

## **Watching for Excess Sulfur Intake in Dairy Cows**

Sulfur is an essential nutrient in cattle diets. Like many nutrients, however, it can be consumed at excessive levels that become harmful to the animal. The possibility that dairy cattle may be consuming too much sulfur has not received much attention, and so it is very reasonable that this nutritional issue can be routinely overlooked. Sulfur intake can occur from a variety of sources, and it requires a close look to determine what level of sulfur a herd is consuming. The purpose of this article is to draw your attention to this issue and encourage you to evaluate your herd's sulfur feeding. There is a very real possibility that you are limiting your cows' productivity by effects of high sulfur.

An Integrated Livestock Management research team, headed by Dr. Dan Gould, professor in Pathology at CSU, has been conducting research on effects of cattle sulfur intake for several years. The initial focus of these research efforts was on a brain disease of cattle known as polioencephalomalacia (PEM, polio, brainer cattle). This is a problem of the cerebral cortex that occurs suddenly and leads to blindness, abnormal behavior, severe depression, convulsions, and death. It is seen occasionally in individual animals, and historically has been attributed to problems with thiamine (a B-vitamin) metabolism. The disease can also occur as outbreaks of disease that affect several animals in a short time period. Dr. Gould and colleagues have demonstrated that a common cause of PEM is sulfur toxicity.

Initially, our sulfur research in herds of animals focused on cattle in the feedlot environment. These projects demonstrate that PEM is only one of the outcomes of excess sulfur intake. More commonly, lower sulfur intakes that do not produce clinical disease can substantially decrease animal performance. We also recognize this problem in range cattle. Research findings have clarified many aspects of how toxicity occurs, how the cattle respond to excess sulfur intake, and suggest that many dairy operations may have excess sulfur intake as well.

**Effects of High Sulfur Intake.** When dietary sulfur is consumed by ruminants it is reduced to sulfide by ruminal microorganisms. It can then be either incorporated into microbial protein or absorbed, converted to sulfate and excreted. If excessive sulfur is consumed, imbalances in ruminal microbial metabolism can occur, and excessive ruminal sulfide accumulates. Sulfide exists in the rumen in 2 forms. The soluble hydrosulfide anion is in the rumen fluid phase and hydrogen sulfide (H<sub>2</sub>S) gas accumulates in the rumen gas cap. H<sub>2</sub>S has the odor of rotten eggs.

Non-reduced forms of sulfur such as sulfate and elemental sulfur are relatively non-toxic, whereas H<sub>2</sub>S and its various ionic forms are highly toxic substances that interfere with cellular energy metabolism and cause tissue damage.

The adverse effects of excessive sulfur intake can vary. If sulfur intake is large, excessive rumen-generated sulfide can be absorbed in sufficient quantities to result in polio. The disease is characterized by blindness, staggering, inability to rise and sometimes, seizures. In our region, this severe form of sulfide toxicity is usually seen in feedlot and

grazing beef cattle. But if dairy cattle consume sufficient sulfur, PEM will occur in dairy breeds as well.

Lower levels of ruminal sulfide can also produce adverse effects. Excess ruminal sulfide can depress ruminal motility. Excess dietary sulfur can also result in secondary metabolic effects due to interference with other nutrients. Copper bioavailability is decreased by high dietary sulfur concentrations. This is probably due to the formation of copper sulfide and/or the thiomolybdate-copper complex. High sulfur intake conditions can result in conditions that lead to destruction of thiamin. Although severe thiamin deficiency states have not been demonstrated under high sulfur intake conditions, moderate thiamin deficits are possible.

Although the stimulus for the ILM research projects initially was PEM problems, it appears the more insidious problems are likely far more common and more important. With moderately high levels of sulfur intake PEM may not occur, but animal performance can be affected. Such performance problems may be attributed to another cause (heat stress, copper deficiency) while the potential role high sulfur has played goes unnoticed. Analysis of sulfur intake is required to identify this cause.