Effect of different levels of chromium chloride on performance and antibody titre against Newcastle and Avian Influenza virus in broiler chicks

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Three hundred one-day-old male broilers (Ross 308) were allocated to five treatments with four replicates in a completely randomized design. Treatments supplemented with 0 (control), 400, 800, 1200 or 1600 ppb chromium in the form of chromium chloride. All birds were intramuscularly immunized with killed vaccine of Newcastle and Avian Influenza (H9 N2) virus at 8 d. On days 18 and 28 blood samples were collected from the wing vein of eight birds per treatment and serum antibody titres against Newcastle and Influenza virus were determined. At 42 days of age, two chicks from each replicate were slaughtered, spleen and bursa of fabricius were removed, weighed and expressed as a percentage of live body weight. Body weight, weight gain and feed efficiency improved significantly (P<0.05) in broilers fed 1600 ppb supplemental chromium. Feed intake of broilers was not affected by supplemental chromium. Percentage of bursa of fabricius and spleen in broilers fed 1600 ppb chromium increased. Broilers fed chromium supplementation had higher antibody titres against Newcastle and Influenza virus (P<0.05). The results of this experiment indicated that chromium supplementation improved performance and antibody titre against Influenza and Newcastle virus in broiler chicks.

Key words: broiler; chromium chloride; performance; antibody titre.

Introduction

Trivalent chromium (Cr) is a well known essential trace element for human and animals (Schwartz and Mertz, 1959). Cr is a component of an oligopeptide low molecular-weight Cr-binding substance, chromodulin, functioning as a part of the insulin signalling auto-amplification mechanism (Vincent, 2000). This element is also involved in carbohydrate, lipid, protein and nucleic acid metabolic function (Steele and Rosebrough, 1981; Ohba et al., 1986; McCarty, 1991). Dietary Cr supplementation has been shown to positively affect growth rate and feed efficiency in growing poultry (Cupo and Donaldson, 1987; Lien et al., 1999; Sahin et al., 2002). Improvements in immune response have been observed when Cr were supplemented to broilers (Luo et al., 1999), stressed feeder calves (Chang and Mowat, 1992; Moonsie-Shageer and Mowat, 1993) and dairy cows (Burton et al., 1993). Nevertheless, recommendations regarding the dietary inclusion level of Cr in diets of livestock including poultry are yet to be finalized (National Research Council, 1994). Moreover, poultry diets are composed mostly of ingredients from plant origin, which are low in Cr (Giri et al., 1990).

The present experiment was conducted with broiler chickens receiving either no Cr supplementation or different levels of Cr chloride. The objective of this study was to assess the effects of these supplemental Cr on performance and antibody titre against Newcastle and Avian Influenza virus in broiler chicks.

Materials and methods

Three hundred one-day-old male broilers (Ross 308) were allocated to five treatments with four replicates in a completely randomized design. Treatments supplemented with 0 (control), 400, 800, 1200 or 1600 ppb chromium in the form of chromium chloride. Each treatment consisted of 4 pens with 15 birds in each pen. Birds were fed *ad libitum* with a basal diet for starter (0-10 d), grower (11-28 d) and finisher (29-42d) periods. The basal diets were formulated to meet or exceed the nutrient requirements of broiler chicks (Ross broiler management manual, 2002). Body weight, Feed intake and feed conversion ratio were measured at 11, 28 and 42 days of age. All birds were intramuscularly immunized with killed vaccine of Newcastle and Avian Influenza (H9 N2) viruses at age of 8 days. Live Newcastle disease vaccine (Nobilis ND Lasota) was administered orally (drinking water) on 20d. On days 18 and 28 blood samples were collected from the wing vein of twelve birds per treatment and serum antibody titres against Newcastle and Influenza diseases were determined by haemagglutination inhibition (HI) test and were expressed as the logarithm base 2. Three chicks from each replicate were slaughtered on day 42, and lymphoid organs such as thymus, spleen and bursa of fabricius were collected, weighed and expressed as a percentage of live body weight.

The experiment data were analyzed using SAS statistical program (SAS, 1997). General linear model was used to analyze variance, and significant differences ($P<0.05$) among treatment means were determined using Duncan's new multiple range test.

Results

The effects of Cr supplementation on performance of broiler chicks are shown in Table 1. Chromium supplementation at level of 1600 ppb increased significantly ($P<0.05$) body weight of broilers either for 10, 28 and 42 days of age. Feed consumption of broilers was not affected by different levels of supplemental Cr ($P>0.05$). Supplement of 1600 ppb Cr to broiler diets significantly increased weight gain ($P<0.05$). Feed conversion ratio of broilers fed 1600 ppb Cr was significantly ($P<0.05$) lower than other groups. Table 2 shows the effects of Cr supplementation on carcass traits and lymphoid organs. Carcass yield of broilers fed 1600 ppb Cr increased and percentage of abdominal fat decreased in broiler fed 1200 and 1600 ppb Cr ($P<0.05$). Percentage of liver and pancreas to live body weight were not affected by different levels of Cr. Weight of bursa of fabericius of broiler chicks fed 800, 1200 and 1600 ppb Cr were greater than other groups and spleen of broilers fed 1600 ppb.

