

Mycotoxin adsorption capability of PowerGuard, a porous ceramic particle, with Aflatoxin B₁, Fumonisin B₁, Ochratoxin A, and Zearalenone.

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Purpose

Experiment 1 was conducted to screen the adsorption capability of two MB Nutritional Science ceramic sources against the mycotoxins Aflatoxin B₁ and Zearalenone. Further, we compared the adsorption capability against 4 commercial feed supplements with purported mycotoxin adsorptive capacity. We used Aflatoxin B₁ and Zearalenone as candidate mycotoxins because of their different chemistries and can be broadly classified as hydrophilic and hydrophobic, respectively.

Experiment 2 was conducted using the optimized ceramic from Experiment 1. The ceramic is commercially known as PowerGuard. The experiment also analyzed a wider spectrum of mycotoxins at more sub-optimal conditions (lower adsorbent:toxin ratios). Further, we compared to a wider range of commercial mycotoxin mitigation products commonly available within the US.

Methods

Experiment 1

- a. The mineral clay/ceramics:mycotoxin ratios were 100,000:1; 50,000:1; and 25,000 to 1.
- b. These ratios reflect the suggested feed inclusion recommendations and observed mycotoxin concentrations in the feed of livestock
- c. The binding environment for both the mineral clays/ceramics and yeast extracts were the same, which was performed in a phosphate buffered saline with pH=7.2 under constant agitation at 150 rpm and a temperature of 37°C. This pH was chosen because it is suboptimal for adsorption of most mycotoxins and is physiological in the intestines of livestock species. All incubations were conducted for 4 hours. The cultures were then centrifuged at 1,200 x g for 15 minutes and the amount of free mycotoxin was determined

in the supernatant using an Enzyme Linked Immunosorbent Assay. A standard curve was fitted to calculated absorbance to part per billion free mycotoxin remaining in solution.

- d. Percent adsorption was calculated as $[(\text{Negative Control} - \text{Sample}) / \text{Negative Control}] * 100$
- e. Negative Control had no putative adsorbent added to the incubation and therefore represented 0% adsorption.

Experiment 2

- a. The mineral clay/ceramics:mycotoxin ratios were approximately 15,000:1; 800:1; 2,000:1; and 2,000:1 for Aflatoxin B1, Fumonisin B1, OTA, and Zearalenone.
- b. All experimental procedures were similar to those described in Experiment 1, except the incubation time was reduced to 2 hours and the buffer used was pH=7.0.
- c. Data were reported as % adsorption relative to PowerGuard.

