

EVALUATION OF THE EFFICACY OF MYCO-AD IN PREVENTING FUMONISIN TOXICITY IN BROILER CHICKS

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INTRODUCTION

Natural contamination of grains by *Fusarium* mycotoxins is a global phenomenon. The World Health Organization working group found that globally 59% of corn and corn product samples were contaminated with Fumonisin B₁ (FB₁), the major secondary metabolite of *Fusarium moniliforme* (1).

High levels of FB₁ in broiler chicks produced acute toxic effects, including poor performance, increased liver and kidney weights, and multifocal hepatic necrosis; suggesting that diets containing 75 ppm of FB₁ may be toxic to young broiler chicks. (2,3) Wu *et al* also demonstrated that dietary inclusion of 50 and 110 ppm FB₁ caused reduction in body weight, poor feed efficiency and increase in liver weight. (4)

At present, the most practical approach to ameliorate the deleterious effects of mycotoxins in animals consist on using adsorbent materials in the diet to reduce the absorption of mycotoxins from the gastrointestinal tract. The dietary use of 0.25% Myco-Ad has been proven to effectively prevent the toxic effects of aflatoxin (5), ochratoxin (5), and T-2 toxin (6) in broilers. Therefore, studies were conducted to evaluate the fumonisin (FUM) adsorption capacity of Myco-Ad and its efficacy in preventing the deleterious effects of high levels of FUM in broiler chicks; as part of the regulatory anti-mycotoxin additives (AMA) approval process in Brazil.

MATERIALS AND METHODS

This experiment was conducted at the Poultry Unit of the Department of Zootecnia of the Universidade Federal de Santa Maria, RS, Brazil under the toxicological coordination of LAMIC (Laboratório de Análises Micotoxicológicas). Feed was experimentally contaminated with FUM obtained from a culture of *Fusarium moniliforme* containing 94.4% Fumonisin B₁ and 5.6% Fumonisin B₂ produced in LAMIC. The AMA used was a commercial smectite, Myco-Ad, produced in Texas (Special Nutrients, Miami, FL, USA).

For the *in vitro* adsorption capacity, triplicates artificial gastric (pH 3) juice with FB1 concentration of 2.5 µg/ml and Myco-Ad additions of 0.055, 0.120, 0.185, and 0.25 % were used. HPLC with pre-column derivatization (ASPEC XL4) and attached with Agilent ChemStation System for data analysis.

A total of 600 day-old Cobb male chicks were placed in battery cages randomly distributed into 5 treatments with 12 replications each and reared for 21 days under uniform management conditions, with feed and water provided *ad libitum*. Birds were fed a mash corn-soybean meal based diet containing or exceeding NRC recommendations (7) All ingredients used were tested free of mycotoxins contamination. Treatments were: 1 basal diet; 2 basal + 0.5% Myco-Ad; 3 basal + 100 ppm FUM; 4 basal + 100 ppm FUM + 0.25% Myco-Ad and 5 basal + 100 ppm FUM + 0.5% Myco-Ad.

Chickens were weighed individually, total feed consumption recorded by replicate group, relative liver weight, total plasma proteins, and sphingolipids measured at the end of the experiment.

Data were evaluated with ANOVA for a complete randomized design, using Statgraphics Centurion XV 15.1 software. When the ANOVA showed significance, Bonferroni test was used for mean comparison. Statistical significance was accepted at $P \leq 0.05$.

RESULTS

Myco-Ad *in vitro* adsorption capacity of 2.5 ppm FUM was 74.6% at pH 3. The effects of dietary treatments on chick performance at 21 days of age are presented in Figures 1, 2, 3, 4, 5 and 6. Consumption of FUM contaminated feed resulted in significant reduction in feed intake (4.5%), body weight (9.1%), poorer feed efficiency (5.6%), and altered sphinganine:sphingosine ratio (31.4%). Supplementation of 0.25% or 0.5% Myco-Ad to the diet contaminated with 100 ppm FUM significantly improved feed intake (2%), body weight (4.6%), feed efficiency (3.0%), and sphinganine:sphingosine ratio (54.3%) Relative liver size and total plasma proteins were not significantly affected by the treatments. None of the parameters measured were significantly influenced by the high inclusion of the adsorbent in the absence of added FUM.

