

Effects of Boron Supplementation on Tibia Mineral, Ash and Weight Parameters and Peripheral Blood Leucocyte Percentages of Layers

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Abstract

In this study the effects of 0, 50, 100, 150, 200 and 250 ppm boron (B) supplementation into laying hen diets on tibia B, calcium (Ca) and phosphorus (P) concentrations, tibia weight and ash content (in % and g DM), peripheral blood leucocyte (PBL) percentage were investigated. Boron supplementation caused significant increases in tibia B concentrations but decreased tibia Ca levels. Supplementation of B did not have any effect on tibia ash content and tibia weight. Whole blood haematocrit (HCT) and haemoglobin (Hb) levels were not significantly increased by the B addition. In general, the findings of the present study supported the hypothesis that B has an important biological role that influences mineral metabolism of the layers.

Introduction

Boron has been examined as a possible nutritional factor in Ca metabolism and utilisation, and thus as a factor in the development and maintenance of normal bone (Nielsen, 1992). Bone-breaking strength and bone ash content are often used as criteria for assessing the values of various dietary supplements, cage designs and animal densities for preventing bone breakage. Several studies (Kurtoğlu et al., 2001, 2002, 2005; Wilson and Ruzsler, 1997, 1998) have also indicated that B is an important mineral for body weight, feed consumption, reduced mortality rate, normal cartilage and bone formation in poultry. In laying hens, a method to improve mineral balance in order to increase the bone strength of laying hens could benefit for the poultry industry (Kurtoğlu et al., 2002). It seems that B also could affect blood cell counts and composition because blood cell formation and maturation are influenced by changes in cell membrane or kidney function or in calcium metabolism (Nielsen et al., 1991). But there were only limited data on blood cell variables affecting by B supplementation in chicks or other animal species.

Materials and Methods

A total of 480, 40-week-old Hysex-Brown layer hybrids, which were obtained from University of Selçuk, Faculty of Veterinary Medicine, Animal Husbandry and Research Unit were used in this study. The animals were randomly divided into six groups. To limit the position differences, these groups were divided into eight subgroups consisting of 10 layers in each (8 replicates of 10 layers making a subgroup). Experimental period was 120 days. Composition and analyses of the diet was formulated as in Table 1. As the B source, *orthoboric acid* was used. Crude nutrient in food were analysed by the methods of AOAC (1984).

At 120th day, 10 layers from each group were killed by cervical dislocation. The left tibias were removed and prepared for ash and B, Ca and P analyses (Rossi et al., 1993). Tibia mineral analyses were made by using an Inductive Coupled Plasma Atomic Emission Spectrometer (ICP AES Varion Vista Model, Australia) according to Rossi et al. (1993). Cardiac blood samples were taken into heparinized tubes. The smears were fixed in glutaraldehyde-acetone solution. Two of them were stained with May Grünwald-Giemsa and PBL percentages of the samples were determined by counting 200 leucocytes on each specimen. Data belonging to the biochemical and the other parameters were measured individually and analysed by using Duncan's multiple range test (SPSS, 1998).

Results and Discussion

Tibia B concentrations (Table 2) increased in closely related manner to the dietary B concentrations. However, B additions decreased the tibia Ca and P concentrations. B additions had no effect on whole blood variables such as haemoglobin, haematocrit, WBC, RBC, platelet (PLT) but, HCT and Hb levels were gradually increased by the concentrations of the B (Table 2). Boron supplementation caused lower tibia Ca and P concentrations in agreement with previous research (Wilson and Ruszler, 1998). In the other section (Kurtoğlu et al., 2002) of present study, we found that serum Ca and P levels were increased in B supplemented groups. It was also reported that 5 and 25 ppm B additions into broiler diets increased the tibia Ca levels (Kurtoğlu et al., 2005). This concept showed in the present study may be reflect that high (50-250 ppm) B supplementations to diets may be caused the Ca mobilisation from bone to extracellular fluid or high B supplementation may be caused the increasing the Ca absorption and retention in long term effect.

There are only a few study reporting a close relationship between B and blood parameters such as blood HCT and Hb levels and counts for leukocyte, erythrocyte, monocyte cells. We found that Hb and HCT levels were not significantly ($P>0.05$) increased in B supplemented group as seen in Table 2. Hunt (1989) reported that 3 ppm B addition to cholecalciferol deficient chicks had no effect on HCT and Hb values. However, Kurtoglu et al. (2005), found that HCT and Hb concentrations of broilers were significantly ($P<0.05$) increased by dietary 5 and 25 ppm B additions. The findings of the present study support the hypothesis that boron may have an important biological role that influences mineral metabolism of the animals by biochemical and haematological mechanisms.