Results

Experiment 1

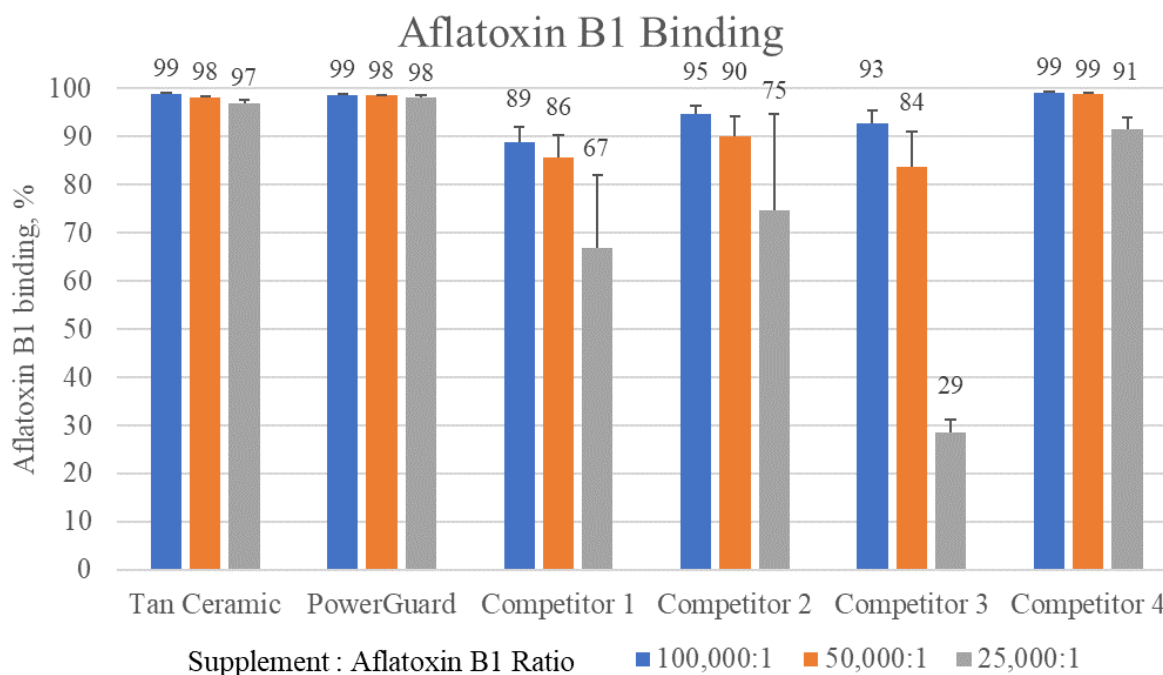


Figure 1. Aflatoxin B1 adsorption at pH 7.2 after 4 hours of incubation with Tan Ceramic, PowerGuard (Gray Ceramic), and 4 commercial products. 100,000:1; 50,000:1; and 25,000:1 are the ratios of adsorbent to aflatoxin tested. Data reported as the mean \pm SEM of triplicate cultures.

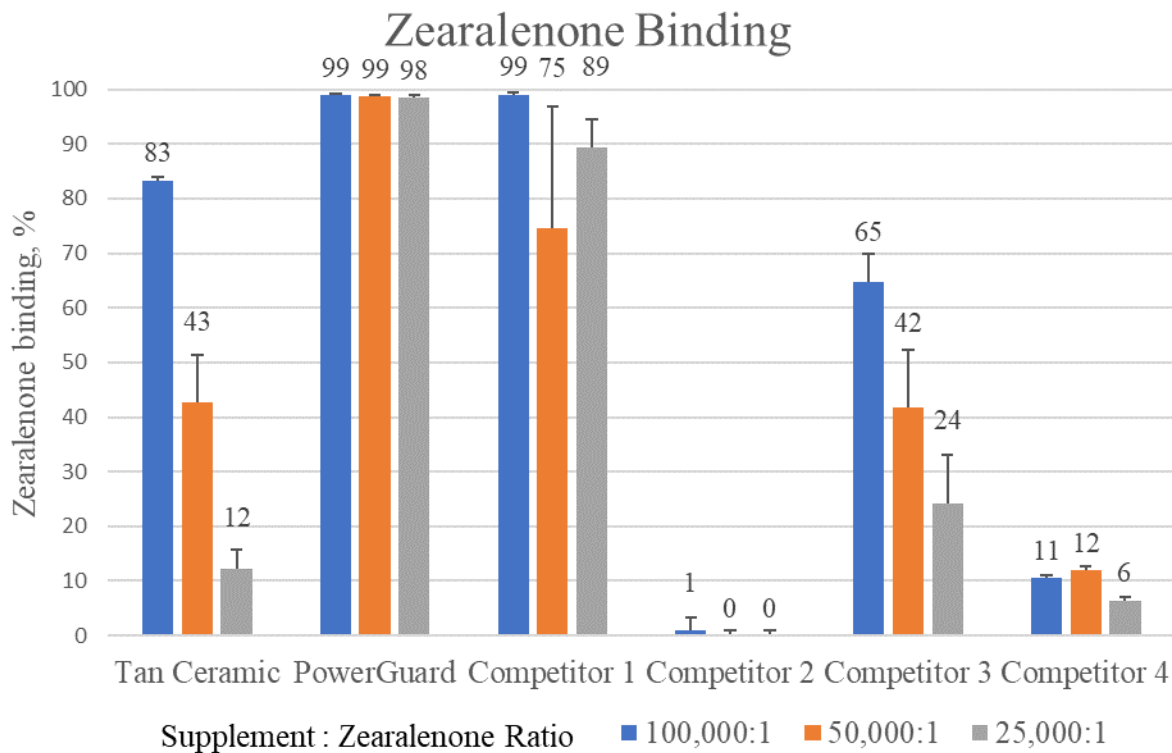


Figure 2. Zearalenone adsorption at pH 7.2 after 4 hours of incubation with Tan Ceramic, PowerGuard (Gray Ceramic), and 4 commercial products. 100,000:1; 50,000:1; and 25,000:1 are the ratios of adsorbent to zearalenone tested. Data reported as the mean \pm SEM of triplicate cultures.



