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Does Bentonite Reduce Aflatoxin Digestion in Young Broilers?

Mycotoxins are a common contaminant problem in feed ingredients. Aflatoxins are a class of these fungal contaminants produced by the genus *Aspergillus*. Aflatoxin B_1 (AFB_1) is the most common and is a harmful mutagen and liver carcinogen (Biehl and Buck, 1987). Aflatoxins negatively influence growth performance, liver performance, immune response, serum protein levels and relative organ weights.

Poultry livers are usually pale and enlarged from aflatoxicosis. There are microscopic changes in fatty tissue, evidence of necrosis and biliary hyperplasia (Hoerr, 1997). Genes associated with energy production and metabolism, growth, and immune protection were decreased and genes associated with cell proliferation were increased in studies where birds were fed 1 mg AFB_1/kg diet (Yarru et al. 2009).

Adsorbants are proving to be beneficial in preventing or reducing the toxic effects of aflatoxins. The adsorbents close off Aflatoxin through the digestive process which moves the mycotoxin harmlessly through the animal (Phillips et al., 1990). They are not all equally effective and some even impair nutrient utilization Scheideler, 1993).

For this reason, current research is being conducted to determine the efficacy and potential for impaired nutrient utilization of adsorbents. Shannon, et al., (2016), used raw bentonite (RC) and a concentrated form (CC) of the adsorbent in a recent experiment to compare efficacy of the two forms in preventing or reducing the toxic effects of aflatoxins in broilers from hatch to day 21.

The experiment

Shannon, et al., (2016), conducted this experiment using 180 day old straight run broiler chicks. The birds were weighed, wing-banded and divided into 6 replicates of 5 chicks each on 6 dietary treatments from hatch to day 21.

Continued on p. 2

Continued from p. 1

Table 1. Chemical composition of raw clay (RC) and concentrated clay (CC)

	Content, %								
	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	Na_2O	K_2O	TiO_2	I.L.[a]
RC	49.24	25.04	5.67	5.07	1.57	0.16	0.38	0.84	11.99
CC	49.26	22.18	5.76	2.59	1.70	0.04	0.33	0.76	13.10

[a] Ignition loss, 900° C.

The treatment diets included: 1) the basal diet (BD) that contained no mycotoxins or adsorbents; 2) BD and 0.50% raw clay (RC); 3) BD and 0.50% concentrated clay (CC); 4) BD and 2.0 mg AFB_1/kg; 5) BD and 2.0 mg of AFB_1/kg, and 0.50% RC; 6) BD and 2.0 mg AFB_1/kg and 0.50% CC. The RC was a natural bentonite mined in Bosnia. The CC was a concentrated form of the RC containing montmorillonite mineral with minor amounts of quartz and calcite. Table 1 shows the chemical composition of both clays.

The chicks were weighed at the beginning and end of the experiment. Food intake was monitored and feed conversion (FC) was calculated. Dead birds were necropsied to determine cause of death. Birds were inspected daily for health related problems that were recorded. At day 22, 18 birds were anesthetized and blood samples were collected to determine serum concentrations of proteins (globulin [GLOB], total protein [TP], albumin [ALB]), enzymes (aspartate aminotransferase [AST], gamma-glutamyltransferase [GGT]), glucose (GLU), uric acid (UA), and calcium (Ca).

Table2. Efficacy of bentonite clays to reduce the effects of aflatoxin on growth performance of broilers fed dietary treatments from hatch to day 21.[a]

	Variables				
Treatments	Initial Body Weight (g)	Body Weight Gain (g)	Feed Intake (g)	Feed/gain (g:g)	Mortality (%)[b]
BD[c]	37.50	739	987	1.34	0
BD + 0.50% RC	37.43	760	1034	1.36	3.33
BD + 0.50% CC	37.43	706	974	1.39	3.33
BD + 2 mg/kg AFB_1	37.53	579	806	1.40	10
BD + 2 mg/kg + 0.50% RC	37.47	701	967	1.39	10
BD + 2 mg/kg + 0.50% CC	37.53	693	941	1.36	6.67

[a] Data are means of six replicate pens of 5 chicks each.
[b] Data were transformed before subjected to analysis.
[c] BD = basal diet.

