EFFECT OF ORGANIC AND INORGANIC SELENIUM WITH AND WITHOUT VITAMIN E ON IMMUNE SYSTEM OF BROILERS

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ABSTRACT

The present project was designed to investigate effects of organic and inorganic selenium with and without vitamin E on the immune system of broiler chickens. For this purpose, 130 (day-old) broiler chicks were divided into three groups A, B (60 chicks each) and C (10 chicks). Group A was divided into six subgroups A1, A2, A3, A4, A5 and A6 which were fed on organic selenium at dose rates of 0.25, 0.25, 0.5, 0.5, 1.0 or 1.0 mg/kg and vitamin E at the dose rates of 0, 200, 0, 200, 0 or 200 IU/kg, respectively. Group B was also divided into six subgroups B1, B2, B3, B4, B5 and B6, which were fed on inorganic selenium at dose rates of 0.25, 0.25, 0.5, 0.5, 1.0 or 1.0 mg/kg and vitamin E at the dose rates of 0, 200, 0, 200, 0 or 200 IU/kg, respectively. Group C (control) received no selenium or vitamin E. Parameters studied were haemagglutination inhibition antibody titre against Newcastle disease virus, pathological examination of lymphoid organs, lymphoid organs weight/body weight ratio and growth traits. Results showed that the effects of organic selenium supplementation were better than that of inorganic selenium. Moreover, the effects of organic or inorganic selenium with vitamin E were better than the supplementation of organic or inorganic selenium without vitamin E.

Key Words: Selenium, vitamin E, broiler chickens, immune system, lymphoid organs.

INTRODUCTION

Minerals and vitamins are essential compounds of balanced diet and are required for the metabolism and utilization of nutrients. Feeding of minerals and vitamins deficient poultry rations may lead to diverse types of clinical symptoms and poor flock performance.

Selenium is an essential mineral, which is necessary for vital activities inducing immune response of birds. A deficiency of selenium mitigates resistance to microbial and viral infections, neutrophil function, antibody production, proliferation of T and B lymphocytes in response to mitogens, cytodestruction of T lymphocytes and natural killer lymphocytes (Blood *et al.*, 1995). Selenium metabolites in the body are closely linked with activities of glutamine peroxides, which eliminate lipid hydroxyl peroxides in cellular structures (Atlavin and Apsite, 2001).

Of all vitamins, vitamin E (α-tocopherol) appears to have most significant effect on immune system (Tizard, 1987). It is known that vitamin E improves the phagocytic cell action, antibody production, the activity of T helper cells, the responsiveness to mitogens and the passive immune transfer. It also plays an important role in the stimulation of the immune system against certain diseases and stressors (El-Boushy, 1988). As a fat-soluble intracellular antioxidant, a primary function of vitamin E is a protective effect on cell membranes. Deficiency of vitamin E is also attributed to impaired immune function in chickens (Marsh *et al.*, 1981).

The present project was designed to investigate effects of organic and inorganic selenium with and without vitamin E on the immune system of broiler chickens. In future, the results of this study will hopefully serve as a basis for supplementation of organic and inorganic selenium with and without vitamin E with special emphasis on immunity.

MATERIALS AND METHODS

Experimental design

A total of 130 (day-old) broiler chicks were procured from a local hatchery and were divided into 3 groups A, B and C. Group A and B consisted of 60 chicks each, while group C consisted of 10 chicks. Group A was divided into 6 subgroups A1, A2, A3, A4, A5 and A6 which were fed on organic selenium at the dose rates of 0.25, 0.25, 0.5, 0.5, 1.0 or 1.0 mg/kg and vitamin E at the dose rates of 0, 200, 0, 200, 0 or 200 IU/kg, respectively. Group B was further divided into six subgroups B1, B2, B3, B4, B5 and B6, which were fed on inorganic selenium at the dose rates of 0.25, 0.25, 0.5, 0.5, 1.0 or1.0 mg/kg and vitamin E at the dose rates of 0, 200, 0, 200, 0 or 200 IU/kg, respectively. Group C received no selenium or vitamin E and served as control group.

