

MEAT QUALITY AND BLACK BONE INCIDENCE IN BROILERS FED ELEVATED DIETARY VITAMIN LEVELS CHALLENGED WITH AFLATOXIN

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Resumo: This experiment was conducted to evaluate the influence of optimum vitamin nutrition (OVN) in diets contaminated with aflatoxin in broilers from 1 to 44 days of age. A total of 1,800 male chicks were allotted among 8 dietary treatments with 15 replicated pens each containing 15 birds, using a 2 x 2 x 2 factorial (commercial and high vitamin levels, 2 levels of aflatoxin - 0 ppm and 0.5 ppm with binder levels of 0 and 10,000 mg/kg). To determine carcass characteristics and Black Bone Syndrome (BBS), two birds were slaughtered from each group at 45 days. Other analyses included breast tenderness, water loss by dripping and malonaldehyde (MDA) concentrations. The OVN treatment decreased the frequency of unacceptable and intermediate levels of BBS ($P < 0.05$) and the analysis of breast quality showed that the treatments did not influence water loss by dripping ($P > 0.05$). It was concluded that feeding OVN improved meat quality and bone characteristics in broilers.

Palavras Chave: Optimum vitamin nutrition; mycotoxin; bone quality; meat defect.

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Abstract: This experiment was conducted to evaluate the influence of optimum vitamin nutrition (OVN) in diets contaminated with aflatoxin in broilers from 1 to 44 days of age. A total of 1,800 male chicks were allotted among 8 dietary treatments with 15 replicated pens each containing 15 birds, using a 2 x 2 x 2 factorial (commercial and high vitamin levels, 2 levels of aflatoxin - 0 ppm and 0.5 ppm with binder levels of 0 and 10,000 mg/kg). To determine carcass characteristics and Black Bone Syndrome (BBS), two birds were slaughtered from each group at 45 days. Other analyses included breast tenderness, water loss by dripping and malonaldehyde (MDA) concentrations. The OVN treatment decreased the frequency of unacceptable and intermediate levels of BBS ($P < 0.05$) and the analysis of breast quality showed that the treatments did not influence water loss by dripping ($P > 0.05$). It was concluded that feeding OVN improved meat quality and bone characteristics in broilers.

Keywords: Optimum vitamin nutrition; mycotoxin; bone quality; meat defect.

Introdução: Improvements in nutrition has been one of the significant transformations of the poultry sector. There is a large amount of data showing the nutritional requirements for proteins, amino acids, and minerals. However, few studies have evaluated broiler vitamins requirements, mainly about supplying vitamin levels above nutrition tables. A challenge faced by the poultry sector is the use of feed ingredients containing aflatoxin, which hinder poultry performance, compromising the immune system and, in extreme cases, causing death. Meat redness accompanied by the presence of blood is related to a meat defect called BBS (Baldo et al., 2013). Since vitamin D plays an important role in calcium (Ca) and phosphorus (P) absorption, and, therefore, influences bone quality, the use of higher vitamin levels would help to minimize BBS. This study was developed to analyze the levels of OVN in broiler diets from 1 to 44 days of age, with or without aflatoxin, on meat quality traits and BBS incidence.

Material e Métodos: A total of 1,800 one-day old male chicks were randomly allocated to 15 sets of 8 different treatment groups of 15 birds, using a factorial 2 x 2 x 2 (levels of vitamin supplementation, control and OVN; levels of aflatoxins: 0 and 0.5 ppm; and, levels of binder: 0 and 10,000 mg/kg). The mash diets were corn and soybean meal based, formulated according to commercial practices. Feed and water were provided ad libitum during the trial. The levels of vitamins used can be found in Table 1. The deactivated bentonite and yeast-based binder was used in the pre-starter and starter diets only. The aflatoxin used was produced by cultivating the toxic strain *Aspergillus parasiticus* (NRRL 2999) in rice, according to a method developed by Shotwel et al. (1966), and was introduced into the formulation replacing the carrier. Breast samples were taken to determine meat quality (tenderness, water loss by dripping and lipid peroxidation), and the tibias were used to verify the incidence of BBS, which were dried, preserving the periosteum, and were submitted to the L* test. For this purpose, a Minolta 410R colorimeter was placed on the proximal epiphysis of the growth plate. The tibias received a score, based on the light parameters as described by Baldo et al. (2013). Data were submitted to analysis of variance and means were compared using the Tukey test at 5% probability.

