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Effects of aflatoxin on production performance of commercial broiler chickens

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Abstract

Aflatoxin (AF) (0.5ppm) and a commercial Mycotoxcin Binder (Niltox) (0.5, 0.75 and 1%) were tested in an *in vivo* study forming 8 dietary treatments each with three replicates on a total of 336 on broiler chicks up to five weeks. Results showed that chicks receiving AF contaminated feed had suppressed body weight, which significantly improved with inclusion of Niltox. Supplementation of Niltox at 0.75 and 1% to the diets containing AF significantly (9.97 and 9.15%, respectively) improved feed consumption. Efficiency of feed utilization decreased significantly with addition of 0.5 pm AF, improved with inclusion of Niltox. The serum antibody titers against ND and IBD vaccination which were significantly depressed by AF, were restored with the inclusion of 1% Niltox. The serum concentration of total protein (38.37%) uric acid and albumin were not affected either in AF fed or Niltox supplemented groups. The activity of serum GGT significantly increased in AF fed group and the addition of Niltox did not show significant reduction in activity of serum GGT. Compared with control, activity of serum ALT was not affected either in AF, control or Niltox supplemented groups.

Keywords: Aflatoxin, broilers, performance.

Introduction

Cereal grains and associated by-products constitute important sources of energy for poultry. There is increasing evidence that global supplies of cereal grains for animal feedstuffs are commonly contaminated with mycotoxins (Manafi et al., 2011). Aflatoxins are secondary toxic metabolites produced by certain strains of fungi, e.g. *Aspergillus flavus* and *Aspergillus parasiticus* species. Aflatoxin B1 (AFB1), the most toxic of all aflatoxins (AFB1, AFB2, AFG1 and AFG2), is produced by certain strains of fungi in greater quantities than in others (Miazzo et al., 2005). In poultry, aflatoxin ingestion leads to "Aflatoxicosis" syndrome which is characterized by retardation of growth, feed consumption, feed conversion efficiency, bruising, immunosuppression and mortality (Manafi et al., 2011). Co-contamination of cereal grains with mycotoxins produced by different fungal genera, including *Fusarium* and *Aspergillus* has been reported to increase the toxicity symptoms in poultry (Hagler et al., 1984).

At present, one of the more encouraging approachesis is the addition of non-nutritive and natural adsorbent materials to contaminated feed in order to selectively bind the mycotoxin during the digestive process and make it harmless to the feed. The major advantages of these adsorbents include low cost, safety and the ease with which they can be added to animal feed. Layered amino silicates such as sodium bentonite found to be effective in counteracting mycotoxins (Unsworth et al., 1989; Smith and Ross, 1991; Hagler et al., 1992; Santurio et al., 1999; Eralsan et al., 2005), However, the ability of bentonite to bind mycotoxins depends on pH, molecular arrangements and its geographic region of origin (Vieira, 2003). Considering all these facts, the present study was undertaken to investigate the ability of graded levels of Niltox (A property product of Zeus Biotech, Mysore, India) to counteract the toxic effects of aflatoxin broilers.

Materials and Methods

Experimental animals and design

Three hundred and thirty six, unsexed one-day old commercial broiler chicks were wing banded, weighed and assigned to a 4×2 factorial arrangement of two

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levels of Aflatoxin AF (0 and 0.5ppm) and four levels Niltox (0, 0.5, 0.75 and 1%) in a Completely Randomized Design, forming a total of 8 dietary treatments, each with 3 replicates.

Each replicate was housed in an independent pen in an open sided deep litter conventional house. Chicks in all the replicate were reared till five weeks of age under uniform standard conditions throughout the study. Brooding was done until three weeks of age using incandescent bulbs. Each pen was fitted with an automatic bell type drinker and a hanging tubular feeder. Chicks were provided continuous light throughout the study.

Aflatoxin was produced using the pure culture of *Aspergillus parasiticus* MTCC 411 grown on potato dextrose agar. The toxin produced on rice was then extracted as described by Romer (1975) and quantified by thin layer chromatography (TLC) as described by A.O.A.C. (1995).

The experimental diets were prepared by the addition of required quantities of rice containing aflatoxin to arrive at the levels of 0 and 0.5ppm of aflatoxin B_1. To each of these diets, Niltox was added at 0, 0.5, 0.75 and 1% levels.