Experimental parameters

The following experimental parameters were studied:

1. Antibody response against Newcastle disease virus

Antibody response against Newcastle disease virus was determined by Haemagglutination Inhibition (HI) test (Thayer and Beard, 1998). Blood samples from each of the bird of each group was collected on days 7, 14, 21, 28 and 42, serum was separated and processed for HI test.

2. Examination of lymphoid organs

At the age of 6 weeks, 5 birds from each group or subgroup were slaughtered and the lymphoid organs (bursa of Fabricius, thymus and spleen) were removed. These organs were grossly examined to detect any significant gross pathological change. The tissues showing significant gross lesions were subjected to histopathological examination (Drury and Wallington, 1980).

3. Lymphoid organs weight/body weight ratio

Lymphoid organs were weighed separately to determine the lymphoid organs weight /body weight ratio by using the following formula (Giamborne and Closser, 1990):

$$\text{Organ-body weight ratio} = \frac{\text{Organ weight (g)} \times 100}{\text{Body weight (g)}}$$

4. Growth traits

On the first day just after grouping, all the birds were weighed separately. At the end of 6th week, feed conversion ratio (FCR) of each group and subgroups was calculated by the following formula (Singh and Panda, 1992):

$$\text{FCR} = \frac{\text{Feed consumption}}{\text{Body weight gain}}$$

Statistical analysis

The data of all groups were compared by analysis of variance. Statistically significant differences among various treatment means were determined by using Least Significant Difference test (Steel and Torrie, 1982).

RESULTS AND DISCUSSION

Results are summarized in Tables 1 and 2. The geometric mean HI titres of birds fed on diet containing higher doses of organic and inorganic selenium were higher on all sampling days than those fed on lower or no organic selenium. These findings are in line with the findings of Hegazy and Adachi (2000), who reported an increase in antibody titre with increased level of selenium. Similarly, DengHua *et al.* (1999) and DengHua *et al.* (2001) reported an increase in antibody titre with increased level of inorganic selenium. The perceptible reason for enhanced antibody production is increased number of lymphocytes with increased selenium supplementation.

The geometric mean HI titres of birds fed on vitamin E were higher than those receiving no vitamin E in the feed. This finding is in accordance with the findings of Siddique (1991), who reported that high dose of vitamin E improved antibody production to viral and bacterial antigens. Similarly, Bertuzzi *et al.* (1998) reported that vitamin E increased the humoral and cellular immune response.

The histopathological slides of bursa of Fabricius, spleen and thymus in groups receiving organic or inorganic selenium with and without vitamin E appeared normal, whereas control group showed mild depletion of lymphocytes in these organs. These results are in agreement with the findings of Marsh *et al.* (1986), who reported that vitamin E and selenium deficiencies resulted in depletion of lymphocytes and gradual degeneration of epithelium of bursa of Fabricius and thymus. Marsh *et al.* (1987) also reported that the depression of splenocytes was due to the deficiencies of vitamin E and selenium. Similarly, Chang *et al.* (1990) reported that vitamin E and selenium were capable of supporting optimal cell proliferation and their deficiency might affect the distribution of lymphocyte surface. These finding support the idea that supplementation of selenium and vitamin E improve the functioning of immune system.

The mean lymphoid organs (bursa of Fabricius, spleen and thymus) weight/body weight ratio of control birds was significantly lower than the birds fed on diet containing organic/inorganic selenium with or without vitamin E. These findings are in agreement with the observations of Marsh *et al.* (1986), who reported that vitamin E and selenium deficiency had adverse effects on the development of lymphoid organs (specially spleen and thymus) and also resulted in impaired function of these organs. Similarly, Hegazy and Adachi (2000) reported that the spleen had significantly increased relative weight in selenium supplemented birds. The mean lymphoid organ weight/body weight ratio of birds fed on diet containing organic selenium was higher than the birds fed on diet having inorganic selenium.