DISCUSSION

The addition of 2.5 kg of Myco-Ad per metric ton of feed significantly diminished the adverse effects of FUM in broiler chicks. This is the first report showing the *in vivo* effectiveness of an adsorbent against FUM. The use of 0.3% of a sodium bentonite was not effective in reducing the toxicity of 200 ppm of FB1 (8). The protective action of Myco-Ad appears to involve sequestration of T-2, similar to aflatoxin, as suggested by Phillips *et al.* (9)

CONCLUSIONS

1. Myco-Ad at 2.5 kg per metric ton of feed was effective in reducing the toxic effects caused by high levels of FUM in broiler chicks; and therefore met the requirements for AMA registration in Brazil.
2. The addition of 5 kg of Myco-Ad per metric ton of feed did not show any statistical difference in overall performance compared to the control diet, demonstrating its lack of interference with nutrients absorption.

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ABSTRACT

The dietary use of 0.25% Myco-Ad has been proven to effectively prevent the toxic effects of aflatoxin, ochratoxin and T-2 toxin in broilers. Studies were conducted to evaluate the fumonisin (FUM) adsorption capacity of Myco-Ad and its efficacy in preventing the deleterious effects of high levels of FUM in broiler chicks; as part of the regulatory anti-mycotoxin additives (AMA) approval process in Brazil. Six hundred day-old Cobb male chicks were placed in battery cages randomly distributed into 5 treatments with 12 replications each and fed a basal corn-soy diet containing or exceeding NRC recommendations. All ingredients used were tested free of mycotoxins contamination. Treatments were: 1 basal diet; 2 basal + 0.5% Myco-Ad; 3 basal + 100 ppm FUM; 4 basal + 100 ppm FUM + 0.25% Myco-Ad and 5 basal + 100 ppm FUM + 0.5% Myco-Ad. FUM was obtained from a culture of *Fusarium moniliforme* containing 94.4% Fumonisin B₁ and 5.6% Fumonisin B₂ produced in LAMIC. Myco-Ad adsorption capacity of 2.5 ppm FUM was 74.6% at pH3. Results at 21 days of age indicated that broiler fed 100 ppm FUM contaminated diet presented significant lower feed intake (4.5%), smaller body weight (9.1%), poorer feed conversion (5.6%) and altered sphinganine:sphingosine ratio in blood (31.4%) than chicks fed the control diet. The addition of either 0.25 or 0.5% Myco-Ad significantly improved the feed intake (2%), body weight (4.6%) and sphinganine:sphingosine ratio in blood (54.3%) observed in chicks fed the FUM contaminated diet. Liver size and plasma proteins were not significantly affected by the treatments. The addition of 0.5% Myco-Ad to the chick diet did not show any statistical difference in the parameters measured compared to the control diet, demonstrating its lack of interference with the absorption of nutrients. These results indicated that 0.25% Myco-Ad was effective in reducing the toxic effects of FUM in broiler chicks; and therefore met the requirements for AMA registration in Brazil.

Table 1. Effects of different levels of Myco-Ad on performance, liver weight, and blood parameters of broilers exposed to FUM at 21 days of age.

TREATMENT	Body weight g	Feed intake g	Adjusted FCR	Relative liver weight %	Total plasma proteins g/dl	SA:SO
Control	717 a	1145 a	1.60 a	3.15 a	2.95 a	0.51 a
5 kg Myco-Ad	694 ab	1129 ab	1.63 a	3.15 a	3.07 a	0.58 a
100 ppm FUM	651 c	1093 c	1.69 b	3.30 a	2.67 a	0.35 b
100 ppm FUM + 2.5 kg Myco-Ad	679 b	1115 b	1.64 a	3.21 a	2.74 a	0.54 a
100 ppm FUM + 5.0 kg Myco-Ad	681 b	1117 b	1.64 a	3.28 a	2.74 a	0.53 a

a, b, c Means within columns with no common superscripts differ significantly ($P \leq 0.05$)

Figure 1. Effect of different levels of Myco-Ad on body weight of broilers exposed to FUM at 21 days of age.

