# Use of a glucomannan polymer to reduce the effects of mycotoxin-contaminated diets in finishing pigs

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**ABSTRACT:** The use of feed additives with mycotoxin adsorption capacity is a common strategy for controlling negative effects of mycotoxins in swine production systems. However, adsorbents that may results very effective under experimental conditions, i.e. when feed contamination level is rather high, do not necessarily retain their efficacy when tested under field conditions feed with generally low mycotoxin contamination. In this study, the effects of diets artificially contaminated with aflatoxin B1 or ochratoxin A on fattening performance and serum chemistry of fattening pigs are investigated. Moreover, the ability of a commercial glucomannan polymer (Gm polimer) to reduce or eliminate the effects of the contaminated feeds is tested. Thirty heavy pigs (BW = 110±10.6 kg) were fed 6 diets (n = 5 pigs/diet) for 4 weeks until slaughtering. Diets were: control without toxin added (C); added with 0.02 ppm of aflatoxin B1 (AFB1); added with 0.05 ppm of ochratoxin A (OTA); other three diets as the previous but the addition of 2.0 g/kg of Gm polymer (C-GM, AFB1-GM, OTA-GM). Daily weight gain (ADG) and Feed efficiency ratio (FE) were measured every two weeks. Data were analyzed with a two-way ANOVA that included the fixed effect of diet, time and their interaction. After the first 2 weeks the ADG did not differ significantly between the diets, even if the ADG of AFB1 diet was about 20% lower than AFB1-Gm or C. In the last 2 weeks the ADG of AFB1 diet was significantly lover than the other diets ($P<0.01$) and was about one-half of the values reported for the same group in the first period. The contamination with ochratoxin A did not affect fattening performance of pigs during the whole experimental period. No damages were found in kidneys of all diets. Moreover, no evidence of association between observed liver damages and different diets was found. Finally, no differences between experimental diets were evidenced for the haematological parameters.

**Key words:** Pig, Aflatoxin b1, Ochratoxin a, Glucomannan polymer.

**INTRODUCTION** –The contamination by mycotoxin represents a crucial point in the definition of feed quality and, consequently, of the profitability of pig farming. Several studies have shown that diet contaminated by aflatoxin B1 and or ochratoxin A at relatively low levels result in reduced feed intake, growth performances (Malagutti *et al*., 2005) and immune function (Marin *et al*., 2002). Physical, chemical, and biological detoxification methods of feed are used to prevent exposure to the toxic effect of mycotoxins. The feedstuff industry often uses sequestering agents to bind, at least partially, mycotoxins in the digestive tract and therefore to reduce their absorption. Polymeric glucomannan mycotoxin adsorbents, derived from the yeast cell wall (GM polymer), has been recently proposed as a feed additives able to reduce damages caused by mycoxin feed contamination. Diaz-Llano and Smith (2006) reported that a supplementation (2 g/kg) of GM polimer to feeds naturally contaminated by *Fusarium* mycotoxins (i.e. deoxynivalenol, 15-acetyl deoxynivalenol and zearalenone) could to prevent the toxic effects on pregnant gilts. However, there is no experimental evidence on the effect of GM polymer diet supplementation in pigs at relatively low contamination levels of aflatoxin B1 or ochratoxin A, i.e. those that are commonly found under field conditions. The European Union aims to harmonise legislation between the countries, so maximum thresholds for aflatoxins and ochratoxin A for pig feeds have been fixed: 0.02 ppm for aflatoxin B1 (Commission Directive

2003/100/EC) and 0.05 ppm for ochratoxin A (Commission Recommendation 2006/576/EC), respectively. In this work, the effects of GM polymer added to diets artificially contaminated by aflatoxin B1 and ochratoxin A at maximum content fixed by EU on performances of finishing pigs are evaluated.

**MATERIAL AND METHODS** – The experiment was carried out on a commercial pig farm in Sardinia. Thirty Large White × Landrance pigs (mean live weight of 110±10.6 kg) were randomly assigned to three diets: control diet, that consists of 12.5 kg/d of a commercial feed administered per group (diet **C**); diet with 0.02 ppm aflatoxin B1 added (AFB1); diet with 0.05 ppm ochratoxin A added (OTA); the last three diets were the same as the previous except for the addition of 2.0g of GM polymer (Mycosorb®, Alltech Inc.) per kilogram of feed. Water was provided during the trial by nipple waters. Pigs were weighed at the beginning of the trial ,at the end of the 2nd week (period 1) and at the end of the of the trial (period 2). Individual average daily weight gain (ADG) was calculated per each experimental period. Blood samples were collected at the end of the 2nd week. After 4 weeks, 18 pigs (three for each group) were slaughtered. Blood samples were collected during slaughtering. Tissue samples of kidney and liver were taken to evaluate the presence of histopathological lesions. Samples were fixed in 10% buffered neutral formalin and then embedded in paraffin wax, sectioned at 4 - 6 µ and finally stained with haematoxylin and eosin for further histological exams. Serum concentrations of urea, total protein, albumin, total bilirubin, creatinine, and serum activities of: alkaline phosphatase (ALP), gamma-glutamyltransferase (GGT), glutamic oxaloacetic acid transaminase (GOT); and glutamic pyruvic acid transaminase (GPT) were determined by using a clinical chemistry system autoanalyzer (Dimension RXL, Dade Behring). Effects of the mycotoxin contamination and of the detoxification action of the GM polymer on ADG and serum parameters were analysed separately in each experimental period with the following linear model :