Table 1: Geometric mean HI titres against Newcastle disease virus

Subgroup/ Group	Geometric mean HI titres				
	Day 7	Day 14	Day 21	Day 28	Day 42
A1	40.97	74.98	81.75	149.62	273.84
A2	48.69	82.90	97.44	177.82	325.46
A3	44.66	74.98	89.12	163.11	298.53
A4	53.24	98.28	115.47	211.34	354.81
A5	48.69	82.90	97.44	177.82	325.46
A6	53.24	98.28	141.25	358.62	421.69
B1	37.58	68.78	74.98	137.24	211.34
B2	40.97	74.98	89.12	163.11	298.53
B3	40.97	74.98	81.75	149.62	273.84
B4	48.69	82.90	97.44	177.82	325.46
B5	40.97	74.98	89.12	163.11	298.53
B6	53.24	98.28	115.47	211.34	354.81
C	34.47	63.09	68.78	125.89	193.86

Table 2: Feed conversion ratio and mean lymphoid organ weight/body weight ratio

Subgroup/ Group	FCR	Lymphoid organ weight/body weight ratio (Mean ± S. E)		
		Bursa of Fabricius	Spleen	Thymus
A1	2.28	$2.02 \pm 0.002_a$	$1.24 \pm 0.002_a$	$4.12 \pm 0.002_a$
A2	2.21	$2.08 \pm 0.002_b$	$1.66 \pm 0.002_b$	$4.24 \pm 0.002_b$
A3	2.26	$2.02 \pm 0.004_a$	$1.62 \pm 0.004_c$	$4.16 \pm 0.004_c$
A4	2.19	$2.18 \pm 0.006_c$	$1.82 \pm 0.006_d$	$4.46 \pm 0.006_d$
A5	2.24	$2.04 \pm 0.004_d$	$1.64 \pm 0.004_e$	$4.34 \pm 0.004_e$
A6	2.17	$2.40 \pm 0.006_e$	$2.04 \pm 0.006_f$	$4.68 \pm 0.006_f$
B1	2.30	$2.02 \pm 0.002_a$	$1.22 \pm 0.002_g$	$4.11 \pm 0.002_g$
B2	2.23	$2.06 \pm 0.002_f$	$1.64 \pm 0.002_e$	$4.22 \pm 0.002_h$
B3	2.28	$2.02 \pm 0.004_a$	$1.60 \pm 0.004_h$	$4.14 \pm 0.004_i$
B4	2.21	$2.14 \pm 0.006_g$	$1.80 \pm 0.006_i$	$4.42 \pm 0.006_j$
B5	2.25	$2.02 \pm 0.004_a$	1.62 ± 0.004e	$4.30 \pm 0.004_k$
B6	2.19	$2.36 \pm 0.006_h$	$2.02 \pm 0.006_j$	$4.66 \pm 0.006_l$
C	2.40	$1.90 \pm 0.004_i$	$1.18 \pm 0.006_k$	$3.60 \pm 0.006_m$

The values having different subscripts along the column differ significantly (P<0.05).

Feed conversion ratio (FCR) of birds of treatment groups was better than the birds of control group. These findings are in line with the findings of Colnago *et al.* (1984) and Bassiuni *et al.* (1990), who reported that the selenium and vitamin E supplementation significantly increased the body weight and reduced feed conversion efficiency. Mani *et al.* (2000) and Swain and Johri (2000) also reported that the maximum body weight gain and best efficiency of feed utilization were observed in chicks fed on diet containing selenium and vitamin E.

From the above discussion it can be inferred that supplementation of organic/inorganic selenium with or without vitamin E gave better results than no supplementation of selenium and vitamin E. Immune response after supplementation of organic selenium was better than supplementation of inorganic selenium. Moreover, the effects of organic and inorganic selenium with vitamin E were better than the supplementation of organic or inorganic selenium without vitamin E.

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