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Table 1. Composition and analysis of diets

Ingredients	%		
Corn	20.00	ME, MJ/kg*	11.66
Wheat	48.90	Crude protein, %	16.12
Soybean meal	17.00	Dry matter, %	90.75
Fish meal	1.50	Ash, %	8.01
Oil	2.50	Crude fibre, %	5.12
Limestone	9.00	Ether extract, %	3.05
Di calcium phosphate (DCP)	0.50	Ca, %	3.49
Salt	0.25	P, %	0.65
Vitamin premix ¹	0.25	Methionine+Cysteine, %*	0.55
Mineral premix ²	0.10	Lysine, %*	0.90

¹ Per 2.5 kg of vitamin premix contains 3.6 mg vitamin A, 0.05 mg vitamin D₃, 30 mg vitamin E, 3 mg vitamin K₃, 3 mg vitamin B₁, 6 mg vitamin B₂, 5 mg vitamin B₆, 0.015 mg vitamin B₁₂, 25 mg niacin, 0.04 mg biotin, 8 mg carotenoid, 1 mg folic acid, 300 mg choline chloride, 50 mg vitamin C.

² Per kg of mineral premix contains 80 mg Mn, 35 mg Fe, 50 mg Zn, 5 mg Cu, 2 mg I, 0.4 mg Co, 0.15 mg Se.

*Obtained by calculation.

Table 2. Effects of boron supplementation on some selected variables of layers

	0 ppm	50 ppm	100 ppm	150 ppm	200 ppm	250 ppm
Tibia characteristics						
B (µg/g DM)	0.99±0.22 ^e	2.81±0.22 ^d	3.81±0.20 ^c	4.63±0.43 ^c	5.71±0.28 ^b	6.98±0.41 ^a
Ca (µg/g DM)	34574±279 ^a	32807±316 ^b	31698±402 ^b	31488±848 ^{bc}	31218±454 ^c	31014±582 ^c
P (µg/g DM)	15141±213	14483±398	14046±586	13731±410	13684±214	13586±365
Tibia Weight (g, DM)	5.42±0.17	5.66±0.25	5.41±0.28	5.56±0.25	5.33±0.20	5.80±0.25
Ash (% DM)	56.79±0.76	56.64±0.31	56.92±0.54	56.45±0.73	57.41±0.71	56.91±0.36
Ash (g DM)	3.08±0.12	3.21±0.16	3.09±0.19	3.14±0.17	3.07±0.14	3.30±0.16
Whole blood variables						
Hb (g/100ml)	8.25±0.55	8.90±0.57	8.78±0.51	8.86±0.49	9.42±0.59	9.73±0.64
HCT (%)	26.40±1.30	28.10±1.59	27.40±1.56	28.00±1.97	30.90±2.02	32.40±1.93
WBC (10 ³ mm ³)	38.24±3.65	37.86±3.52	36.24±3.27	37.15±3.76	36.95±3.04	38.11±3.75
RBC (10 ⁶ mm ³)	2.14±0.070	2.19±0.081	2.16±0.092	2.18±0.095	2.29±0.107	2.34±0.100
PLT (10 ⁵ mm ³)	0.38±0.037	0.37±0.045	0.36±0.056	0.38±0.047	0.39±0.061	0.37±0.072
Lymphocyte (%)	58.10±2.72	57.30±3.01	56.40±2.87	57.30±3.38	58.10±3.42	56.60±2.92
Monocyte (%)	3.20±0.47	2.90±0.43	3.10±0.43	3.00±0.36	3.10±0.31	2.90±0.28
Eosinophil (%)	1.30±0.15	1.20±0.13	1.10±0.18	1.20±0.25	1.10±0.23	1.30±0.26
Heterophil (%)	34.90±2.20	35.90±3.03	36.80±2.98	35.80±3.21	35.10±3.24	36.70±3.06
Basophil (%)	2.50±0.31	2.70±0.30	2.60±0.27	2.70±0.26	2.60±0.31	2.50±0.27

Values represent the mean ± SEM of six group of 10 laying hens each per treatment; ^{a-c} Means within lines with no common superscripts are significantly different (P<0.001), according to Duncan's multiple range tests. No differences were observed the groups (P>0.05). DM: Dry matter