$$Y_{ijk} = \mu + \text{contamination}_i + GM_j + (\text{contamination} \times GM)_{ij} + \varepsilon_{ijk}$$

**RESULTS AND CONCLUSIONS** – Type of micotoxin contamination and presence of the sequestering agent did not affect ADG in the first experimental period, although a tendency of the animal fed the diet contaminated by AFB1 to have ADG lower than the other two groups can be observed (Table 1). A significant effect of the type of mycotoxin in the second experimental period: in particular, the presence of AFB1 in the diet results in a significant ($P$<0.001) reduction of ADG about 40% in comparison with the control and in the OTA contaminated diets. These results are consistent with Harvey *et al*. (1989) that reported a depressive effect on body weight gain in growing pigs fed diet with 2.0 mg of aflatoxins/kg of feed for 28 days. The absence of a significant effect of the OTA contamination could be related to the length of the experimental period: Malagutti *et al*. (2005), in pigs which diets were contaminated by 0.025 ppm of OTA for about 4 months, did not observed differences after 2 months, while a significant reduction of growth parameters was observed after the last 2 months. The use of the GM polymer did not affect the ADG, even though a tendency in the second period in diets treated with GM to show an higher ADG ($P$=0.09) can be observed.

Table 1. Performance of pigs fed control or contaminated diets by AFB1 or OTA with or without the supplementation with GM polimer (GM) after the first 2 weeks (week1-2) and the last 2 weeks (week3-4) of treatment.

| | Basal diets | | | Basal diets + GM polimer | | | SEM |
|---|---|---|---|---|---|---|---|
| ADG[1] (kg/d) | C | AFB1 | OTA | C-GM | AFB1-GM | OTA-GM | |
| Period 1 | 662,9$^{Aa}$ | 524,4$^{Aab}$ | 710.0$^{Aa}$ | 668.6$^{Aa}$ | 644.3$^{Aa}$ | 730.0$^{Aa}$ | 122.2 |
| Period 2 | 701.4$^{Aa}$ | 251.4$^{Bb}$ | 678.6$^{Aa}$ | 674.3$^{Aa}$ | 591.4$^{Aa}$ | 600.0$^{Aa}$ | 122.2 |
| FE[2] (kg ADG/kg feed) | | | | | | | |
| Period 1 | 0.265 | 0.210 | 0.284 | 0.267 | 0.258 | 0.292 | |
| Period 2 | 0.280 | 0.101 | 0.271 | 0.270 | 0.237 | 0.240 | |

*[1]:Data computed from each animal; [2]:Data computed from each experimental group.*
*Means followed by different letters differ significantly $^{A,B}$: P<0.01; $^{a,b}$: P<0.03.*

Least squares means of the interaction term (table 2) show that the reduction in the ADG caused by the AFB1contamination can be partly avoided by using the GM. No effects of the contamination and on the use of the GM polymer were observed on the haematological parameters considered in this study. These results did not agree with those reported by Harvey *et al*. (1989) that found several alterations in serum of pigs fed aflatoxins and ochratoxin A contaminated diets. The lack of effect of diets on metabolic parameters could be hidden by the overall altered metabolic status of pigs observed for all experimental groups.

During the experiment, no signs of clinical suffering nor abnormal behaviour were observed in animals. No lesions were macroscopically evident in kidneys and in livers. Microscopic examination demonstrated the presence of focal fatty changes, rare multifocal necrosis as well as cholangiolar proliferations with fibrosis in the liver of several animals. However, the damage was in all cases moderate and no differences were found when animals belonging to the different group were compared with the controls. The kidneys did not displayed damages. There is no evidence of association between liver damage and different alimentary treatment of the pigs.

The use of a complete feedstuffs for pigs with a content of AFB1 near the maximum level indicated by the EC Commission could negatively affect the performances of finishing pigs, whereas no effects were detected for the OTA contamination.. As reported for other species, the addition of GM polymer in the di*et al*low for the reduction of the negative effect of AFB1 on growth performances of pigs, even if the positive effect would be tested during a more long exposition time.

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