Feeding Fusarium-Contaminated Grain to Livestock

2006

Introduction

Fusarium Head Blight (FHB) is a fungal disease of various grasses. It is found most often in wheat but can also affect barley, oats, rye and some forage grasses. Under certain environmental conditions, the fusarium mould may produce a mycotoxin called DON (deoxynivalenol). DON is a mild toxin compared to other toxins which can form in grains and forages. Reduced feed intake, and the accompanying decrease in performance, are the only symptoms of DON toxicity livestock producers will likely encounter.

This response to DON appears to occur through the central nervous system. DON belongs to a class of mycotoxins (tricothecenes) which are strong protein inhibitors. Inhibition of protein synthesis following exposure to DON causes the brain to increase its uptake of the amino acid tryptophan and, in turn, its synthesis of serotonin. Increased levels of serotonin are believed to be responsible for the anorexic effects of DON and other tricothecenes. Irritation of the gastrointestinal tract may also play a role in reducing feed intake.

Because DON functions as a protein inhibitor, it may also reduce the production of antibodies by the immune system and increase an animal's susceptibility to disease. Different livestock species respond differently to DON. In pigs, DON is efficiently absorbed, poorly metabolized, widely distributed through body tissues and excreted at a comparatively slower rate than in other farm species. This makes pigs quite susceptible to the effects of DON. With ruminants and poultry though, DON has been shown to be poorly absorbed, extensively metabolized, and rapidly cleared from tissues and fluids.

The effects of DON on different livestock species and the Agriculture Canada guidelines for DON intake are discussed below.

Agriculture Canada Guidelines

The following guidelines for DON intake are given on a 100% dry matter basis and refer to the complete ration. This would include the forage component of cattle rations. For example, grain with a DON level of 15 ppm could meet the guideline for growing cattle if it makes up one-third of the animal's total dry matter intake. The remaining two-thirds of the ration could be forage.

Swine: Agriculture Canada Guideline 1 ppm

Feeding DON at levels above 1 ppm in the complete feed will result in some degree of feed refusal. Producers can expect to see feed refusal of about 5% when levels of 1-2 ppm DON are fed and feed refusal of 25% with DON levels of 4 ppm. At 10-20 ppm DON, complete feed refusal may occur. Vomiting seldom occurs but has been reported at high DON intakes (20 ppm).

Weanling pigs are more susceptible to the effects of DON and may exhibit feed refusal with dietary concentrations of less than 1 ppm. If possible, avoid using DON contaminated grain in rations for weanlings.

Although DON does not appear to have a strong reproductive effect, the effects of feeding DON on reproductive performance are not fully known. The use of DON in
ration for gestating and lactating sows should, therefore, be avoided or minimized. Keeping DON levels below 1 ppm will minimize the chance of reproductive problems occurring.

**Dairy Cattle: Agriculture Canada Guideline 1 ppm**

Until 1993, very few feeding trials had been conducted with lactating dairy cows. Recent research, however, has indicated that dairy cows may be able to tolerate higher levels of DON. In an Agriculture Canada trial, heifers were fed rations containing 6.4 ppm DON for 10 weeks during mid lactation with no effect on production. Research at the University of Manitoba showed that feeding 8.4 ppm DON had no effect on dry matter intake or milk yield of cows producing over 33 kg milk/day.

**Growing Beef Cattle and Sheep: Agriculture Canada Guideline 5 ppm**

Growing-finishing cattle and lambs can tolerate much higher levels of DON in their diet without going off-feed. Some research has shown that feeding 15 ppm DON to feeder lambs for 4 weeks had no effect on feed intake or gain. In an University of Minnesota feeding trial (1993-94) steers were fed rations containing up to 18 ppm DON through the finishing phase with no effect on gain, feed intake or feed efficiency. An NDSU trial (1993-94) fed up to 9 ppm DON during the growing phase and up to 12 ppm during the finishing phase with no effects on performance.

**Pregnant Cows and Ewes**

Based on research trials conducted since 1993, it appears that, at the levels tested, DON has no effect on reproductive performance. North Dakota State University fed heifers rations containing 10 ppm DON, on a dry matter basis, during mid and late gestation. No differences in feed intake, gain, calving rate or calf birth weights were observed. This is similar to results obtained with sheep at the University of Manitoba and the University of Minnesota where ewes were fed up to 12 ppm DON during late gestation with no effect on number of lambs born, % born alive or lamb birth weights. The University of Minnesota also fed ewes a diet with 7 ppm DON for 10 days pre-breeding until 30 days post-breeding with no subsequent effect on reproductive performance.

**Horses: Agriculture Canada Guideline 1 ppm**

Limited information is available on feeding DON contaminated grain to horses. In 1996, a study at the University of Missouri fed DON contaminated grain (36-44ppm) to adult horses at the daily rate of 1.3 kg for a 40 day period. This corresponds to approximately 6ppm DON on a dry matter basis. No effect on health or performance was noted.

**Poultry: Agriculture Canada Guideline 5 ppm**

Poultry are the most tolerant of livestock species to DON. Some studies show that feeding 20-50 ppm DON has no effect on production.

