FCR was also observed in the similar group (T_4) and it was 8.62% less than control group (T_4).

Table 3. Growth performance of raising broilers fed diet supplemented with different levels of organic selenium and vitamin E (mean±SE)

Particulars	Feed intake (g/bird per d)	Body weight (g)	Feed conversion efficiency (g of feed/ g of body weight)
T_1	3413.19^{a}±1.39	1963.73 ^{a}±15.52	1.74 ^{e}±0.01
T_2	3495.97 ^{d}±0.5	2164.39 ^{d}±14.30	1.62 ^{b}±0.01
T_3	3526.20 ^{e}±0.15	2146.56 ^{e}±12.09	1.64 ^{bc}±0.01
T_4	3473.07 ^{c}±0.85	2183.53 ^{f}±11.59	1.59 ^{a}±0.01
T_5	3462.72 ^{b}±0.33	2105.55 ^{b}±14.22	1.65 ^{cd}±0.01
T_6	3584.52 ^{f}±1.21	2143.96 ^{c}±13.16	1.67 ^{d}±0.01
Organic selenium effects			
0 ppm	3454.58 ^{a}±10.07	2064.06 ^{a}±26.40	1.68 ^{b}±0.02
0.1 ppm	3499.63 ^{b}±6.46	2165.04 ^{c}±9.28	1.62 ^{a}±0.01
0.2 ppm	3523.62 ^{c}±14.78	2124.75 ^{b}±10.49	1.66 ^{b}±0.01
Vitamin E effects			
0 mg/kg	3467.37 ^{a}±9.08	2071.95 ^{a}±17.22	1.68 ^{b}±0.01
300 mg/kg	3517.85 ^{b}±9.44	2163.96 ^{b}±7.91	1.63 ^{a}±0.01
Source of variations (probabilities)			
Organic selenium	P<0.01	P<0.01	P<0.01
Vitamin E	P<0.01	P<0.01	P<0.01
Organic selenium × vitamin E interaction	P<0.01	P<0.01	P<0.01

Superscripts are read column wise for comparison of means. Means in the same column with different superscript a, b, c are significantly different; NS, nonsignificant.

The present findings were in agreement with others (Attia *et al.* 2001, Deniz *et al.* 2005, Skrivan *et al*. 2010). Result was also in accordance with He-Jianhua *et al.* (2000) who noted that lower dietary supplementation (0·1 mg/kg) resulted in growth promotion, while higher level (0.3mg/kg) of selenium caused growth depression. The reason for better FCR might be the activation of thyroid hormone by selenium which subsequently reduces the energy requirement for broilers (Naylor and Choct 2000). In contrast Guo *et al*. (2001) and Yoon *et al*. (2007) did not

Table 4. Effect of organic selenium and vitamin E on various carcass cuts of broiler chicken as percentage of live weight

Particulars	Dressing percentage	Liver	Heart	Gizzard	Breast	Thigh	Wing	Back and neck	Giblet
T_1	74.42^{c}±0.23	2.72 ^{f}±0.12	0.55^{e}±0.02	2.11 ^{b}±0.09	9.87 ^{a}±0.18	19.77^{d}±0.08	19.55 ^{c}±0.12	15.31 ^{c}±0.37	5.38 ^{e}±0.15
T_2	73.72 ^{b}±0.24	2.55 ^{d}±0.08	0.54 ^{d}±0.03	2.03 ^{a}±0.01	10.74 ^{b}±0.33	19.34 ^{c}±0.26	19.35 ^{b}±0.07	14.88 ^{b}±0.13	5.12 ^{c}±0.03
T_3	74.47 ^{d}±0.39	2.29 ^{b}±0.08	0.51 ^{b}±0.03	2.08 ^{b}±0.11	11.11 ^{c}±0.16	18.73 ^{b}±0.19	18.99 ^{a}±0.46	15.54 ^{a}±0.34	4.89 ^{b}±0.19
T_4	76.15 ^{f}±0.22	2.09 ^{a}±0.03	0.53 ^{c}±0.02	2.02 ^{d}±0.08	11.55 ^{d}±0.13	20.10 ^{a}±0.19	19.55 ^{c}±0.42	13.97 ^{c}±0.25	4.64 ^{a}±0.08
T_5	73.47 ^{a}±0.23	2.66 ^{e}±0.04	0.51 ^{a}±0.01	2.23^{c}±0.07	9.93 ^{a}± 0.19	18.07 ^{a}±0.10	20.20 ^{d}±0.46	14.03 ^{d}±0.31	5.40 ^{e}±0.14
T_6	75.22 ^{e}±0.12	2.32 ^{c}±0.04	0.57 ^{f}±0.02	2.36^{a}±0.06	9.90 ^{a}±0.20	19.31 ^{e}±0.23	19.10 ^{a}±0.34	14.78 ^{a}±0.08	5.25 ^{d}±0.10
Selenium effects									
0 ppm	74.07 ^{a}±0.18	2.64^{b}±0.07	0.54^{a}±0.02	2.07 ^{a}±0.05	10.31 ^{a}±0.21	19.56^{a}±0.14	19.45 ^{a}±0.07	15.09 ^{b}±0.20	5.25^{b}±0.08
0.1 ppm	75.31 ^{b}±0.30	2.19^{a}±0.05	0.52 ^{a}±0.02	2.05 ^{a}±0.07	11.33 ^{b}±0.11	19.41 ^{b}±0.19	19.27 ^{a}±0.29	14.76^{ab}±0.28	4.77^{a}±0.10
0.2 ppm	74.34 ^{b}±0.25	2.49 ^{b}±0.05	0.54 ^{a}±0.02	2.30 ^{b}±0.05	9.92 ^{a}±0.14	18.69^{a}±0.21	19.65 ^{a}±0.31	14.40 ^{a}±0.18	5.33 ^{b}±0.08
Vitamin E effects									
0 mg/kg	74.12 ^{a}±0.18	2.56 ^{a}±0.06	0.53±0.01	2.14±0.06	10.30 ^{a}±0.15	18.86 ^{a}±0.16	19.58±0.22	14.96±0.23	5.22^{b}±0.10
300 mg/kg	75.03 ^{b}±0.22	2.32 ^{b}±0.05	0.54±0.01	2.14±0.04	10.73 ^{b}±0.18	19.58 ^{b}±0.15	19.33±0.18	14.54±0.12	5.00^{a}±0.07
Source of variations (probabilities)									
Selenium	P<0.01	P<0.01	NS	P<0.01	P<0.01	P<0.01	NS	P<0.05	P<0.01
Vitamin E	P<0.01	P<0.01	NS	NS	P<0.05	P<0.01	NS	NS	P<0.05
Selenium × vitamin E interaction	P<0.01	NS	NS	NS	NS	P<0.01	NS	P<0.01	NS

