Feed Processing to Reduce Ergot Toxicity

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Summary

Wheat and rye screenings heavily contaminated with ergot (400 to 500 ppm) were subjected to either steam explosion (200 psi) or pelleting to evaluate the impact on toxicity. Total ergot content decreased 40 to 60% with processing, with a greater decrease associated with more drastic processing (steam explosion). Results also indicated that not all the ergot alkaloids are affected similarly by processing. However when these screenings were included in diets (0 to 4 ppm ergot) for weanling pigs growth and feed intake were linearly reduced in the first week with increasing ergot, but only when the ergot was unprocessed, indicating that the processing (steam explosion) did indeed reduce toxicity.

Introduction

Ergot alkaloids infect grasses and cereal crops such as rye, wheat, triticale and barley. Most commercial assays determine total alkaloid content and typically about 8 different alkaloids. There is some evidence that theses alkaloids vary in toxicity. Unlike other mycotoxins, ergot alkaloids are toxic to all livestock species, including ruminants. Symptoms of toxicity range from reduced feed intake to gangrene in the extremities. Synthesis or release of the hormone, prolactin, appears to be especially sensitive to ergot toxicity. The negative effect of ergot on prolactin is responsible for the decrease or complete cessation of milk production observed following ergot ingestion.

There is some limited evidence that suggests ergot toxicity can be reduced by processing such as pelleting. This project set out to utilize steam explosion as an example of extreme processing to determine potential effects on ergot toxicity, monitoring the alkaloid composition of contaminated material following steam explosion under different conditions. Feeding trials with piglets measured the change in toxicity. This information will be used to determine potential processing strategies to decrease ergot toxicity in growing pigs.

Experimental Procedures

Study 1

Rye and wheat screenings were subjected to steam explosion at 200 psi for two or five minutes with or without prior soaking for 40 minutes or "harsh" or "mild" pelleting with temperatures of approximately 75 or 85 °C, respectively. Samples of the processed or unprocessed screenings were assessed for ergot alkaloid content (HPLC/MS; Prairie Diagnostics Services, Saskatoon, SK)

Study 2

A total of 324 newly weaned piglets, housed four pigs per pen, were grouped by gender and weight and assigned to one of nine treatments. They received a phase 1 diet for 3 days, then the treatment diets for a 28 d growth trial.

1. Control (0 ppm ergot)
2. No processing 0.5 ppm ergot
3. No processing 1.0 ppm ergot
4. No processing 2.0 ppm ergot
5. No processing 4.0 ppm ergot
6. Steam exploded 0.5 ppm ergot
7. Steam exploded 1.0 ppm ergot
8. Steam exploded 2.0 ppm ergot
9. Steam exploded 4.0 ppm ergot

Heavily contaminated wheat screenings previously utilized in experiment one were steam exploded at 200 psi. The heavy contamination of these screenings allowed incorporation of only small amounts to achieve the desired ergot levels in the final diets.

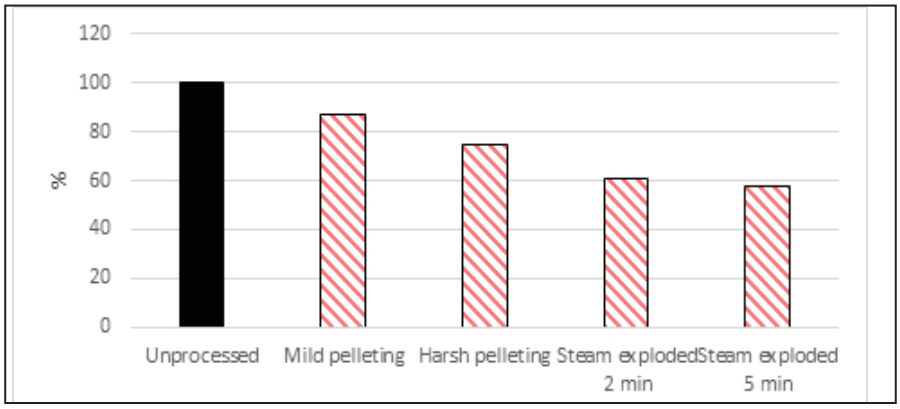

Figure 1. The percentage change in ergot concentration when heavily contaminated rye screenings (~ 518 ppm) were subject to various processing methods

