Feed Processing to Reduce Ergot Toxicity

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Ergot has long been known to have detrimental effects when fed to pigs, and a producer's best option is to avoid feeding ergot contaminated grains. Ergot alkaloids are produced by fungi and infect grasses and cereal crops like rye, wheat, triticale and barley. Although it can vary significantly from year to year, most regions in Western Canada have seen a recent increase in ergot occurrence. There are more than 50 different ergot alkaloids that differ in toxicity, with only about eight measured in traditional assays. Alkaloids exist as R and S epimers and the toxicity of these vary as well. Unlike other mycotoxins, ergot alkaloids are toxic to all livestock species, including ruminants. The maximum level of ergot alkaloids that is tolerable in young pigs is 1 to 2 ppm, while symptoms can range from reduced feed intake to gangrene in extremities depending on the amount of ergot consumed in the diet. The hormone, prolactin, seems to be especially sensitive to ergot toxicity leading to a decrease or complete cessation of milk production following ergot consumption.

Currently, visual inspection is the most practical method for reducing the risk of ergot toxicity, however sorting based on appearance or size is unreliable. There is some limited evidence that ergot toxicity can be reduced by processing methods such as pelleting. The use of heat and moisture may destroy some of the alkaloids or change the ratios of the epimers, reducing toxicity.

What We Did

Rye and wheat screenings heavily contaminated with ergot were subjected to different processing methods and fed to a group of 324 newly weaned piglets in the nursery. Pigs were grouped by weight and gender and assigned to one of nine different treatments. Diets were formulated in two phases allowing for changing nutrient requirements of the piglets through the 28 day trial, where ADG, feed intake and plasma prolactin were analyzed. A sample of piglets were scanned using a thermography camera measuring changes in temperature of the extremities, possibly due to vasoconstriction caused by the ergot. Feeding trials with piglets determined if the toxicity of the ergot was changed due to the steam explosion.

1. Control
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

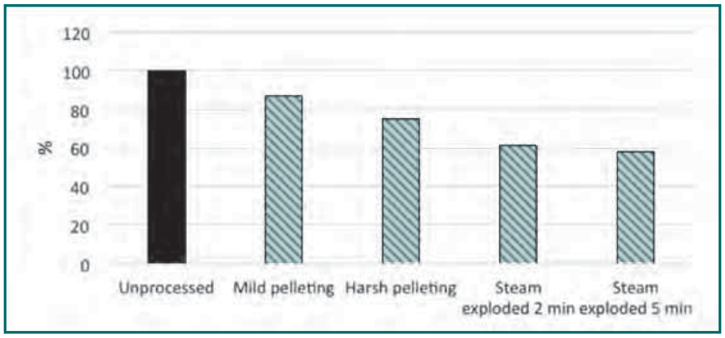

Figure 1: The percentage change in ergot concentration when heavily contaminated rye screenings (~ 518 ppm) were subject to various processing methods

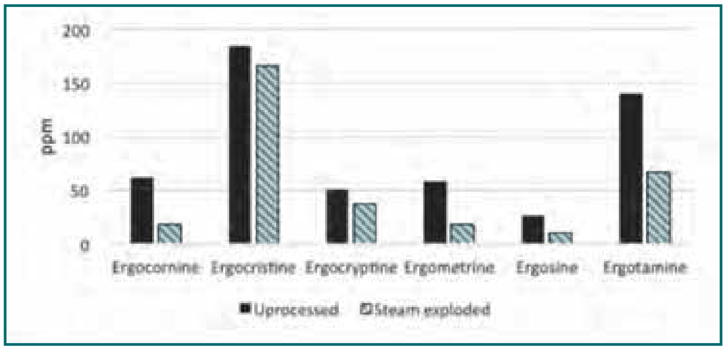

Figure 2: The effect of steam explosion on ergot alkaloid content (ppm) of heavily contaminated rye screenings

What We Found

Pelleting and steam explosion reduced the ergot concentration of heavily contaminated rye to approximately 75 - 85% and 60% of the original concentrations respectively. (Figures 1 and 2). Similar results were found with wheat screenings (Figure 3) as steam explosion (at 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%.

Performance

Overall (d0 to 28) growth, feed intake and feed efficiency of piglets fed diets with 0 to 4 ppm ergot alkaloids was similar among the ergot treatments. However, in the first week of the trial, growth rate and feed efficiency was reduced linearly by ergot, but only when the piglets received the unprocessed screenings. Piglets receiving the processed screenings, regardless of ergot levels had increased growth rates, feed intakes and feed conversion throughout the entire experiment.