Resultado e Discussão: Vitamins are essential nutrients, involved in over 30 metabolic reactions at the cellular level (Marks, 1975). The benefits of vitamin supplementation were demonstrated in this experiment, since the diets with OVN decreased the frequency of unacceptable and intermediate levels of BBS (Table 2) and improved the percentage of acceptable bone light results ($P < 0.05$). Regarding the incidence of BBS, the number of acceptable ratings for the light parameters increased when the birds were fed OVN, whereas the presence of aflatoxin in the diet increased the number of intermediate readings. Aflatoxin impacts liver, kidneys and the organs involved in biosynthesis of the active form of vitamin D, responsible for transferring Ca and P from the

diet to the blood stream (Hamilton, 1984). Given the toxic effects of aflatoxin, and, consequently, the decrease in the amount of active vitamin D, the level of Ca absorbed by the intestine and deposited in the bones decreases. The analysis of breast quality showed that the treatments did not influence water loss by dripping ($P>0.05$) (Table 3). It is worth noting that the presence or absence of aflatoxins and the different vitamin levels had no effect on broiler breast tenderness. The feeding OVN decreases lipid peroxidation, a characteristic of much interest to the industry. Providing broilers with high levels of natural antioxidants gives the poultry industry a simple method to improve stability against oxidation, sensory quality, shelf life and acceptability of the meats.

Table 1 – Minimum levels of vitamins provided by the control vitamin supplement and OVN supplement

Vitamin	Unit	Control vitamin supplement			
		Pre-starter	Starter	Grower	Finisher
Vitamin A	Iu/ton feed	8 000 000	7 000 000	6 000 000	5 000 000
Vitamin D3	Iu/ton feed	2 000 000	2 200 000	2 000 000	1 000 000
Vitamin E	Iu/ton feed	12 000	11 000	10 000	8 000
Vitamin K3	mg/ton feed	2 000	1 600	1 600	1 600
Vitamin B1	mg/ton feed	2 400	2 000	1 400	0
Vitamin B2	mg/ton feed	4 000	5 000	4 000	2 000
Vitamin B6	mg/ton feed	4 000	3 000	2 000	0
Vitamin B12	mg/ton feed	14	12	10	5
Folic acid	mg/ton feed	1 000	800	600	0
Niacin	mg/ton feed	40 000	36 000	30 000	20 000
Pantothenic acid	mg/ton feed	15 000	13 000	11 000	9 000
Choline	g/ton feed	346	328	242	128
OVN supplement ¹					
Vitamin A	Iu/ton feed	13 000 000	11 250 000	11 250 000	11 250 000
Vitamin D3	Iu/ton feed	4 000 000	4 000 000	4 000 000	4 000 000
Vitamin E	Iu/ton feed	220 000	79 000	79 000	79 000
Vitamin K3	mg/ton feed	3 600	3 600	3 600	3 600
Vitamin B1	mg/ton feed	3 600	2 500	2 500	2 500
Vitamin B2	mg/ton feed	9 000	8 000	7 000	7 000
Vitamin B6	mg/ton feed	6 000	6 000	6 000	6 000
Vitamin B12	mg/ton feed	30	25	25	25
Folic acid	mg/ton feed	2 250	2 250	2 250	2 250
Niacin	mg/ton feed	70 000	70 000	65 000	65 000
Pantothenic acid	mg/ton feed	17 000	15 000	12 000	12 000
Choline	g/ton feed	650	650	675	675
Vitamin C	mg/ton feed	150 000	150 000	150 000	150 000
H ₂ O	mg/ton feed	69	69	69	69
Biotin	mg/ton feed	200	200	200	200

¹OVN, optimum vitamin nutrition

Table 2 – Incidence of BSE in broilers fed different levels of vitamin in the diets, with or without aflatoxin challenge, at 45 days of age

Vitamin	Aflatoxin (mg/kg)	Binder (mg/kg)	Incidence of BSE		
			Unacceptable	Intermediate	Acceptable
Control	0	0	12.00	21.00	67.00
OVN ¹	0	0	9.00	18.00	73.00
	0.5	0	19.00	23.00	58.00
	0	10 000	10.00	20.00	70.00
Control	0	0	10.67	19.33	70.00
Control	0	10 000	10.33	18.67	70.00
Control	0.5	0	19.00	21.00	60.00
Control	0.5	10 000	11.66	21.33	67.00
OVN	0	0	7.67	16.33	76.00
OVN	0	10 000	7.33	16.66	76.00
OVN	0.5	0	8.00	18.00	73.00
OVN	0.5	10 000	8.67	18.33	73.00

Probability

Vitamins

Aflatoxins

Binder

Vit x Afla

Vit x Binder

Vit x Afla x Binder

SEM

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