Basal diet was formulated and compounded to meet the nutrient requirements of commercial broilers during the starter (0-3 wks) and finisher (4-5 wks) phases. Chicks were provided *ad libitum* supply of feed and water throughout the study. Feeding of test diets commenced at zero day of age and continued until the termination of the experiment at five weeks of age. Chicks were vaccinated against Newcastle Disease (ND) on the 7^{th} day using F_1 strain (Ventri's Biologicals, Bangalore) and against Infectious Bursal Disease (IBD) on the 14^{th} day using intermediate strain (Ventri's Biologicals, Bangalore). Both vaccines were given via the ocular route.

Data collection

At the end of the trials, body weight, feed consumption and mortality, if any were recorded and weight gain and feed efficiency were calculated. Six birds from each replicate were sacrificed by cutting the jugular vein at the end of the trial. Blood was collected in non-heparinized tubes from six birds in each treatment (3 males and 3 females) by puncturing the brachial vein during the 5th week of age. Serum was separated after 8 to 10 hours as per the standard procedures (Calnek et al., 1992) and was stored at –20 ^{o}C for subsequent analysis. The individual serum samples were analyzed for total protein, serum albumin, uric acid and the activities of gamma glutamyl transferase (GGT) and alanine amino transferase (ALT) using an automatic analyzer (Boehringer Mannhein Hitachi 704 automatic analyzer, Japan). Antibody titers against Newcastle disease (ND) and Infectious Bursal Disease (IBD) were determined using ELISA technique.

Statistical analysis

The experimental data were analyzed using the General Linear Model procedure of the Statistical Analysis System (SAS®) software (SAS Institute, USA, 2000). Overall data were analyzed by repeated measures design. The Duncan multiple range test was used to compare means (Duncan, 1955). The result of this study was subjected to one way ANOVA test.

Results and Discussion

Body weight, feed consumption, feed conversion ratio and mortality data for broilers fed control and different experimental diets at fifth week of age are presented in Table 1. Chicks receiving AF contaminated feed had significantly ($P<0.05$) suppressed body weight, feed consumption and efficiency of feed utilization compared to chicks fed the control diet. Feeding Niltox at 0.75 and 1.00 per cent in the diets containing AF significantly ($P<0.05$) improved body weight and feed consumption when compared to the toxin control group and it remained non significant with the control diet. Efficiency of feed utilization decreased significantly with addition of 0.5 ppm AF, was improved with inclusion of 0.75 and 1.00 per cent Niltox. High mortality rate of 14.20 per cent was observed in the group fed with diet containing 0.5ppm AF. Mortality rate was reduced considerably in the groups supplemented with 0.5, 0.75 and no mortality in 1.00 per cent Niltox fed chicks.

The decreased body weight, feed consumption and increased feed conversion ratio due to AF are consistent with the findings of Swamy and Devegowda (1998), Raju and Devegowda (2000), Arvind et al. (2003), and Girish et al. *(*2004). The growth depression effects of AF may be due to their inhibitory action on protein synthesis and nutrient utilization (Marquardt and Frohlich, 1992). Addition of Niltox at graded levels (0.5, 0.75 and 1per cent) to control diet did not affect body weight and feed consumption in broilers. Feed conversion ratio was significantly ($P<0.05$) superior in birds given either 0.75 or 1 per cent Niltox. The results indicated that the naturally occurring sorbent used in the study is inert and non toxic. Kurnick and Reid (1989) reported similar results. The results suggest a beneficial effect of addition of Niltox in the presence of AF on growth performance.

The effect of Niltox supplementation on the diets containing AF on the antibody titers against ND and IBD, serum protein, serum albumin, uric acid, the activities of GGT and ALT are presented in Table 2. A significant ($P<0.05$) decrease in antibody titer values against ND and IBD vaccine was observed upon

Table 1: Effect of Niltox on fifth week body weight, feed consumption, feed conversion ratio and mortality of broilers fed aflatoxin.

AF (ppm)	Niltox (%)	Body weight (g)	Feed consumption (g/bird)	Feed Conversion Ratio	Mortality (%)
0	0	1313.4±0.88^{a}	2513.1±6.07^{a}	1.91±0.00^{c}	4.70
0.5	0	1180±7.49^{c}	2306±2.92^{b}	2.09±0.005^{a}	14.20
0	0.5	1314±11.11^{a}	2505±10.3^{a}	1.90±0.008^{d}	0
0	0.75	1326±4.91^{a}	2501±8.13^{a}	1.88±0.006^{de}	0
0	1.0	1339±10.07^{a}	2495±14.5^{a}	1.86±0.003^{e}	0
0.5	0.5	1202±8.81^{c}	2305±2.89^{b}	2.05±0.006^{b}	7.10
0.5	0.75	1240±6.35^{b}	2517±14.63^{a}	2.03±0.005^{b}	4.70
0.5	1.0	1274±0.73^{b}	2536±7.77^{a}	1.99±0.005^{a}	0

