



Cattle Producer's Handbook

Animal Health Section

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White Muscle Disease and Other Selenium-Responsive Diseases of Livestock

John Maas, Extension Veterinarian, University of California, Davis

*Ronald Hathaway, Extension Agent, and
J. E. Oldfield, Director, Nutrition Research Institute,
Oregon State University*

The discovery, in 1958, at Oregon State University that the cause of white muscle disease was selenium deficiency began our understanding of the importance this trace element has in cattle nutrition and health. Today, our understanding of selenium (Se) deficiency is much more comprehensive, yet far from complete.

The fact that Se deficiency occurs because of low soil concentrations of Se is modified by many factors. Since the original soil Se maps of the western U.S. were completed in the early 1960s, Se deficiency has been recognized in many additional areas of the West. Reasons for the increasing areas of Se deficiency include:

1. Increased use of fertilizers,
2. More intensive irrigation methods,
3. Modern plant breeding (cultivars that grow more rapidly), and
4. Improved genetics in cattle, resulting in increased growth rates.

Plants, which do not require Se as a nutrient, incorporate Se into plant tissues as a function of time and speed of plant growth. The more production per unit (e.g., through irrigation, plant genetics, and fertilization) the less the Se concentration is in the plants. Also, sulfur (S) in fertilizers directly competes with Se for uptake by plants. Plants with lower Se concentrations cause the resulting Se deficiency in cattle because the concentration of Se is too low to meet nutrient requirements.

Additionally, as cattle grow faster and are more feed efficient because of improved cattle genetics, the Se deficient plants in their diet create a greater deficit. Cattle on most cow-calf operations consume forage from a small geographic area. If the forage is Se deficient, Se may be the limiting nutrient for the herd.

Clinical Signs of Selenium Deficiency Muscular Damage (Myopathy)

The classic symptoms of Se deficiency were referred to as white muscle disease because of the white appearance of diseased muscles. This problem most often occurs in calves 1 to 3 months of age, affects the muscles of the hind legs, back, and shoulders, and causes lameness and progressive weakness with death occurring within 72 hours.

If the disease occurs in younger calves (1 to 4 weeks of age) it causes more damage to the heart muscle and the muscles of respiration. These younger calves appear to have pneumonia, with elevated respiratory rates, rapid heart rate, and increased body temperature.

The muscle damage can occur in calves before birth and may result in late-term abortions. This condition is basically white muscle disease occurring before birth. Severe muscle damage can also occur in yearling and adult cattle. In these cases, red urine results from the release of muscle pigment (myoglobin) into the urine.

Diarrhea and Weight Loss

This Se deficiency problem is often referred to as "Ill Thrift." Both young cattle and adults can be affected. Many will develop profuse, watery diarrhea, appear unthrifty, and the hair becomes light in color, dry, and doesn't shed. These cattle have decreased weight gains and experience decreased feed efficiency. This aspect of Se deficiency is by far the most economically important and has become the commonly recognized problem with Se deficiency.

Selenium deficiency can cause large economic losses without a single calf dying. Weight loss, diarrhea, poor gains, and an unthrifty appearance have many other causes. Some of these other problems in-

clude parasites, bovine virus diarrhea (BVD), copper deficiency, and Johne's disease. Thus, it is important to seek help from your veterinarian to accurately diagnose the problem. Remember, it is not uncommon to have more than one disease problem in a herd.

Reproductive Clinical Signs

Retained placenta can occur in beef as well as dairy cattle that are Se deficient. Anytime the placenta is not passed within 24 hours (retained) the uterus is more likely to become infected, which will delay or prevent subsequent pregnancy. Even mild uterine infections may prevent a cow from having her next calf within 12 months. Other Se-responsive conditions include infertility (in both bulls and cows) and early embryonic death, which can mimic Trichomoniasis or vibriosis.

Immune System Function

Selenium deficiency can cause cattle to be more susceptible to many infectious diseases and can also result in a decreased immune response to many of our common vaccines. If your cattle herd seems more susceptible to disease or does not respond to vaccination, be sure to include Se deficiency as a possible cause.

Determining the Selenium Status of Cattle

The occurrence of one or more of the diseases discussed above can result in a diagnosis of Se deficiency in a herd or an individual animal. However, it is commonly necessary to know if a Se supplementation program is working properly. Therefore, the ability to sample the herd and determine the Se status is important.