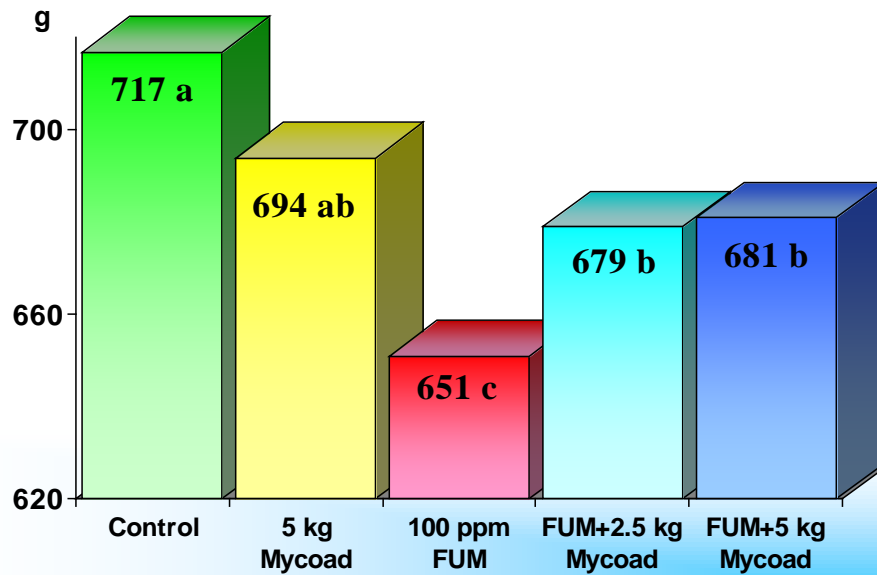


Figure 2. Effect of different levels of Myco-Ad on feed intake of broilers exposed to FUM at 21 days of age.

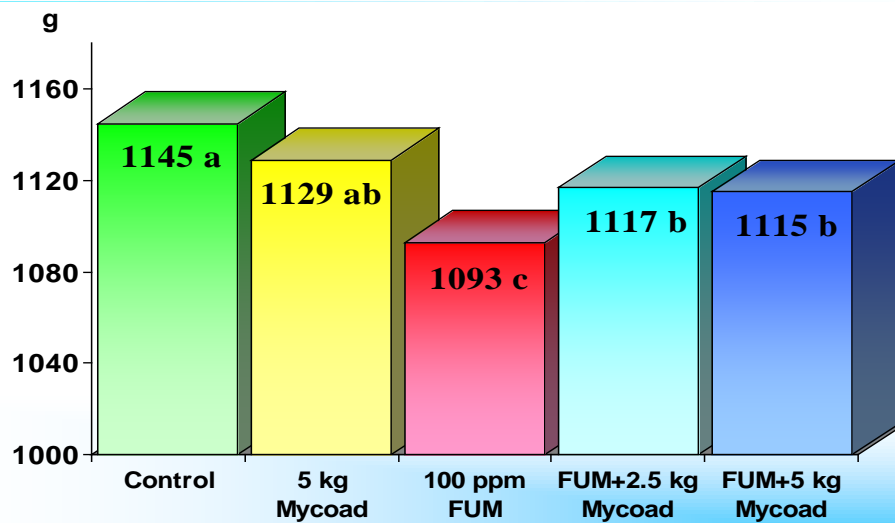


Figure 3. Effect of different levels of Myco-Ad on adjusted feed conversion of broilers exposed to FUM at 21 days of age.