**Interpreting the Guidelines**

Several factors, including stress and the presence of other mycotoxins, can influence an animal's response to DON. Stressed animals are more susceptible to the effects of mycotoxins and may react negatively to lower levels of DON. Some common sources of stress are:

1. High levels of production
2. Poor health status of animals
3. Less than optimum feeding programs
4. Overcrowding and other housing conditions

Mycotoxins can act in a synergistic manner and the presence of other mycotoxins may cause an animal to show toxicity symptoms at lower than expected dietary levels of DON.

**Tissue Residues**

When higher levels of DON contaminated grain are fed to the more tolerant livestock species, the concern shifts from the effects on animal performance to the potential accumulation of DON in edible products i.e., meat, milk and eggs. Numerous research trials have shown that tissue residues of DON are not a concern. DON is rapidly metabolized by animals and there is no extensive uptake or retention of DON by any animal tissues.

**Detoxifying DON**

A number of chemical and physical treatments have been looked at as potential methods of detoxifying DON. Unfortunately, there is no easy way to reduce the toxicity of DON contaminated grain other than removing the contaminated kernels. A hydrated sodium aluminum silicate (HSAS) product has been marketed in Manitoba as a possible detoxifying agent. HSAS is sold under a variety of brand names and is used in the feed industry as an anti-caking agent. From the information available, it appears to be very effective at binding aflatoxin, a mycotoxin common in the United States. However, HSAS does not appear to be effective in binding significant amounts of DON. The results of a trial with three commercially available products are shown below.

<table>
<thead>
<tr>
<th>% Mycotoxin Absorbed From Aqueous Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product A</td>
</tr>
<tr>
<td>Aflatoxin</td>
</tr>
<tr>
<td>DON</td>
</tr>
</tbody>
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This data is consistent with that obtained from animal feeding trials. Recent research has shown that the addition of 1% HSAS (10 kg/tonne) did not improve the performance of pigs fed diets containing up to 6.8 ppm DON. Producers are urged to follow the Agriculture Canada feeding guidelines rather than relying on a sodium aluminum silicate product to reduce DON toxicity.

**DON and Straw**
A joint study between Manitoba Agriculture and Food and the Canadian Grain Commission showed that DON is found almost entirely in fusarium damaged kernels. Negligible levels are found in non-damaged kernels and in the stem. The amount of DON in cereal straw will depend primarily upon the presence of contaminated grain and chaff. Straw with a high concentration of this material should not be fed to horses or used as bedding for hogs.

The quick test (ELISA) offered by some laboratories for analysing DON in straw appears to be unsatisfactory. Producers wishing to check their straw should do so at a lab which uses GC-MS methodology (gas chromatography-mass spectrophotometer).

**DON and Greenfeed and Silage**

DON levels peak two to three weeks prior to seed maturity and then start to decrease. Because greenfeed and silage are harvested prior to the seed being completely mature, the level of DON in the harvested material could be significantly higher than that found in threshed grain. These levels will, however, be blended down through the contribution of leaves and stem. The leaves and stem do not produce any significant amount of DON.

Ensiling, if done correctly, will prevent further mould development. It is essential that the silo be airtight. Ensiling will not destroy any DON present in the seed prior to ensiling.

**DON and High-Moisture Grains**

High moisture grains are also a concern because they too are harvested prior to maturity. The level of DON is not, however, blended down by the stems and leaves.

**DON Testing Procedures**

Suspect grain can be tested for DON at the various laboratories listed below. North Dakota State University (DNSU) can test for DON contamination in forage as well as grain.

For greatest accuracy, be sure to submit a representative sample from the field or bin:

- If the grain is unharvested, combine a swath from a typical section of the field
- If the grain has been combined, take sub-samples from 15 to 20 different spots in the bin or during loading and unloading. Mix these sub-samples in a container and collect a final sample from the mixture

For more information on sampling procedures and prices, contact the laboratories directly:

**Canadian Grain Commission**

Vomitoxin Testing
Using DON Test Results

DON analysis of fusarium infected grains is an important part of planning a safe feeding program for livestock. It is not, however, the only part. It is even more important that producers continue to monitor livestock and take action if feed refusal occurs.

Below are several points producers should be aware of regarding DON test results.

1. Feed analysis, whether for nutrient content or mycotoxin content, is meant to be used only as a guideline when preparing livestock rations. A close watch still needs to be kept on the animals. A drop in feed intake may indicate that DON levels are higher than they should be.

2. Variation in DON test results is common because the mycotoxin being detected is not uniformly distributed. It is common for DON levels in grain to fluctuate within the same field (i.e. field margin to center) as well as between fields. In addition, DON is not distributed uniformly throughout every seed. This could lead to different DON test results even within what appears to be approximately the same sample.

Prepared by:

Karen Dupchak
Farm Production Extension - Animal Nutritionist
Manitoba Agriculture, Food and Rural Initiatives
Livestock Knowledge Centre
204-545 University Crescent
Winnipeg, MB R3T 5S6
Phone: 204-945-7668