

Biotransformation - A successful way to deactivate T-2 toxin in growing broiler chickens

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Abstract

Aim of the present study was to investigate the efficacy of four commercially available feed additives against the adverse effects of 2 ppm dietary T-2 toxin in broiler chickens. The primary effect of the type A trichothecene T-2 toxin in chickens is an inflammatory response in the mouth that progresses to necrosis and invasion by normal microbial flora. Other adverse effects of T-2 toxin exposure, at levels ranging from 1 to 4 ppm, include decreased feed intake, growth rate and body weight (Diaz et al., 1994). Mycofix[®] Plus was tested against two selected aluminosilicates and a product based on esterified glucomannans. 2 ppm dietary T-2 toxin significantly decreased 28-day's body weight gain and impaired FCR. These adverse effects on performance were completely overcome by the dietary supplementation of 2.0 kg/t Mycofix[®] Plus but none of the other three feed additives were capable of satisfactorily counteracting the adverse effects on performance.

Introduction

Trichothecene mycotoxins are a group of fungal metabolites with a similar chemical structure. Aluminosilicates can effectively adsorb aflatoxins but are not effective against trichothecenes (Kubena et al., 1990, Phillips, 1999). Aravind et al. (2003) suggested that esterified glucomannan is effective in counteracting the toxic effects of mycotoxins, including T-2 toxin. Toxicity of trichothecenes is caused by the presence of a C-12,13 epoxide. Binder et al. (2000) isolated a new species of *Eubacterium* capable of biotransforming this epoxide group which led to non-toxic metabolites. A fermentation and stabilization process was established to formulate this bacterium as a feed additive for the detoxification of trichothecenes. The aim of this study was to investigate the efficacy of four commercially available feed additives, one of them including the *Eubacterium*, against the adverse effects of 2 ppm dietary T-2 toxin in broiler chickens.

Materials and Methods

A total of 180 one-day-old male meat-type broilers of the Ross 308 line were used. The experimental diets were fed for 28 days. Each dietary treatment was replicated 5 times, with 6 chicks per replicate pen from days 1 to 14, and 4 birds per replicate pen from days 15 to 28. The six experimental treatments consisted of the same commercial mash ration added with T-2 toxin and/or a feed additive, as follows.

- Group 1:** negative control, no T-2 toxin, no feed additive
- Group 2:** positive control, 2 ppm T-2 toxin, no feed additive
- Group 3:** 2 ppm T-2 toxin + 2.0 kg/t Mycofix[®] Plus
- Group 4:** 2 ppm T-2 toxin + 2.0 kg/t MOS
- Group 5:** 2 ppm T-2 toxin + 2.5 kg/t Aluminosilicate1
- Group 6:** 2 ppm T-2 toxin + 3.0 kg/t Aluminosilicate2

Variables measured during the experiment included body weight (days 1, 7, 14, 21, and 28), body weight gain (days 7, 14, 21, and 28), feed intake (days 7,14, 21, and 28), feed efficiency (days 7, 14, 21 and 28), and serum activity of selected enzymes used in avian clinical chemistry (Lumeij, 1997; Diaz et al., 1999), namely, aspartate aminotransferase (AST), and lactate dehydrogenase (LDH) (day 24 of age). At the end of the experimental period (day 28 of age), the 20 remaining chickens from each experimental treatment were sacrificed and

examined for gross lesions. The liver, heart, spleen, proventriculus, gizzard, and bursa of Fabricius of each bird were carefully removed and weighed in order to determine the relative organ weights.

Results and Discussion

Table 1: Effect of the dietary supplementation of four feed additives on 28-day performance

Group	Feed additive	T-2 toxin	Weight Gain [g]	Feed Intake [g]	FCR
1	No additive	-	1118.5	1577.8	1.41
2	No additive	2 ppm	1023.7	1641.5	1.61
3	Mycofix [®] Plus (2.0 kg/t)	2 ppm	1110.8	1615.5	1.46
4	MOS (2.0 kg/t)	2 ppm	1018.4	1531.8	1.51
5	Aluminosilicate 1 (2.5 kg/t)	2 ppm	996.7	1615.0	1.64
6	Aluminosilicate 2 (3.0 kg/t)	2 ppm	1018.1	1509.6	1.48

Body weight gain at 28 days was significantly lower in all groups fed 2 ppm T-2 toxin, except for the group receiving 2.0 kg/t Mycofix[®] Plus. Feed intake was not significantly different among any experimental group. FCR was significantly higher in groups fed 2 ppm T-2 alone and combined with 2.5 kg/t Aluminosilicate 1. No significant differences in the FCR were observed between the control group and the groups receiving T-2 toxin combined with Mycofix[®] Plus, MOS or Aluminosilicate 2; however, FCR of groups 4 to 6 was higher (103.5, 107.1 and 105.0%) than that of the control group (100%).