Superscripts are read column wise for comparison of means. Means in the same column with different superscript a, b, c are significantly; NS, nonsignificant.

report any significant effect on growth performance by selenium and vitamin E. Upton *et al*. (2008) observed that the body weight of broiler chickens improved in supplemented groups. Vitamin E alone and in combination with selenium significantly ($P < 0.05$) diminished the growth inhibitory effect of ochratoxin (Kumar *et al*. 1999). Similarly Kumar *et al*. (2009) observed that selenium and vitamin E having ameliorating effect against aflatoxin and ochratoxin in broiler chickens.

Table 4. Effect of organic selenium and vitamin E supplementation to some relative broiler carcass traits at the end of experiment.

Dressing percentage were significantly ($P \leq 0.01$) increased for the broiler fed organic selenium and vitamin E independently and simultaneously. The highest dressing percentage was determined in birds fed 0.1 ppm organic selenium with 300 mg/kg vitamin E (T_4) in the diet which was 2.27% more than control.

Group (T_1). As the level vitamin E increased in the diet percentage of breast and thigh muscle significantly (P<0.01) increased as compared to control. Total giblets (heart, gizzard and liver) relative weights were not significantly influenced due to interaction of selenium and vitamin E.

Similar findings also observed by others (Payne and Southern 2005, Markovic 2007). In contrast Choct and Naylor (2004) did not observe any significant effect on carcass traits due to selenium and vitamin E supplementation.

The study revealed a significant interaction (P<0.01) between organic selenium and vitamin E for muscle protein and lipid percentage (Table 5). As vitamin E concentration increased in diet, lipid percentage of both type of muscles (thigh and breast) were significantly (P<0.01) decreased whereas protein percentage significantly (P<0.01) increased. Lowest muscle lipid and highest protein obtained in broilers

Table 5. Effect of organic selenium and vitamin E on protein and lipid content of thigh and breast muscle in broiler chicken

Particulars	Thigh		Breast	
	Protein%	Lipid%	Protein%	Lipid%
T_1	18.19^{a}±0.01	3.15 ^{d}±0.01	20.21 ^{a}±0.03	1.26 ^{d}±0.00
T_2	18.59 ^{e}±0.05	1.21 ^{b}±0.01	20.64 ^{d}±0.06	1.05 ^{b}±0.00
T_3	18.33 ^{c}±0.02	1.27 ^{c}±0.01	20.40 ^{bc}±0.02	1.13 ^{c}±0.00
T_4	18.75 ^{f}±0.03	1.17 ^{a}±0.00	20.82 ^{e}±0.03	0.84 ^{a}±0.03
T_5	18.26 ^{b}±0.00	1.26 ^{c}±0.00	20.31 ^{b}±0.02	1.15 ^{c}±0.00
T_6	18.38 ^{d}±0.07	1.18 ^{a}±0.00	20.43 ^{c}±0.03	1.03 ^{b}±0.00
Selenium effects				
0 ppm	18.39 ^{b}±0.05	2.18 ^{b}±0.23	20.42^{a}±0.06	1.16^{c}±0.03
0.1 ppm	18.54 ^{c}±0.05	1.22 ^{a}±0.01	20.61^{b}±0.05	0.99^{a}±0.04
0.2 ppm	18.32 ^{a}±0.02	1.22 ^{a}±0.01	20.37^{a}±0.02	1.09^{b}±0.01
Vitamin E effects				
0 mg/kg	18.26 ^{a}±0.02	1.89^{b}±0.17	20.31^{a}±0.02	1.18^{b}±0.01
300 mg/kg	18.57 ^{b}±0.24	1.19^{a}±0.00	20.63^{b}±0.04	0.97^{a}±0.02
Source of variations (probabilities)				
Selenium	P<0.01	P<0.01	P<0.01	P<0.01
Vitamin-E	P<0.01	P<0.01	P<0.01	P<0.01
Selenium x vitamin E interaction	P<0.01	P<0.01	P<0.01	P<0.01

Superscripts are read column wise for comparison of means. Means in the same column with different superscript a, b, c are significantly; NS, nonsignificant.

received 0.1 ppm organic selenium with 300 mg/kg vitamin E (T_4). Findings were in agreement with Markovic *et al*. (2010) who reported that increased selenium and vitamin E concentration increased protein content in the liver and decreased the fat content in breast and heart of broilers.

From the present study it is concluded that organic selenium and vitamin E significantly improved body weight, FCR and dressing percentage in supplemented treatments. Vitamin E supplementation decreased the lipid percentage of muscle whereas, protein percentage significantly increased. Best treatment effect obtained in birds fed 0.1ppm organic selenium and 300 mg/kg vitamin E (T_4) amongst all treatments.

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