Experiment 2

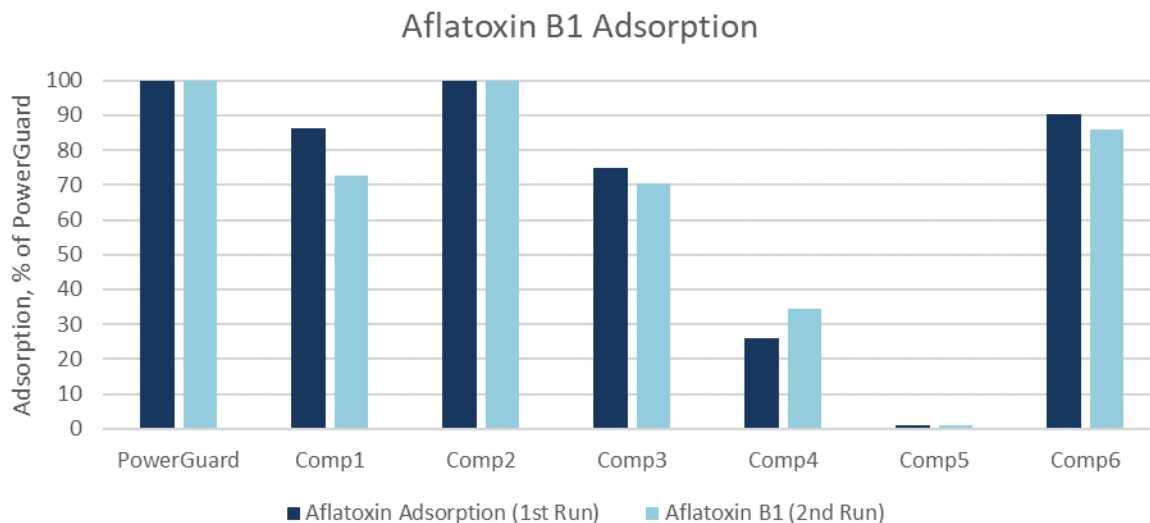


Figure 3. Aflatoxin B₁ adsorption at pH 7 after 2 hours of incubation with either PowerGuard or 6 leading commercial mycotoxin mitigation products. The approximate adsorbent:toxin ratio was 15,000:1. Data reported as the mean of triplicate cultures for each independent analysis (run).

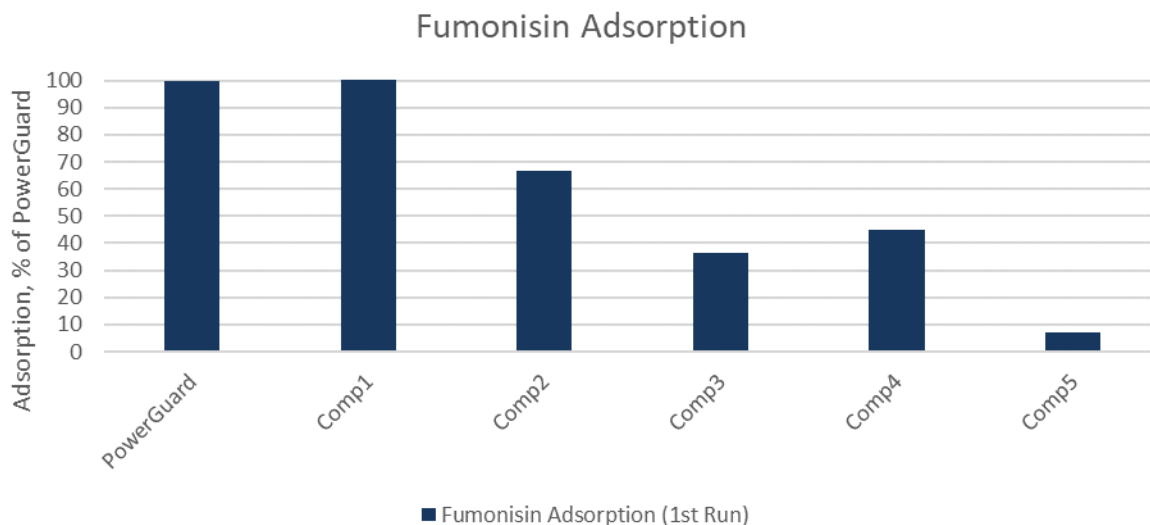


Figure 4. Fumonisin B₁ adsorption at pH 7 after 2 hours of incubation with either PowerGuard or 6 leading commercial mycotoxin mitigation products. The approximate adsorbent:toxin ratio was 800:1. Data reported as the mean of triplicate cultures.