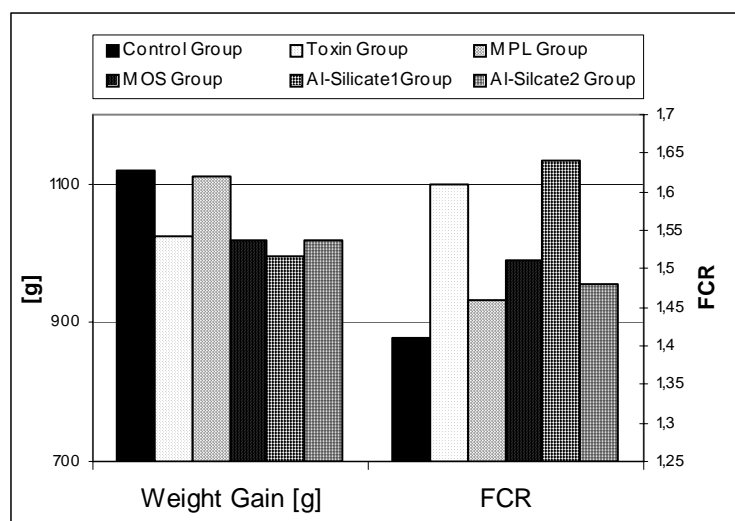


Figure 1: Effect of the dietary supplementation of four feed additives on 28-day performance

No significant differences in the relative weights of liver, spleen, heart, proventriculus or bursa of Fabricius were observed among the six experimental groups. However, groups 4 to 6 had significantly higher relative gizzard weights than the control group (table 2).

Table 2: Effect of the dietary supplementation of four feed additives on the relative weights of liver, spleen, heart, proventriculus, gizzard and bursa of Fabricius

Group	Relative Weight (% body weight)					
	Liver	Spleen	Heart	Proventriculus	Gizzard	Bursa
1	2.09	0.089	0.62	0.47	1.28	0.37
2	2.19	0.096	0.64	0.50	1.39	0.34
3	2.10	0.101	0.60	0.47	1.32	0.29
4	2.29	0.092	0.64	0.44	1.50	0.32
5	2.09	0.089	0.64	0.50	1.53	0.31
6	2.05	0.086	0.60	0.47	1.51	0.31

The serum enzyme activities of AST and LDH at 24 days of age are summarized in table 3. No significant differences were found for LDH activity; however, the serum AST activity of

the chickens fed 2 ppm T-2 toxin plus 3.0 kg/t Aluminosilicate 2 was significantly lower than that of the control group.

Table 3: Effect of the dietary supplementation of four feed additives on enzyme activities of alanine aminotransferase (AST) and lactate dehydrogenase (LDH)

Group	Feed additive	Enzyme activity at age of 24 days			
		AST	[%] of control	LDH	[%] of control
1	No additive	59.6	100	799.8	100
2	No additive	57.5	96.5	746.2	93.3
3	Mycofix [®] Plus (2.0 kg/t)	56.3	94.5	933.0	116.7
4	MOS (2.0 kg/t)	60.1	100.8	598.4	74.8
5	Aluminosilicate 1 (2.5 kg/t)	61.0	102.3	907.1	113.4
6	Aluminosilicate 2 (3.0 kg/t)	50.9	85.4	660.2	82.5

In the present experiment, the dietary supplementation of MOS and Aluminosilicates significantly increased relative gizzard weight compared with control birds; this effect was not observed in birds fed T-2 toxin alone or combined with Mycofix[®] Plus. Furthermore, supplementation of Aluminosilicate 2 significantly decreased the enzymatic activity of AST. The findings suggest that some of the dietary supplements are not only incapable of counteracting the adverse effect of T-2 toxin but also caused other adverse effects on chickens. This issue demands further research since it could have important economic implications for the poultry industry.

Conclusion

It can be concluded that out of four tested commercial products only Mycofix[®] Plus was capable of counteracting the adverse effects on performance caused by the dietary administration of 2 ppm T-2 toxin. This feed additive did not cause any alteration in the relative organ weights measured or the serum enzymes analyzed. This study confirms previous reports showing that aluminosilicates are not effective against trichothecenes and also indicates that esterified glucomannans are not effective either.

References

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