The most practical method is to take whole blood samples [blood in anticoagulant tubes (heparin or EDTA)] and have them analyzed for Se content. Do not use serum! Serum samples are more work and give inaccurate results. Take blood samples from five to seven animals in each herd. Do not take samples from sick animals, as the Se concentration in blood can vary widely in these individuals.

Selenium blood concentrations less than 0.05 ppm (parts per million) are considered to be frankly deficient and are often associated with signs of disease such as described earlier. Blood Se values of 0.05 to 0.09 ppm are deficient, however, signs of disease may not be observed. Blood Se values of 0.10 to 0.25 ppm are normal and a response to additional Se would not be expected. Blood Se concentrations of 4.0 ppm or more are associated with Se toxicity.

Selenium status in cattle can be determined by measuring blood glutathione peroxidase (a Se-containing enzyme). Few laboratories, however, are set up to offer this as a routine assay. It is a more involved assay and the samples are more sensitive to delays in transportation to the laboratory.

Soil and plant Se concentrations can also be determined as with blood samples. However, there are so

many interactions among soil, plants, and animals that these values fail to provide useful information in many cases and are generally only of academic interest. Blood Se concentration provides bottom line information for decision-making by you and your veterinarian.

Selenium Supplementation

Selenium Injections

Injections of sodium selenite have been used for decades to treat Se deficiency diseases and for Se supplementation. Recent research has found that these injections rapidly supply Se to the animal and, therefore, are effective agents for therapy of white muscle disease and similar problems. They provide only partial Se supplementation for a period of time lasting from 28 to 45 days.

Thus, if injectable Se products were used as the sole means of Se supplementation, they would have to be repeated eight to a dozen times per year. They can be effective as strategic Se supplementation if given a month or 2 months before calving. This is because Se is effectively transferred across the placenta to the developing calf.

Selenium in Free-Choice Supplements

Selenium is commonly incorporated into salt-mineral mixes for cattle on pasture or range. Currently, Se can be legally added to these mixes at concentrations up to 120 ppm, as long as consumption of Se does not exceed 3 milligrams (mg) per animal per day. Selenium can also be added to molasses products, salt blocks, and other materials provided that Se consumption does not exceed 3 mg per animal per day.

Providing Se in these types of supplements is the cheapest method. It can be labor intensive, however, and encouraging adequate consumption on a year-round basis can be difficult. In feedlot situations, Se is simply added to the mineral premix and supplementation is cheap and effective.

Slow Release Selenium Boluses

Many slow release Se boluses have been developed over the years. These boluses are given orally, reside in the reticulum (anterior part of the rumen), and slowly release Se to the animal. Currently, there is an investigation feed additive slow-release bolus available in California (Se 365; Pacific Trace Minerals, Inc.), which provides supplemental Se for 1 year and has been proven safe and effective for cattle 3 months of age and older. It is hoped that full FDA approval will allow access for all of the U.S. in the near future.

Selenium Fertilizers

Selenium fertilizers have been used safely and effectively in many countries (New Zealand, Australia, Finland, and Serbia) for many years. These Se containing fertilizers are used to increase the Se concentration in pastures, forages, and grain crops to aid in providing

Se to animals via their feed. Currently, these Se fertilizers are being used in Oregon under the direction of the Oregon Department of Agriculture.

Other Considerations

Selenium is efficiently transported across the placenta of pregnant cows. Therefore, cows supplemented with Se during the last 3 months of pregnancy can easily give birth to Se normal calves. However, Se is not well transferred through the milk.

Methods that only supplement the cow can result in calves with normal Se stores at birth and no risk of white muscle disease. These calves can become deficient by 3 to 5 months of age. These calves have low

weaning weights and are at risk from other Se deficiency problems if not supplemented directly by some method.

Supplementing Se to beef cattle on pasture or range has many practical limitations. If your herd is Se deficient for all or part of the year, discuss the potential methods with a veterinarian and closely monitor any program that is initiated with yearly blood samples from the herd. This will provide the best means to prevent costly losses from this nutritional deficiency.

Do not over supplement. Selenium can be toxic when given in excess.



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