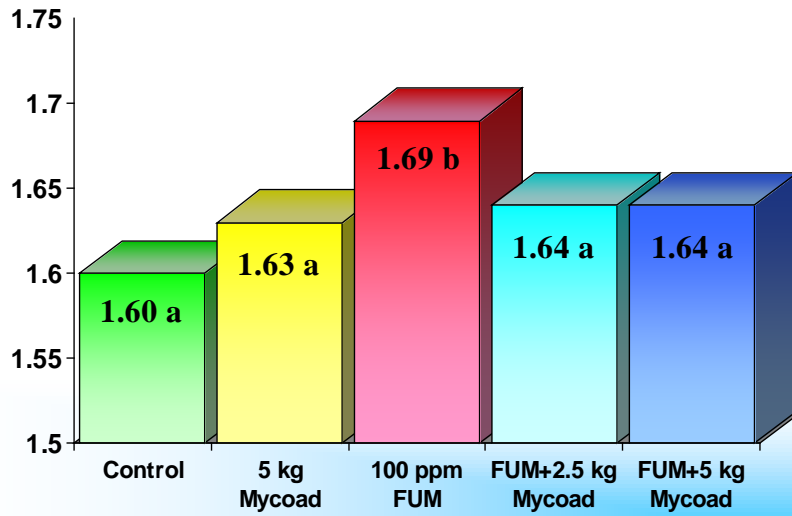


Figura 4. Effect of different levels of Myco-Ad on the SA:SO ratio of broilers exposed to FUM at 21 days of age.

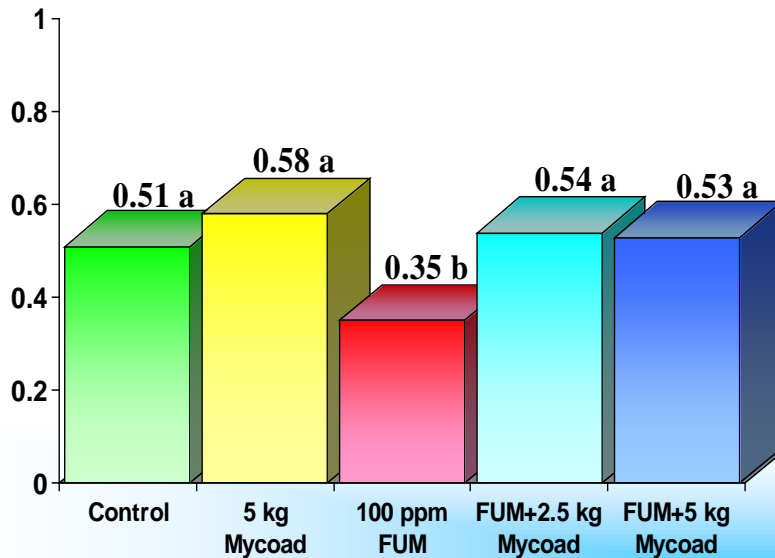


Figure 5. Effect of different levels of Myco-Ad on the relative liver weight of broilers exposed to FUM at 21 days of age.

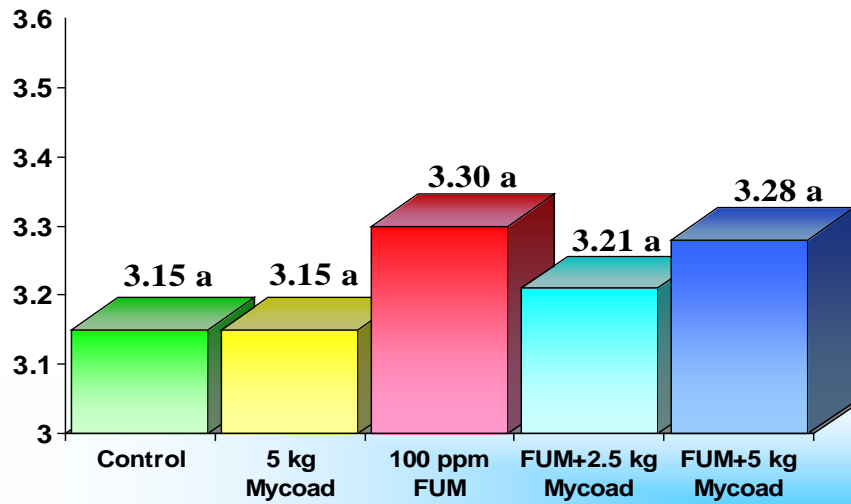


Figure 6. Effect of different levels of Myco-Ad on total plasmatic proteins of broilers exposed to FUM at 21 days of age.