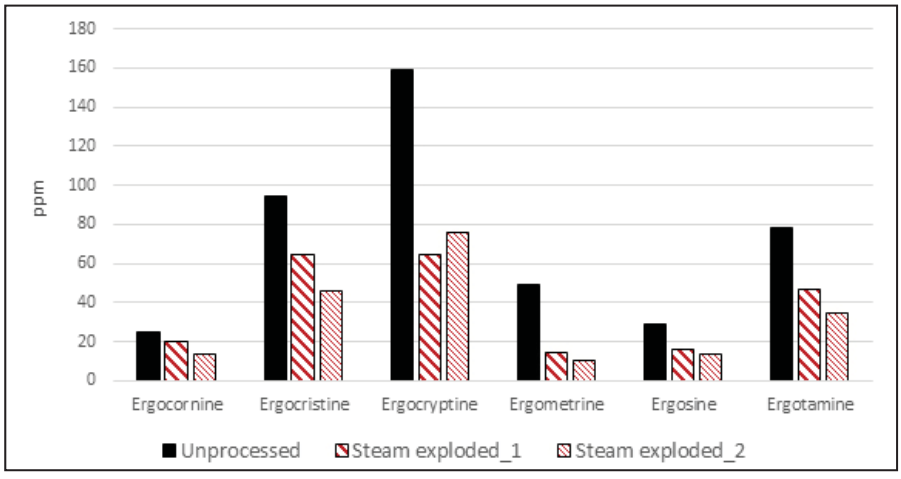

Figure 2. The effect of steam explosion (1) or steam explosion preceded by soaking for 40 minutes (2) on ergot alkaloid content (ppm) of heavily contaminated wheat screenings (approximately 434 ppm total ergot content)

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Results and Discussion

Pelleting reduced the ergot concentration of heavily contaminated rye to approximately 85% of the original concentrations, while steam explosion reduced it to approximately 60% of the original concentrations (Figure 1). Comparable results were observed with wheat screenings (Figure 2) as steam explosion (200 psi) resulted in a 55% reduction in total ergot alkaloid content, and steam explosion, preceded by soaking for 40 minutes reduced this by an additional 5%. As can be seen in Figure 2, the extent of the decrease in ergot content with processing varied among the various alkaloids tested. This is important as there is some evidence that toxicity of the alkaloids varies.

Study 2

Overall growth, feed intake and feed efficiency of piglets fed diets with 0 to 4 ppm ergot alkaloids for 28 days post-weaning was comparable among the ergot treatments (ergot $P > 0.10$). However, there was an ergot by processing interaction for the first week of the experiment ($P < 0.01$; Figure 3), as there was a linear reduction in growth rate when the piglets received the unprocessed screenings that was not observed when the screenings were processed. Unexpectedly, a comparable effect was not observed with feed intake (ergot by processing, day 0 to 7; $P > 0.10$) and thus there was an effect on feed efficiency (gain:feed ratio, ergot by processing interaction, day 0 to 7; $P < 0.02$). Piglets receiving the processed screenings, regardless of ergot levels exhibited increased growth rates, feed intakes and feed conversion throughout the entire experiment (processing, $P < 0.01$).

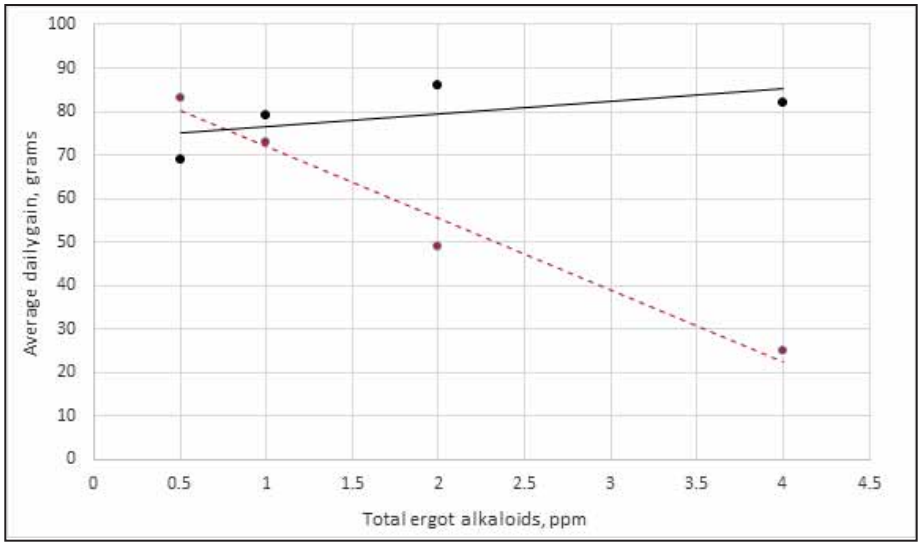

Figure 3. The effect of processing (steam explosion) heavily contaminated wheat screenings on the response of growing pigs, experimental day 0 to 71 post weaning, to 0.5 to 4 ppm ergot alkaloids in their diet (experimental d0 was 4 d post-weaning)

Implications

Extreme processing is a potential solution for reducing ergot contamination in cereal grains.

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