EFFICACY OF A COMMERCIAL PURIFIED PHYLOSILICATE IN PREVENTING FUMONISIN TOXICITY IN FINISHING PIGS.

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INTRODUCTION

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

Mycotoxin-induced pulmonary edema was first documented in swine in 1981 after they were exposed experimentally to corn contaminated by *F. verticillioides* (2). Fumonisin (FUM) toxicosis in swine was named Porcine Pulmonary Edema (PPE) after outbreaks of a fatal disease in pigs fed *F. verticillioides* (*F. moniliforme*) contaminated screenings from the 1989 corn crop in Iowa, Illinois and Georgia. Pigs that died had severe pulmonary edema, which has not been identified in other species after exposure to FUM. Pulmonary edema has been experimentally reproduced by swine exposure to fumonisin containing material and to purified FB1 given orally or intravenously (3,4,5). In pigs, as in other species, fumonisin alters sphingolipids biosynthesis, with the greatest alterations in sphingosine (SO) and sphinganine (SA) concentrations in kidney, liver, lung, and heart. Blood SA: SO ratio is an indicator of FUM toxicosis.

Similar to other mycotoxins, FUM are immunosuppressive even at low doses. Thus, mycotoxin contamination can result in a compromised health status of the swine herd. Associations between fumonisin contamination and infectious disease in swine have been reported (6,7), indicating the possibility of affected performance parameters caused by FUM. A practical approach to prevent mycotoxicosis consists of using adsorbent materials in the feed that reduce the absorption of mycotoxins from the gastrointestinal tract.

OBJECTIVE

The objective of this study was to determine the efficacy of a low inclusion modified phylosilicate, Myco-Ad A-Z, to ameliorate the deleterious effects of fumonisin contamination in finishing pigs.

MATERIALS AND METHODS

The experiments were conducted at the Swine Unit of the Department of Zootecnia of the Universidade Federal de Santa Maria, RS, Brasil under the toxicological coordination of LAMIC (Laboratorio of Anaslises Micotoxixologicas). Two experiments (Exp 1 and Exp 2) of different length of time (28 and 56 days) were conducted. Twelve male pigs averaging 58.5 kg initial body weight were used in each experiment. Pigs were individually housed with feed and water provided *ad libitum*. Diets were corn-soy based, containing or exceeding NRC recommendations (8). All ingredients used were tested free of mycotoxins (aflatoxin, zearalenone, deoxinivalenol, fumonisin (FUM), ochratoxin A, T2 and diacetoxiscirpenol).

During a pre-experimental adaptation period of 7 days, animals were fed a mycotoxin-free basal corn-soy diet to ameliorate any effect of previous mycotoxin contamination that could interfere with the results of the experiment.

Pigs were randomly distributed into 3 dietary treatments with 4 replications each. Treatments were as follows: 1) control diet; 2) control + 25ppm of FUM; 3) control + 25ppm of FUM + 4.0 kg/mt Myco-Ad A-Z. FUM was obtained from a culture material containing 72% FB1 and 38% FB2 produced in LAMIC. Myco-Ad A-Z is a commercial modified phylosilicate, produced in Texas (Special Nutrients, Miami, FL, USA).

Performance data was recorded every 7 days for 28 and 56 days; relative organ weight (lungs, liver, and heart in Exp1 and lungs in Exp 2) and blood serum (Plasma proteins and SA:SO ratio in Exp 2) were recorded at the end of each experiment. Serum analyses were performed using Bioplus BIO200 equipment.

Data were evaluated with ANOVA for a complete randomized design, using the general linear models procedure of SAS software; SAS Institute (9). When the ANOVA showed significance, Tukey's significant-difference test was applied. Statistical significance was accepted at $P \leq 0.05$.

RESULTS AND DISCUSSION

The control diet resulted negative for all mycotoxins tested.

Performance results from both experiments (Table 1 and 2) showed that pigs fed 25 ppm FUM for 28 or 56 days had significantly lower daily gain, daily feed intake, and poorer feed efficiency than pigs fed the control diet. The addition of Myco-Ad A-Z to the contaminated diet significantly improved performance at the two different ages. In Exp 1, average daily gain was reduced 27% and daily feed intake 8% by the FUM contaminated diet. The use of Myco-Ad A-Z could recover 16% the daily gain and 11% the feed intake. (Table 1) In Exp 2, however, gain was only depressed 7% and feed intake 6% with the contaminated diet; but the use of Myco-Ad A-Z fully recovered gain and feed intake. (Table 2) It appears that finishing pigs can develop or activate through time some mechanism(s) to reduce the intoxication of FUM, especially after four weeks of FUM exposure.