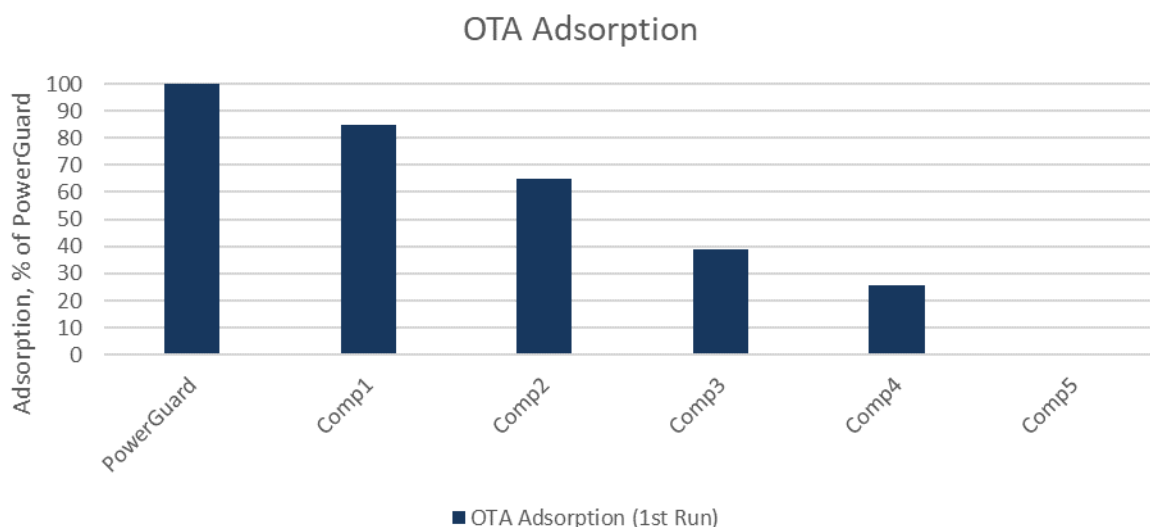


Figure 5. Ochratoxin A adsorption at pH 7 after 2 hours of incubation with either PowerGuard or 6 leading commercial mycotoxin mitigation products. The approximate adsorbent:toxin ratio was 2,000:1. Data reported as the mean of triplicate cultures.

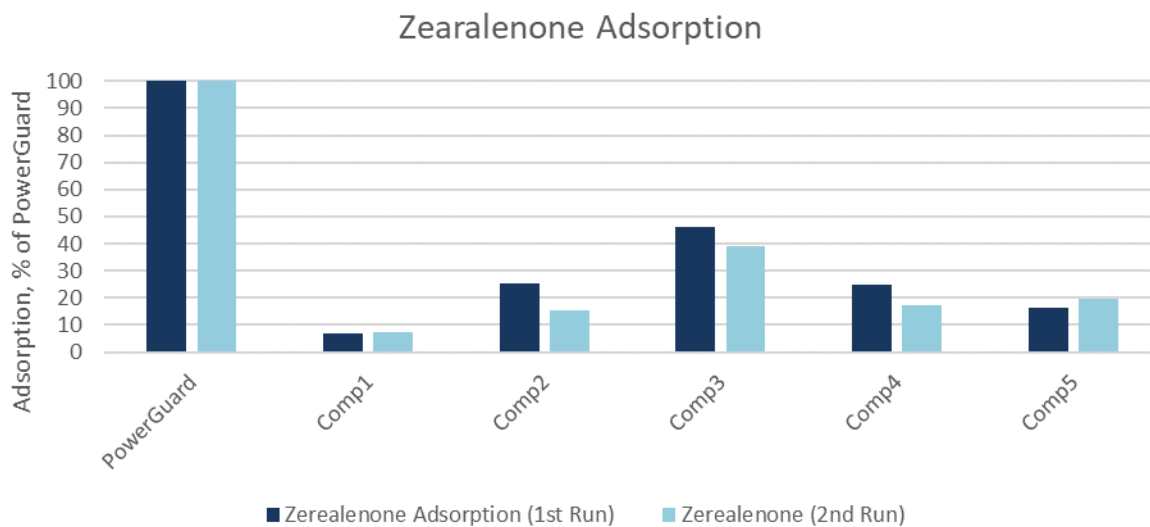


Figure 6. Zearalenone adsorption at pH 7 after 2 hours of incubation with either PowerGuard or 6 leading commercial mycotoxin mitigation products. The approximate adsorbent:toxin ratio was 2,000:1. Data reported as the mean of triplicate cultures for each independent analysis (run).



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Conclusions

These data indicate that the grey ceramic, known as PowerGuard has better adsorption affinity than the tan ceramic for both Aflatoxin B1 and Zearalenone. Further these data indicate that PowerGuard has a broad-spectrum adsorption capacity against mycotoxins and is superior to all commercial based mycotoxin mitigation products, when compared pound per pound. PowerGuard can replace

- Specifications:
 - Grey Powder
 - Ceramic Particle: Median size less than 50 microns; 90% less than 100 microns
- Directions for use
 - Swine: 1 to 5 pounds per ton of finished feed
 - Poultry: 1 to 5 pounds per ton of finished feed
 - Calf Starter & Grower: 5 pounds per ton of finished feed
 - Lactating Cow: 20 to 56 grams per head per day
- Packaging
 - 40 x 50 pound bags