Body temperatures

Body and rectal temperature was similar throughout the experiment in all treatments (Table 1). Pigs fed 1 ppm and 4 ppm of unprocessed ergot had a reduction of 3.78 °C and an increase

Table 1: The change in rectal, body, ears, and feet temperatures of nursery piglets fed processed and unprocessed ergot over 28 days

	Unprocessed		Processed		P-value				
Control	1 ppm	4 ppm	1 ppm	4 ppm	SEM	Process	Ergot	P*E[1]	
Rectal initial	38.18	37.68	38.15	38.29	38.57	-	-	-	-
Rectal change[2]	1.43	1.70	1.43	-2.35	1.02	0.15	0.684	0.998	0.212
Body initial	35.03	34.97	35.08	35.54	35.35	-	-	-	-
Body change	-0.63	-0.33	0.25	-0.64	-0.63	0.36	0.235	0.434	0.360
Foot initial	29.71	32.51	30.61	32.17	30.56	-	-	-	-
Foot change	1.53	-1.88	1.82	-0.57	1.17	0.86	0.836	0.052	0.322
Ear initial	29.48	31.92	30.09	31.22	29.94	-	-	-	-
Ear change	1.78	-3.78	2.73	0.18	0.15	1.05	0.712	0.108	0.012

[1] Processing by ergot level interaction
[2] Temperature change from d1 to d28

of 2.7°C for their ear temperatures respectively; compared to the control diet having an increase of 1.8°C over the 28-day period. An interaction was between processing and ergot for ear temperature. (Table 1).

The foot temperature of pigs fed the control diet had an increase of 1.5°C from day 0 to 28. The pigs fed unprocessed ergot at 1 ppm inclusion had reductions in foot temperature of 1.88°C, while the 4 ppm had an increase of 1.82°C. For the processed ergot, pigs fed a 4 ppm inclusion had an increase of 1.17°C. Results indicate temperatures of the feet and ears were reduced when fed 1 ppm inclusions but increased when fed 4 ppm inclusions in their diet.

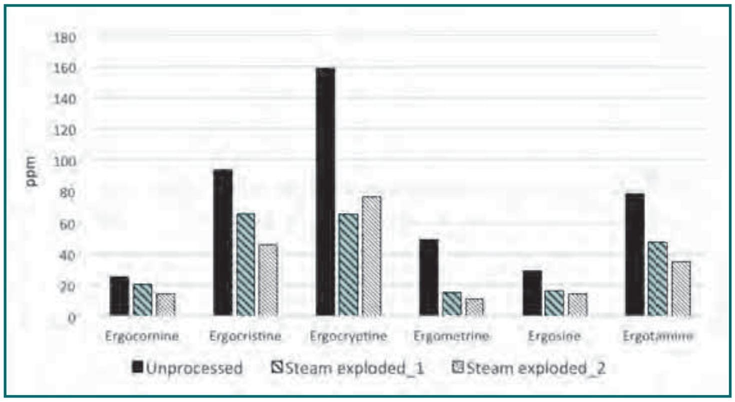

Figure 3: The effect of steam explosion (1) or steam explosion preceded by soaking for 40 minutes (2) on ergot alkaloid content (ppm) of heavily contaminated wheat screenings (approximately 434 ppm total ergot content)

Implications

Severe processing can help reduce ergot alkaloid content and toxicity. The alkaloids responded differently depending on the cereal grain used, indicating that processing may affect grains differently when it comes to toxicity. Ergot only affected performance during the first week and had no effect in the following weeks, indicating piglets may have adapted to the ergot in their diets. The feeding trial confirmed that steam explosion reduced toxicity of ergot in pigs. It is not surprising that the body temperature was not affected by ergot inclusion since ergot typically affects the extremities rather than the core body temperature. However, it is unclear why pigs fed a greater inclusion of ergot had an increase in temperature in the ears and feet.

Extreme processing is a potential solution for reducing ergot contamination in cereal grains. While processing may be an extra cost for the producer, it is a possible strategy to reduce total ergot content enough to be within the maximum allowable inclusion rate, or to improve performance of pigs. Ergot contamination has previously required cereal grains to be downgraded or cleaned; steam explosion could have an economic benefit for producers by allowing them to feed these

grains to livestock without having major negative impacts on their animals. We are currently investigating less extreme processing conditions.

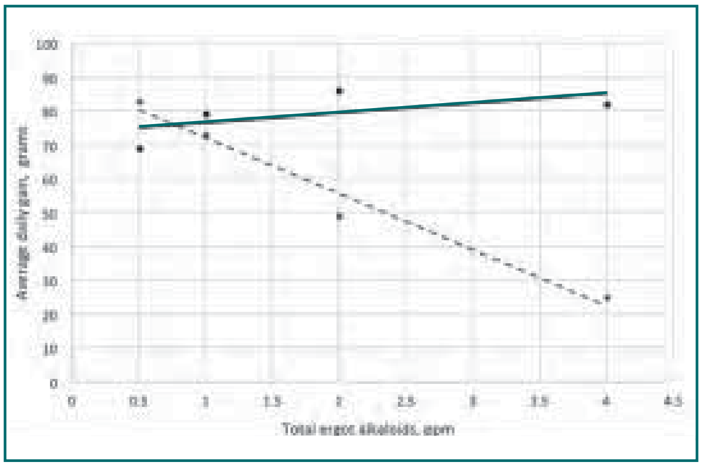

Figure 4: The effect of processing (steam explosion) heavily contaminated wheat screenings on the response of growing pigs, day 0 to 7 post weaning, to 0.5 to 4 ppm ergot alkaloids in their diet

Acknowledgements

Agriculture Development Fund