Means bearing at least one common superscript in a column do not differ significantly (P<0.05)

Table 2: Effect of Niltox on the antibody titers against New Castle Disease (ND) and Infectious Bursal Disease (IBD), serum protein, serum albumin, uric acid, the activities of gamma glutamyl transferase (GGT) and alanine amino transferase (ALT) in broilers fed aflatoxin.

AF (ppm)	Nilto x (%)	ND titer	IBD titer	Serum protein (g%)	Serum Albumin (g%)	Uric acid (µg/dl)	GGT (IU/L)	ALT (IU/L)
0	0	4297.7±17.05^{ab}	4281.0±8.08^{a}	2.72±0.18^{a}	1.28±0.17^{a}	647.9±7.54^{a}	9.53±1.15^{d}	28.17±0.60^{a}
0.5	0	3204±106.3^{e}	3149±69.72^{d}	1.67±0.15^{bc}	1.10±0.18^{a}	600.4±6.73^{a}	17.8±1.72^{ab}	25.83±1.36^{a}
0	0.5	4018±119.2^{bc}	4252±21.79^{a}	2.43±0.23^{abc}	1.23±0.06^{a}	610.6±0.69^{a}	11.65±0.37^{bcd}	25.07±1.47^{a}
0	0.75	4305±93.19^{ab}	4329±25.48^{a}	2.51±0.20^{ab}	1.26±0.07^{a}	629.0±2.02^{a}	11.65±0.14^{bcd}	28.6±1.62^{a}
0	1.0	4418±56.72^{a}	4378±26.74^{a}	2.72±0.15^{a}	1.36±0.06^{a}	653.6±3.01^{a}	10.6±0.96^{cd}	29.67±2.34^{a}
0.5	0.5	3582±30.19^{d}	3352±73.59^{cd}	1.66±0.11^{bc}	1.14±0.17^{a}	614±34.09^{a}	22.57±2.16^{a}	27.73±0.34^{a}
0.5	0.75	3797±10.73^{cd}	3694±73.64^{bc}	1.61±0.15^{c}	1.19±0.17^{a}	610.6±3.00^{a}	17.47±2.25^{ab}	28.67±0.14^{a}
0.5	1.0	4225±78.83^{ab}	4046±182.3^{ab}	2.57±0.22^{a}	1.27±0.37^{a}	636.3±6.98^{a}	13.7±1.01^{bcd}	28.87±0.49^{a}

Means bearing at least one common superscript in a column do not differ significantly (P<0.05).

feeding AF. This depression in titer values is a clear indication of immunodepressing effects of AF on humoral antibody response. These findings agree with the previous reports (Umesh et al., 1990; Devegowda et al., 1994; Swamy and Devegowda, 1998; Ibrahim et al., 2000; Kumar et al., 2002; Gupta et al., 2003). The reduction of antibody titers could be due to inhibition of DNA and protein synthesis by aflatoxin through impaired amino acid transport and mRNA transcription, resulting in lowered level of antibody production (Thaxton et al., 1974).

Addition of graded levels of Niltox alone to control diets did not alter antibody titers against ND and IBD at five weeks of age as compared to control, whereas addition of Niltox to diets containing AF significantly (P<0.05) improved the antibody titers against ND and IBD vaccine when compared to their respective controls. The results demonstrated the protective effects of Niltox at 1.00 per cent inclusion to AF diet in chickens. These findings were comparable to the reports of Daoud (2002).

The serum concentration of total protein which was significantly (P<0.05) decreased by AF, was elevated to normal level with the inclusion of 1.00 per cent Niltox. Compared with the control treatment, serum concentrations of uric acid and albumin were not affected either in AF fed group or Niltox supplemented groups.

The activity of serum GGT significantly (P<0.05) increased in AF fed group. The addition of Niltox to AF containing diet did not show significant reduction in the activity of serum GGT. Compared with the control, activity of serum ALT was not affected either in AF fed group or control, Niltox supplemented groups.

It maybe concluded that Niltox is partially effective in counteracting the adverse effects of aflatoxin in broilers. Among the various levels of Niltox, 1.00 per cent showed the best level against aflatoxicosis in broilers.

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