Simple strategies to reduce impacts of ergot alkaloids on beef cattle.

REDUCING ERGOT'S IMPACT?

PROJECT NO.: ANH.02.18
LEAD RESEARCHERS: Dr. Kim Stanford (University of Lethbridge)
COLLABORATORS: Mike Harding (Alberta Agriculture and Irrigation); Karen Schwartzkopf-Genswein, Tim McAllister (Agriculture and Agri-Food Canada); Barry Blakley, Gabriel Ribeiro (University of Saskatchewan)

Background: Ergot is plant disease caused by a fungus (Claviceps purpurea). It can infect many species of open pollinated annual crops and forages, including rye, triticale, wheat, barley, bromegrass, wheatgrass, orchardgrass, and bluegrasses, among others. The fungus replaces the grain or seed kernels with hard, black or purplish ergot bodies known as sclerotia.

The ergot bodies contain a variety of toxic alkaloids that can be detrimental to cattle health and welfare. Toxicity varies depending on the amount and type of alkaloids present in an ergot-contaminated feed source. High levels of ergot contamination can cause sloughing of hooves, ears, or tails. Rarely, nervous symptoms like convulsions or temporary paralysis may also occur. Long term exposure to low levels of ergot contamination may cause a reduction in feed intake, milk production and growth, or spontaneous abortions.

The maximum allowable concentrations of total ergot alkaloids in diets for cattle in Canada are currently 2 to 3 parts per million (ppm), although CFIA is considering revising allowable limits for all mycotoxins, including ergot, in feed.

Ergot contamination and toxicity can be concentrated in products like pellets that are made from grain screenings, but some previous research in sheep has demonstrated that certain pelleting processing strategies may help reduce ergot toxicity level

Objectives: The objectives of this study were to:

1. Determine if common cereal ergot alkaloid profiles exist in various growing regions and across different cereal crops in Alberta and Saskatchewan
2. Determine if low-cost feed processing strategies (heating, pelleting) changes the types of ergot alkaloids present or their concentrations
3. Evaluate the utility of the most promising grain-processing strategy in a cattle-feed study

What they did: This study had two parts, the first being a survey of ergot-contaminated grain in Alberta and Saskatchewan. Fifteen samples of ergot-contaminated grain were assayed for both R and S epimers of six major ergot alkaloids (ergocryptine, ergocristine, ergocornine, ergometrine, ergosine and ergotamine). Epimers are based on which direction the alkaloid molecule spins around its axis, with R epimers spinning to the right, and S epimers spinning toward the left. The alkaloids can interconvert between R and S epimers for reasons that are not totally understood, although a change in pH is one factor that can trigger this conversion. Knowing total alkaloids (sum of R and S epimers) is a good idea because it has been recently shown that both types of epimers cause constriction of blood vessels, one of the responses which causes the negative health effects of ergot.

From these 15 samples, five were chosen that had large differences in the overall concentrations of the six alkaloids, or in the proportion of R to S epimers in individual alkaloids. Subsamples of these five samples were heated to 60, 80, 120 or 190oC, or heated and then

pelleted by the feed mill at the Lethbridge Research and Development Centre. Somewhat to the surprise of the researchers, alkaloid concentrations significantly increased with increasing temperature, although some individual R epimers were heat stable (ergometrine, ergosine, and ergotamine). Similarly, pelleting also increased concentrations of total alkaloids (R + S epimers), although ergometrine concentrations decreased after pelleting. As heating or pelleting should not generate new alkaloids, after some head scratching, the researchers theorized that heating and pelleting perhaps made it easier to extract alkaloids from the grain as would be necessary for measurement of the alkaloids. As heating can be largely avoided and feeds such as screenings that can have a high risk of ergot contamination are often pelleted, they decided to focus on the effects of pelleting in the cattle-feeding study.

For the feeding study, 48 recently-weaned Angus-cross steers were fed one of four diets: 1) Control Mash (no added ergot), 2) Control Pellet (no added ergot but pelleted supplement), Ergot Mash (target of 1.75 ppm total ergot alkaloids), Ergot Pellet (target 1.75 ppm total ergot alkaloids all in pelleted supplement). Diets were composed of 60% barley silage and 40% barley grain on a dry matter basis, with ergot-contaminated screenings substituted for the barley grain in the ergot diets. All calves were fed the Control Mash diet for one month to allow them to adapt to the diet and the individual pens, before being randomly assigned to one of the four experimental diets for the 64 days of the experiment. Cattle were evaluated for feed intake and growth performance during the trial. Blood and hair samples were collected on days 1, 22, 43 and 64. Haptoglobin (indicator of stress, trauma, and inflammation), prolactin (indicator of reproductive health), and complete blood count (CBC, indicator of immune function) were determined from blood samples, while hair samples were evaluated for cortisol (stress). Temperature of the ears, tail and coronary band above the front hooves were measured using infrared thermography to examine surface temperature of the extremities on the same days as the blood and hair samples were collected. Rectal temperature was also measured on these days

What they learned: Ergot alkaloid contents of the feed were influenced by the type of feed analyzed. If complete diets (including silage) were analyzed, concentration of alkaloids in the two ergot-containing diets varied by up to 1.1 ppm as compared to only measuring the alkaloids in the supplement alone. The mash supplement contained 1.6 ppm while the pelleted ergot supplement contained 2.2 ppm, while the complete diet results were 2.72 ppm and 1.75 ppm for the mash and ergot pellets, respectively.

The pH of the complete diet was 4.7 while that of the supplement was 5.6. There were no differences among treatment groups of cattle for any growth or other measurements except for some CBC parameters which were higher in ergot-fed cattle and indicative of heightened immune response.

What it Means: This study was designed to determine if there were easy and inexpensive methods to reduce the toxicity of ergot alkaloids. The short answer is "no."

Based on this work, the apparent concentrations of ergot alkaloids present in feed can be deceptive, especially for pelleted diets. If just the supplement was analyzed, ergot alkaloid concentrations were higher in pelleted as compared to un-pelleted feed, both in the cattle feeding study and the ergot survey. However, these apparently higher concentrations of alkaloids in pelleted diets did not lead to negative health effects. The pH of the feed also had a major impact on the concentrations of ergot alkaloids detected. If alkaloid results can vary by up to 1.1 ppm when comparing complete diets (including silage) versus just the supplement, it becomes difficult to determine when ergot alkaloids in the diet will cause problems for cattle. Similarly, multiple studies have demonstrated wide ranges of ergot alkaloid concentrations with varying outcomes – with 3 ppm resulting in steers having to be pulled off trial due to significant signs of heat stress, to 0.8 ppm showing no discernable negative effects, to as little as 0.5 ppm demonstrating significant vasoconstriction. In this study, between 1.6 and 2.72 ppm was likely on the cusp of having negative effects based on the changes seen in immune function.

What does seem clear is that ergot alkaloids are difficult to measure, their effects on cattle can be varied, and more robust methods of analysis are needed

This project was also supported by the Saskatchewan Cattlemen's Association.

SINCE 1969 Alberta Beef Producers™

www.albertabeef.org