Continued on p.. 3

Continued from p. 2

After collecting the blood samples, the same birds were euthanized and the livers and kidneys were removed and weighed. Liver color was graded. Additionally livers were harvested from 12 birds in each treatment for gross and histopathologic study. The individual samples were scored based on the severity of main-aflatoxin associated lesions (biliary hyperplasia, periportal swelling, vascular degeneration of hepatocytes and periportal heterophil infiltration). The scale was 1 = liver section unremarkable; 2 = lesions in liver section are compatible with mild aflatoxicosis, affecting less than 20% of the hepatic parenchyma; 3 = lesions in the liver section are compatible with moderate aflatoxicosis affecting 20-60% of the hepatic parenchyma; and 4 = lesions in the liver section indicate severe aflatoxicosis, affecting more than 60% of the hepatic parenchyma.

Findings

The basal diet was tested for a variety of mycotoxins and contained 0.15 mg/kg (ppm) of fumonisin B_1. Aflatoxin B_1 was found in treatment diets 4, 5 and 6. Those same diets also contained AFB_2.

The first three diets did not contain any form of aflatoxin.

Table 2 shows the effects of the treatment diets on growth performance. Feed consumption was the same for the birds fed bentonite as the birds fed the control diet. Growth and feed conversion were also the same between the bentonite and control diets.

Birds fed AFB_1 alone ate 18% less feed and gained 21% less weight than birds on the control diet. Combinations of the AFB_1 and Bentonite ate the same amount of feed, grew similarly and converted feed as efficiently as compared to the control diets.

Organ weights were similar between the bentonite and control diets. Liver and kidney weights were heavier on the diets containing AFB_1 alone. The organ weights for birds fed the bentonite and AFB_1 were in between the control and AFB_1 alone diets.

The liver color scores were similar between the bentonite and control diets. Compared to the control diets, liver color scores were lower on diets of AFB_1 alone and AFB_1 plus RC. The liver color was similar between the control diets and AFB_1 plus CC.

The levels of glucose, total protein and globulin were not influenced by dietary treatments. Albumin concentrations were similar between the bentonite and treatment diets. The AFB_1 diets had lower albumin concentrations, but combination diets of AFB_1/ bentonite were similar compared to the control diets.

The concentrations of serum Ca and UA were not influenced by diet. The AST concentration was higher on the AFB_1 plus CC diet compared to all the other diets, which were similar among others. On the bentonite diets, the GGT concentration was similar to the control diet. The GGT concentration was also higher on the AFB_1 diet, but similar to the control diet in birds fed the AFB_1/bentonite diets.

Lesions were not observed in the birds fed the control or bentonite diets. Mild aflatoxin lesions were found in the livers of the birds fed

Continued on p. 4

Continued from p.3

AFB_1. There was also evidence of heterophils, lymphocytes and macrophages. Heterophils were infiltrating portal tracts. Mild fibrosis bile duct proliferation was also observed in the portal tracts. Lymphocytes were swollen and there was evidence of fatty change. Researchers observed a small number of necrotic and potential cancerous hepatocytes. Adding bentonite to the diet (RC or CC) to the aflatoxin diet did significantly decrease but did not completely prevent liver lesions.

What this means for the industry

Adsorbents did not negatively influence diet nutrition and are safe for use in chicks at the concentration rate of 0.50%. Mycotoxins (AFB_1 and AFB_2), lower feed intake and body weight gain. In this study, adding bentonite to the AFB_1 diet reversed the growth-depressing effects. Adsorbents bind aflatoxins in the digestive tract, and cause the mycotoxins to pass through the birds (Phillips et al., 1990). Adding RC and CC at 0.50% of to the control diet did not cause negative effects in this study, and there was no significant difference between the two types of bentonite on those effects. Because both are effective, it would be more economical to use raw clay (RC) as an adsorbent compared to the concentrated clay (CC), which is more expensive due to processing.

Information for this article taken from:

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