Table 1. Effect of different levels of chromium chloride on performance of broiler chicks

	Control	Chromium supplemented levels (ppb)				SE
		400	800	1200	1600	
Body weight (g)						
10 d	196.4 [b]	205.8 [ab]	202.4 [b]	201.3 [b]	207.1 [a]	4.3
28 d	1052 [b]	1054.7 [b]	1056 [b]	1051 [b]	1077.3 [a]	8.3
42 d	2091.3 [b]	2096.7 [b]	2106 [b]	2097.2 [b]	2156.7 [a]	15.2
Weight gain (g/d)						
0-42d	50 [b]	50.2 [b]	50.4 [b]	50.1 [b]	51.6 [a]	0.42
Feed intake (g/d)						
0-42 d	85.3	85.4	85.1	85.5	85.4	1.54
Feed : gain (g:g)						
0-42 d	1.71 [a]	1.70 [a]	1.69 [a]	1.71 [a]	1.65 [b]	0.189

[a-b] Means within the same row without common superscripts differ significantly ($P<0.05$).

Table 2. Effect of different levels of chromium chloride on carcass traits and lymphoid organ at 42 days of age

Carcass traits*	Control	Chromium supplemented levels (ppb)				SE
		400	800	1200	1600	
Carcass	68.7 [b]	69.7 [b]	70 [b]	69.9 [b]	71.5 [a]	0.682
Abdominal fat	1.48 [a]	1.56 [a]	1.59 [a]	1.34 [b]	1.35 [b]	0.981
Liver	2.12	2.18	1.96	1.93	2.16	0.451
Pancreas	0.207	0.206	0.206	0.198	0.201	
Lymphoid organs*						
Bursa of Fabricius	0.054 [b]	0.059 [ab]	0.062 [a]	0.063 [a]	0.061 [a]	0.003
Spleen	0.122 [b]	0.112 [b]	0.119 [b]	0.124 [b]	0.182 [a]	0.034

[a-b] Means within the same row without common superscripts differ significantly (P<0.05).
*: Percentage of live weight

Antibody titers against Newcastle virus at 18 and 28 d were affected by supplemental Cr and broilers fed 800, 1200 and 1600 ppb Cr had higher antibody titers (P<0.05). Supplement of 1600 ppb Cr to broiler diets significantly (P<0.05) elevated antibody titers against Influenza virus at 18 d in comparison with control. At 18 days of age there was no significant difference in the antibody titer among the treatments.

Table 3. Effect of different levels of chromium chloride on antibody titer against Newcastle and Influenza virus at different ages

Chromium levels (ppb)	Newcastle (log_2 HI titer)		Influenza (log_2 HI titer)	
	18d	28d	18d	28d
Control	1.5 [b]	1.83 [b]	3 [b]	3.83
400	1.83 [b]	2.67 [a]	3.5 [ab]	3.17
800	2.67 [a]	2.83 [a]	3.83 [ab]	3.17
1200	2.67 [a]	2.83 [a]	3.83 [ab]	3.83
1600	2.83 [a]	3.33 [a]	4.33 [a]	4
SE	0.37	0.35	0.21	0.256

[a-b] Means within the same column without common superscripts differ significantly (P<0.05)

Discussion

The present study revealed that Cr supplementation particularly at level of 1600 ppb improved the performance of the broiler chickens in terms of live-weight gain and feed conversion ratio. This is in agreement with the observations of Nam et al. (1995) and Amatya et al. (2004) reported performance of broilers received Cr chloride was improved. Lien et al. (1999) reported that 1600 and 3200 ppb Cr picolinate supplementation in a broiler diets improved live weight gain. Kim et al. (1996) also observed that 1600 ppb Cr picolinate supplementation increased the weight gain in broilers.

The results of this study indicate that Cr supplementation increased carcass yield and decreased abdominal fat (*Table 2*). In accordance with our results, increasing carcass yield and decreasing abdominal fat content in broilers has been reported for diets supplemented with Cr (Sahin et al., 2002; Debski et al., 2004). In broiler chickens, supplementation of 100 to 400 p. p. b. Cr increased carcass protein with a simultaneous reduction in the fat content of the carcass (Kim et al., 1996). Accretion of protein in the carcass was perhaps due to the potentiation of insulin action under the influence of Cr that might in turn have promoted the tissue uptake of protein. On the other hand, Cr was found to exert inhibitory effects on in vitro lipogenic activity in chick adipose tissue (Kim et al., 1996).

Dietary Cr supplementation increased antibody titers against Newcastle and Influenza virus (*Table 3*). Elevated antibody titer against Newcastle disease was reported in broiler chicks with supplement of 2 or 10 ppm Cr, either in the form of $CrCl_3$ or yeast (Guo et al., 1999). Lee et al. (2003) reported antibody titer against Infectious bronchitis was improved in broiler chicks fed 400 ppb Cr picolinate.

The results of this study show that supplemental Cr improved performance, carcass traits and antibody titers against Newcastle and Influenza virus in broiler chicks.

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