The typical effect of FUM toxicity: pulmonary edema, enlargement of lungs, discoloration and enlargement of liver and enlargement of heart were evident in pigs consuming 25 ppm FUM for 28 days. Myco-Ad A-Z was capable of significantly preventing all symptoms of FUM toxicity in the target organs. (Table 3 and Figure 1) Pigs fed the FUM contaminated diet for 56 days also presented heavier relative lungs weight and altered total plasma proteins and SA:SO ratio than pigs fed non-contaminated diet. The addition of Myco-Ad A-Z to the FUM contaminated diet prevented the enlargement of the lungs and the alteration of the blood serum parameters. (Table 4) All these results are consistent with the literature since pulmonary edema in swine appears to result from acute left-sided heart failure and hepatic toxicity mediated by altered sphingolipids biosynthesis (10)

CONCLUSIONS

The deleterious effects of FUM were shown on performance, relative organs weight, and blood serum parameters of finishing pigs. The increased organs weight and the altered SA:SO ratio are a possible cause for the affected performance.

The addition of Myco-Ad A-Z was very effective in preventing all the toxic effects of FUM in finishing pigs.

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ABSTRACT

Two experiments of different length of time (28 and 56 days) were conducted to study the efficacy of a commercial purified phylosilicate (Myco-Ad A-Z) in preventing the deleterious effects of fumonisin (FUM) in finishing pigs. Twelve male pigs averaging 58.5 kg initial body weight were used in each experiment. Pigs were individually housed and randomly distributed into 3 dietary treatments with 4 replications and fed a corn-soy diet containing or exceeding NRC recommendations. All ingredients were tested free of mycotoxins contamination. Treatments were: (1) control diet; (2) control + 25 ppm FUM; and (3) control + 25 ppm FUM + 4.0 kg/mt Myco-Ad A-Z. FUM was obtained from a culture material containing 72% FUM B1 and 38% FUM B2 produced in LAMIC. Performance and organs (lungs, heart, and liver) relative weights (g/kg body weight) were evaluated in experiment 1 (EX1). Performance, lungs relative weight and serum sphinganine / sphingosine ration (SA:SO) were determined in experiment 2 (EX2). Results from both experiments showed that pigs fed 25 ppm of FUM had significantly poorer performance; increased lungs, heart and liver relative weights; and increased SA:SO than pigs fed the control diet. The addition of Myco-Ad A-Z to the contaminated diet significantly improved performance parameters and relative organ weight: feed intake (2615 vs 2315 EX1) (2948 vs 2810 EX2), daily gain (861 vs 722 EX1) (1084 vs 996 EX2), feed efficiency (2.70 vs 3.08 EX1) (3.21 vs 3.46 EX2), lungs (6.68 vs 9.39 EX1) (5.94 vs 6.34 EX2), heart (3.75 vs 4.87 EX1), and liver (18.65 vs 20.89 EX1). Serum SA:SO, a key marker of FUM toxicity, was significantly increased in pigs fed FUM compared to control and Myco-Ad A-Z fed pigs (0.78 vs 0.38 and 0.49). These results indicate that Myco-Ad A-Z was very effective in preventing the toxic effects of FUM in finishing pigs.

Key Words: Myco-Ad A-Z, fumonisin, mycotoxins, pigs

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Table 1. Effect of Myco-Ad A-Z on performance of finishing pigs fed the test diets for 28 days.

TREATMENT	AVERAGE DAILY GAIN g	DAILY FEED INTAKE g	FEED CONVERSION RATIO
Control	985 a	2505 ab	2.56 a
25 ppm Fumonisina	722 b	2315 b	3.08 b
25 ppm Fumonisina + 4 kg/mt MYCO-AD AZ	861 ab	2615 a	2.70 a

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

Table 2. Effect of Myco-Ad A-Z on performance of finishing pigs fed the test diets for 56 days.

TREATMENT	AVERAGE DAILY GAIN g	DAILY FEED INTAKE g	FEED CONVERSION RATIO
Control	1076 a	2979 a	3.23 a
25 ppm Fumonisina	996 b	2810 b	3.46 b
25 ppm Fumonisina + 4 kg/mt MYCO-AD AZ	1084 a	2948 a	3.21 a

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

Table 3. Effect of Myco-Ad A-Z on relative organ weight of finishing pigs fed the test diets for 28 days.

