Efficacy of Toxin Binder in Reducing Induced Aflatoxin B_1 and Ochratoxin A in Broiler Feed

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ABSTRACT. The object of present study was to investigate the efficacy of toxin binder (Bentonite-montmorillonite + Sepiolite; TXB) at different levels of Aflatoxin B_1 (AFB1) and Ochratoxin (OTA) in broilers. Eight iso-caloric/iso-nitrogenous experimental feeds i.e. A: standard feed/ control + zero toxin + zero TXB; B: Feed + zero toxin + TXB @ 1g/kg of feed; C: feed +100 ppb of AFB1+ TXB @ 1g/kg; D: feed + 200 ppb AFB1+ TXB @ 1g/kg; E: feed + 100 ppb of OTA + TXB @ 1g/kg; F: feed + 200 ppb of OTA + TXB @ 1g/kg; G: Feed + 100 ppb of AFB1+ 200 ppb of OTA + TXB @ 1g/kg; H: Feed + 200 ppb of AFB1+ 100 ppb of OTA + TXB @ 1g/kg, were prepared following NRC standards (1994) for commercial broiler. The each experimental feed was randomly assigned to 60 birds with 20 birds per replicate for 42 d. The data on feed intake (g), body weight gain (g), FCR, mortality, toxin binding ability, dressing %, keel and shank length, giblet weight (g), bursa, spleen and thymus weight (g), were recorded. Statistical analysis of data under Completely Randomized Design through One-way ANOVA revealed non-significant differences for feed intake, weight gain and FCR. Significantly higher dressing %, thymus and bursa weight was observed in birds fed 1g/kg TXB followed by 220ppb OTA + 1g/kg TXB and 200ppb AFB1 + 100 ppb OTA + 1g/kg TXB, respectively. It was concluded from the present study that TXB had significant effect in reducing AFB1 and OTA in broilers due to toxins binding and their excretion through excreta. The economic analysis showed 7% increase in profit with addition of TXB.

Keywords: Broiler, Toxin binder, Mycotoxin, Production

INTRODUCTION

Mycotoxins are unavoidable contaminants in feed resources and considered as a major problem of the feed industry all over the world (Wood, 1992). Aflatoxins, deoxynivalenol, ochratoxin A (OTA), fumonisins, zearalenone, patulin, and T-2 toxin are most important mycotoxins that may cause breakdown in vaccinal immunity and occurrence of diseases even in properly vaccinated flocks (Pier, 1992). The ingestion of Aflatoxins increases the severity of infections caused by coccidiosis and salmonellosis in chicken (Kubena *et al*., 2001). Similarly OTA has also been described to increase the susceptibility of chicken to coccidiosis (Stoev *et al.*, 2002), salmonellosis (Fukata *et al.*, 1996) and colibacillosis (Kumar *et al*., 2003). Poultry producers all over the world are in need of latest techniques and methods to assist them in the protection of their flocks against these toxins. It is important to adequately test a potential mycotoxin adsorbent, not only for its in-vitro binding capabilities, but also for its in-vivo ability (Bailey *et al*., 1998). It is claimed that Bentonite-montmorillonite and Sepiolite effectively prevent digestive absorption of feed-borne mycotoxins, ensuring animal health and food safety. The objective of present study was assessing the efficacy of toxin binder composed of Bentonite-montmorillonite and Sepiolite in broilers.

MATERIALS AND METHODS

Research plan was divided into two phases. In phase I Aflatoxin B_1 (AFB1) and OTA was produced in Microbiology laboratory. In phase II deleterious effect of AFB1and OTA and its control using a combination of toxin binder Bentonite-montmorillonite and Sepiolite (TXB) were studied through biological trial. Eight iso-caloric/iso-nitrogenous experimental rations i.e. A: standard feed/control + zero toxin + zero TXB; B: Feed + zero toxin + TXB @ 1g/kg of feed; C: feed +100 ppb of AFB1+ TXB @ 1g/kg; D: feed + 200 ppb AFB1+ TXB @ 1g/kg; E: feed + 100 ppb of OTA + TXB @ 1g/kg; F: feed + 200 ppb of OTA + TXB @ 1g/kg; G: Feed + 100 ppb of AFB1+ 200 ppb of OTA + TXB @ 1g/kg; H: Feed + 200 ppb of AFB1+ 100 ppb of OTA + TXB @ 1g/kg, were prepared following NRC standards for commercial broiler. Each dietary treatment was randomly assigned to 60 birds (3 replicates of 20 birds each) for 42 d experimental period. Data regarding production performance [feed intake (g), body weight gain (g), FCR, mortality)], toxin binding ability (fecal sample), and carcass characteristics (dressing %, keel and shank length, giblet weight, bursa, spleen and thymus weight), were collected. The experimental chicks were kept on littered (rice husk) under standard management conditions with free access to clean and fresh drinking water.

The data obtained were analyzed under Completely Randomized Design through one-way ANOVA technique. The differences among treatment means were worked out using Duncan's (1955) Multiple Range Test. All the analyses were done using SAS 9.1.

