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Managing High Sulfur Concentrations in Beef Cattle Feedlot Rations

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Recent ethanol industry expansion has resulted in a large increase in the amount of corn milling byproducts available for animal feed. According to the Renewable Fuels Association, over 13 million ton of distillers grains were produced from United States ethanol plants in 2006, and approximately 85% of this feedstuff was used by beef and dairy cattle. This feedstuff has many desirable characteristics, such as high energy, protein, and fiber. Due to the use of sulfuric acid to maintain fermenter pH levels, distillers grains also contains an appreciable amount of sulfur (S). The S content of distillers grains can be extremely high and also is quite variable. If not managed properly, high S concentrations in the diet, coupled with S from drinking water, may negatively affect both animal performance and animal health.

Mild cases of S toxicity may result in decrease average daily gain and feed efficiency, and may not be recognized until the cattle have left the feedlot and closeouts are completed. More severe cases of sulfur toxicity may result in polioencephalomalacia (PEM), which may also be known as brainers or polio. This condition is caused when excess S in the diet is consumed and converted to hydrogen sulfide in the rumen. The excess hydrogen sulfide can inhibit cellular respiration, which limits the amount of oxygen and energy delivered to the brain and causes lesions and softening of the brain. Symptoms of PEM include separation from group, head pressing, "star gazing" in which cattle stand with their head held back and upward, teeth grinding, and staggered gait. More extreme and advanced symptoms may include seizures, blindness, and coma, and may eventually lead to death if not treated properly.

The maximum tolerable concentration for S by feedlot cattle is 0.30% of diet dry matter. This level applies to cattle that are consuming a diet with less than 15% roughage, as would be the case in feedlot diets. It appears that step-up periods are especially dangerous, as cattle are being offered increasingly higher concentrate diets which will alter the microbial population and promote hydrogen sulfide production.

One of the problems when formulating diets is determining the S content of distillers grains. Book values from the National Research Council (NRC) list the S content of distillers grains at 0.40% on a dry matter basis. In reality, however, this value is often exceeded. Data from the University of Minnesota's distillers grains information website (www.ddgs.umn.edu) showed a range in dried distillers grains with solubles (DDGS) S concentration of 0.34 to 1.05% in samples collected from eight Minnesota ethanol plants. For wet distillers grains with solubles (WDGS), Pablo Guiroy of Cargill Animal Nutrition reported an average S content of 0.66% in 75 samples collected from various ethanol plants. The best practice when formulating rations with distillers grains would be to request a nutrient profile from the ethanol plant where the distillers grains originated.

Sulfur that originates from water intake needs to be accounted for when determining total S intake. In the

primary cattle feeding areas of Minnesota, water S is generally below 200 ppm. However, like S from distillers grains, water S can be highly variable and site-specific. Therefore, water sulfate tests should be conducted in any area where cattle are fed. It is also important to account for fluctuations in water intake, especially in hot temperatures. A 1,000 lb. steer will consume approximately 9 gallons of water per day when the temperature is 40 degrees F and nearly 21 gallons when the temperature is 90 degrees F. With additional water intake comes additional S intake. Colorado State University has a useful calculator to determine total S intake at various temperatures, and can be found at
http://www.dlab.colostate.edu/webdocs/special_cases/sulfurcalc.cfm

In order to best utilize distillers grains in feedlot diets, a new set of management strategies should be employed. Addition of certain minerals, such as copper and zinc may assist in reducing the amount of S that is converted to hydrogen sulfide in the rumen. Sulfur forms a complex with these minerals that reduces their availability for absorption and utilization by the animal, and therefore supplementation of these minerals beyond traditional recommendations may be needed. During times when conditions may favor PEM, such as during adaptation to a high-grain diet or during times of high temperatures, addition of oxytetracycline or chlortetracycline may help reduce the occurrence of PEM. These two antimicrobial additives will reduce microbial activity in the rumen and therefore reduce the amount of S that is converted to hydrogen sulfide. Thiamine is often added as prevention against PEM. Although it appears that thiamine level does not have an effect on S-induced PEM, it may be useful to include in diets with distillers grains as a form of insurance against other S-related problems. If cattle are observed with PEM-like symptoms, the S-containing feeds should be decreased or removed from the ration. Intravenous injections of thiamine have also been suggested as a treatment for observed PEM.

When formulating rations, the S content of all feedstuffs and water needs to be taken into account. To manage the variability in S concentrations associated with distillers grains, feedlot producers should include a safety margin in ration formulation. This allows for a margin of protection if the S content of a load of distillers grains exceeds what the ethanol plant reported. In hot summer months, distillers grains inclusion may need to be reduced, especially in areas with high sulfate water. In addition, traditional management practices such as proper feed mixing and good bunk management should be emphasized to ensure that distillers grains are uniformly mixed and delivered to cattle.

Unfortunately, the high S content of distillers grains is something we will have to deal with, and may at times limit its inclusion in feedlot diets. Through water and feed sampling, careful ration formulation, and proper management practices feedlot producers should be able to take advantage of this valuable feedstuff. For more information on this or other beef cattle related topics, please visit the Minnesota Beef Industry website at *www.extension.umn.edu/beef.*