TREATMENT	RELATIVE ORGAN WEIGHT		
	Lungs g/1000 g BW	Liver g/1000 g BW	Heart g/1000 g BW
Control	6.17 a	18.36 a	3.75 a
25 ppm Fumonisina	9.69 b	20.89 b	4.87 b
25 ppm Fumonisina + 4 kg/mt MYCO-AD AZ	6.68 a	18.65 a	3.75 a

a, b Means within columns with no common superscripts differ significantly (P≤ 0.05)

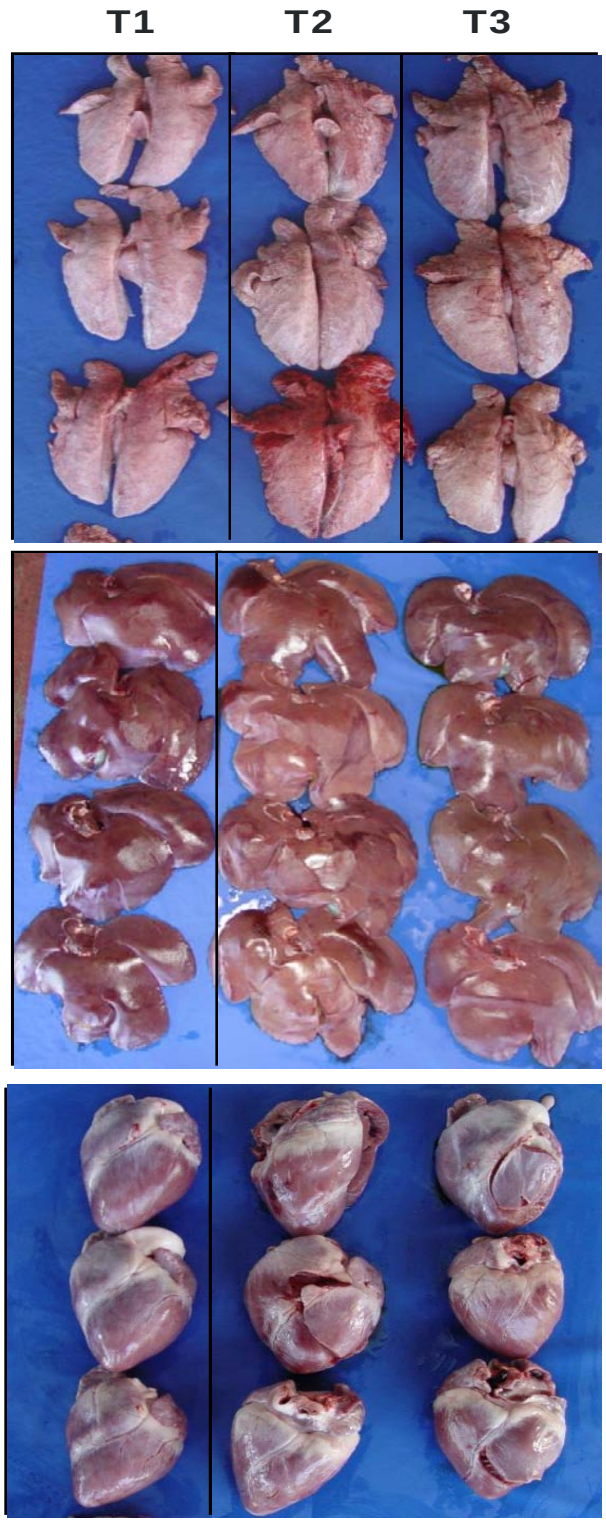
Table 4. Effect of Myco-Ad A-Z on lungs relative weight, total plasma proteins, and serum ratio of Sphinganine:Sphingosine of finishing pigs fed the test diets for 56 days.

TREATMENT	Lungs g/1000 g BW	Total plasma proteins g/dL	Serum Ratio SA : SO
Control	5.84 a	8.82 a	0.38 a
25 ppm Fumonisina	6.34 b	7.67 b	0.78 b
25 ppm Fumonisina + 4 kg/mt MYCO-AD AZ	5.94 a	8.63 a	0.49 a

a, b Means within columns with no common superscripts differ significantly (P≤ 0.05)

Figure 1. Representative organs of finishing pigs fed the test diets for 28 days

T 1 = Control diet T 2 = 25 ppm FUM T 3 = 25 ppm FUM + Myco-Ad A-Z


T1
T2
T3