RESULTS AND DISCUSSION

Production Performance

The results of present study indicated that in the presence of BS, with increasing levels of AFB1 and OTA in diet, the feed intake, weight gain and FCR, did not decrease significantly (Table 1), which could be attributed that toxin binder worked efficiently and didn't let the AFB1 and OTA to exert detrimental effects on the digestive tract of birds. The addition of toxin binder helped binding the toxins from feed and then their excretion from body. In agreement to current findings, the positive effects of toxin binder have also been reported by previous studies in broilers (Mangoli *et al*., 2011; Kubena *et al.*, 1997).

Carcass Characteristics

Dressing %, thymus and bursa weight significantly increased with the addition of toxin binder (Table 1). The toxin binder inhibited the absorption of toxins in the gut and increased its excretion though feces. Non-significant differences among various control and toxin induced feed fed groups regarding keel and shank length, liver, gizzard, heart and spleen weight also show the overall efficiency of toxin binder and producing comparable results (Table 1). Similar findings have been documented previously (Wang *et al.,* 2006).

Toxin binding Ability (Fecal sample)

In groups where toxin binder was added fecal samples had significantly higher amount of toxins (Table 2), showing overall increased efficiency in binding the toxins.

CONCLUSION

Comparable weight gain and FCR in control group and the groups fed toxins induced feed showed the overall toxin binding efficiency of the product, hence; concluded that toxin binder had significant effect on reducing AFB1 and OTA toxicity in broilers due to decreased absorption in gut and increased excretion through feces.

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Table 1. Effect of different levels of toxin binder and mycotoxins on broiler production performance and carcass characteristics

Treatment	A	B	C	D	E	F	G	H
Feed intake (g)	3722.67 ± 105.96	3563.84 ± 20.23	3588.96 ± 76.56	3641.45 ± 54.05	3618.56 ± 157.20	3668.76 ± 165.26	3703.93 ± 197.65	3694.73 ± 151.48
Weight gain (g)	2102.34 ± 19.78	1987.41 ± 49.71	1916.62 ± 56.42	1906.53 ± 20.22	1979.93 ± 10.95	1974.65 ± 99.28	2045.26 ± 64.36	1960.13 ± 115.24
FCR	1.77±0.03	1.79±0.04	1.87±0.03	1.90±0.01	1.82±0.06	1.85±0.02	1.81±0.07	1.88±0.03
Dressing %	57.40±1.51^{ab}	62.49±1.57^{a}	59.70±2.41^{ab}	58.22±1.40^{ab}	61.46±1.15^{a}	59.76±1.26^{ab}	55.29±0.85^{b}	58.29±2.65^{ab}
Keel length (cm)	14.33±0.33	14.66±0.88	14.66±0.33	15.33±0.33	15.00±0.57	14.33±0.33	15.33±0.33	14.33±0.66
Shank length (cm)	6.90±0.10	6.83±0.16	6.13±0.31	6.90±0.30	6.93±0.06	7.00±0	6.80±0.11	6.80±0.10
Liver weight (g)	50.66±2.18	49.00±3.21	52.00±1.73	54.33±2.18	47.66±2.66	47.66±1.45	51.66±3.28	52.33±2.33
Gizzard weight (g)	44.00±1.00	39.66±0.66	40.33±1.76	43.66±2.96	44.33±0.66	42.33±6.17	40.33±2.02	44.00±2.08
Hear weight (g)	13.33±0.88	13.33±1.66	14.00±0.57	14.33±0.66	13.00±1.15	13.66±0.88	14.00±1.00	14.66±0.33
Bursa weight (g)	2.40±0.30^{ab}	2.50±0.05^{ab}	2.26±0.06^{ab}	2.06±0.08^{b}	2.23±0.12^{ab}	2.10±0.11^{b}	2.33±0.17^{ab}	2.70±0.15a
Thymus weight (g)	5.13±0.14^{bc}	4.63±0.08^{d}	5.20±0.15^{bc}	5.20±0.10^{bc}	5.36±0.08^{ab}	5.60±0.05^{a}	5.13±0.17^{bc}	4.93±0.13^{cd}
Spleen weight (g)	2.36±0.03	2.50±0.05	2.26±0.08	2.40±0.10	2.36±0.03	2.20±0.20	2.53±0.23	2.36±0.03

Means with different superscript were different significantly at P>0.05

Table 2. Effect of different levels of toxin binder and mycotoxins on broiler fecal collection

Parameters / Treatments	Aflatoxin B1 (ppb)	Ochratoxin OTA (ppb)
Control Group (A)	0.0±0.0^{d}	0.0±0.0^{c}
Toxin binder@ 1 g/kg (B)	1.75±0.55^{d}	0.75±0.75^{c}
100ppb AFB1+TXB@ 1 g/kg (C)	36.50±4.70^{c}	0.0±0.0^{c}
200ppb AFB1+ TXB @ 1 g/kg (D)	59.72±6.02^{b}	0.0±0.0^{c}
100ppb OTA+ TXB @ 1 g/kg (E)	0.0±0.0^{d}	47.30±1.90^{b}
200ppb OTA+ TXB @ 1 g/kg (F)	0.0±0.0^{d}	72.00±5.60^{a}
100ppb AFB1+200ppb OTA+ TXB @ 1 g/kg (G)	41.20±7.70^{c}	75.05±4.45^{a}
200ppb AFB1+100ppb OTA+ TXB @ 1 g/kg (H)	75.55±8.15^{a}	40.45±2.65^{b}

Means with different superscript were different significantly at P>0.05