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Toxicity Problems with Ammoniated Dry Roughages

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Summary

In two trials conducted at the Fort Hays Experiment Station, symptoms of toxicity (hyperexcitability, circling, convulsions, death) were observed in several newborn calves (1 to 14 days of age) nursing cows consuming ammoniated forage sorghum hay. None of these symptoms was observed in calves nursing cows consuming untreated hay. No toxicity symptoms were observed in the cows on any treatment. However, several instances of similar symptoms in cattle consuming ammoniated forages have been reported in growing calves and adult cattle in Kansas, Texas, California, and Kentucky. The primary forages involved in these incidents were forage sorghum, hybrid sudan, cereal grain, brome, and fescue hays. To date, no problems have been reported with ammoniated wheat straw or other poor quality forages. Analyses of the treated forages associated with several of these toxicity incidents have shown relatively high levels of imidazole compounds - chemicals with convulsive properties previously implicated in toxicity with ammoniated molasses.

Introduction

Based on numerous research trials, treatment of dry roughages with about 3% anhydrous ammonia has shown considerable potential for increasing the usefulness of low quality roughages such as wheat straw, and of increasing the feeding value of medium quality roughages such as prairie, fescue, and brome hays. Unfortunately, several instances of apparent toxicity with ammoniated feeds have been reported. Thus, these trials were conducted to determine if there is potential for toxicity and to study the nature of the toxicity.

Experimental Procedure

Trial 1 - Approximately 90 head of Simmental cross and Angus x Hereford cows were assigned randomly to two treatments: 1) Control - untreated hybrid forage sorghum hay and 2) Ammoniated hybrid forage sorghum hay (treated 12/82). Cattle on both treatments were fed untreated forage sorghum prior to February 28, 1983, at which time one-half of the cows were switched to the ammoniated sorghum hay.

Trial 2 - Thirty-six head of Simmental cross and Angus x Hereford cows were assigned randomly to three treatments: 1) Control - untreated hybrid forage sorghum (same hay as in Trial 1), 2) Ammoniated hybrid forage sorghum (surplus hay from Trial 1 treated 12/82), and 3) Ammoniated hybrid forage sorghum (control hay from Trial 1 freshly treated 9/83). At the time the cows were placed on trial, approximately 5 head of each group of 12 cows were nursing calves 1 to 7 days old.

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Treatment of Forage

In both trials, hybrid forage sorghum from the same 1982 crop was used. The ammoniated forage was treated by stacking numerous large round bales of the forage together, covering with black plastic and sealing the edges with dirt. About 4% (79-80 lbs/ton of forage, as fed) anhydrous ammonia was applied at one location in the stack through a hose under the plastic. In both trials, the stacks were uncovered approximately 10 days prior to feeding. Bales were self-fed in bale racks.

Results and Discussion

Trial 1 - During the first 14 days of the trial, five calves nursing cows consuming ammoniated forage sorghum died, while no deaths occurred in the control group. Two of these calves were observed exhibiting hyperexcitability and convulsions prior to death. On day 14, the trial was terminated, with both groups thereafter receiving untreated forage. Two more calves from the ammoniation treatment group died within 2 days. Necropsy indicated no pathological organisms or other explanation for any of the deaths.

Trial 2 - Approximately 5 days after the start of the trial, several calves in the freshly (9/83) ammoniated forage group showed extreme hyperexcitability (wild running and circling). Within 2 days, five of the seven calves in this group had shown these symptoms, with two exhibiting severe convulsions and subsequent death.

With the cattle on the old (12/82) ammoniated forage treatment, the first sign of hyperexcitability occurred 8 days following initiation of the trial. No symptoms of any toxicity were observed in the group receiving untreated forage sorghum. Also, no symptoms were observed in any of the cows.

Since research at several locations in the 1950's and 60's had shown similar symptoms in cattle fed ammoniated molasses, and the primary active chemical was identified as 4-methylimidazole, samples of the ammoniated forage sorghum and milk from cows whose calves died were analyzed for that compound. Preliminary analyses have shown levels of 40-120 ppm in the ammoniated forage. No imidazole compounds were found in the untreated hay. It appears that a metabolite is present in the milk instead of 4-methylimidazole itself. Thus, this chemical or closely related compounds, which have been shown to be convulsive agents in laboratory animals, are likely the cause of the toxicity in these trials. However, much more research is required before a complete answer is available.

Several sporadic cases of symptoms similar to those observed in these trials have been reported in several states with cattle being fed ammoniated sorghum-sudans (sweet-stemmed cultivars), fescue, brome, and cereal grain hays. In these cases, it seems that higher-quality hays are particularly predisposed to develop toxicity since they have more soluble carbohydrates, which appear to be necessary for 4-methylimidazole formation during ammoniation. In several cases, these incidents have involved growing cattle as well as adult animals. To date, no cases of toxicity have been reported with cattle being fed ammoniated low-quality roughages such as wheat, barley, oat or milo straw. Thus, based on the information available at this time, producers should refrain from ammoniating forage sorghum, sudan, brome, fescue, or cereal grain hays.