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Selenium Deficiency in Dairy Cattle: Diagnosis and Prevention

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Selenium (Se) deficiency in dairy cattle has been recognized for many years as **white muscle disease** in calves. This deficiency commonly causes death in young calves because of damage to the muscles of the limbs, heart and respiratory system. In recent years, selenium deficiency has also been identified as the major component of several other conditions in dairy cattle (Table 1).

White muscle disease in calves most often appears as stiffness, weakness or a reluctance to move. This condition is more common in rapidly growing calves 2 to 4 weeks of age, but can occur at any time. Muscle degeneration in adult cattle with selenium deficiency can mimic milk fever but is not necessarily confined to the period of time near calving.

Ill thrift syndromes, with or without associated diarrhea, are common in dairy cattle that are deficient in selenium. These conditions reduce feed efficiency and weight gains and are probably the most economically

important selenium deficiency problem. The signs of disease may be subtle. Other trace mineral (copper and cobalt) deficiencies and infectious diseases can also cause diarrhea and ill thrift, however, and may even co-exist with selenium deficiency.

The syndromes associated with infertility (retained placenta, abortions, cystic ovaries, etc.) also can commonly be caused by diseases other than selenium deficiency, so you should not supplement with selenium simply because you suspect reproductive disease. Specific diagnosis is important to prevent wasting resources. Furthermore, excess selenium can cause toxicity.

Geographic Distribution Of Selenium Deficiency

The extent of selenium deficiency in dairy cattle in Idaho is not known precisely. However, selenium deficiencies have been confirmed in cattle from all counties within the state. In 19 dairies that were surveyed in Canyon, Gem, Ada and Payette counties, 15 had cattle with selenium deficiency.

Minimum Requirements

The minimum daily requirement of selenium for dairy cattle is approximately 0.1 part per million (ppm) of the diet on a dry weight basis or 2 mg per day for a 1,400-pound cow. Crop surveys in 1941 and 1966 indicated that much of Idaho and the Northwest produces feed that is deficient in selenium. The intensive use of irrigation and fertilizers has compounded the shortage of selenium. Selenium content of feeds varies greatly; one farm can be quite different from the neighboring farm. Additionally, the selenium concentration in alfalfa and other feedstuffs varies from year to year. Certain compounds present in feed and water interfere with selenium absorption and uptake by cows and calves. Commonly, sulfur, sulfates and arsenates in feed or water block an animal's use of selenium.

Table 1. Selenium deficiency syndrome in dairy cattle.

Syndromes	Major features
Nutritional myodegeneration (white muscle disease)	Acute onset, stiffness, skeletal and/or cardiac muscles affected. Signs vary from chronic lameness to death.
Retained placenta	Retained placenta.
Abortions, stillbirths	Late third-trimester abortions and stillbirths.
Neonatal weakness	Neonates born weak with or without gross lesions of nutritional myodegeneration.
Diarrhea	Diarrhea and weight loss in young and adult cattle.
"Ill thrift" syndrome	Decreased feed efficiency, decreased weight gains and unthrifty appearance.
Immune system effects	Poor response to infectious diseases and vaccines.
Myodegeneration in adult cattle	Weakness, myodegeneration, dark red urine.
Infertility	Decreased conception rates, cystic ovaries, irregular estrous cycles, early embryonic death.

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Diagnosis

Selenium deficiency can best be diagnosed by analyzing whole blood for elemental selenium or red blood cells for the selenium-containing enzyme, glutathione peroxidase. These methods allow veterinarians to diagnose selenium deficiencies accurately and quickly. The recommendation is that 10 percent of the herd, or seven animals in herds larger than 60, be tested. Dairy managers need to realize that replacement heifers can be deficient at the same time lactating cows are normal, and vice versa.

Disease Management

Once a diagnosis is made, selenium-deficient cattle can be treated with (1) injectable selenium products, (2) salt mix formulations with supplemental selenium or (3) total-ration formulations with supplemental selenium.

The injectable selenium product contains 1 mg selenium/cc (Bo-Se[®]) and 5 mg selenium/cc (Mu-Se[®]). These products require prescriptions because toxicity can occur in overdoses. The recommended dosage is approximately 2.5 to 3 mg/100 pounds body weight, given intramuscularly or subcutaneously. Depending upon the size and growth rate of the animal patients involved, the dose of injectable selenium provides 30 to 90 days of supplementation. These products can be given repeatedly to maintain adequate selenium status if necessary. The injectables are effective in preventing and treating overt disease in individuals with white muscle disease (nutritional myodegeneration), diarrhea and retained placenta. Injectables are the most effective method for herd therapy. This can be particularly important for selenium-deficient females in the last trimester of pregnancy and for selenium-deficient calves. The injectable products have a long history of safety and efficacy.

In utero transfer of selenium to the fetus is significant even in selenium-deficient females. To decrease the risk of white muscle disease in calves, selenium injections in the cow are often indicated at 30 and/or 60 days before calving as well as to the calf at birth. Because of the efficient transfer of selenium to the offspring, however, a 30- to 60-day oral prepartum supplementation to the mother is more beneficial than the selenium injection. The concentration of selenium in milk falls to comparatively low levels soon after parturition.

The advantages of injectable selenium products include safety, efficacy, uniform supplementation in the

herd, a high degree of availability and ease of strategic supplementation. The disadvantages include limited availability of injected selenium to rumen microbes and the need for repeated injections. Also, there is a 30-day withdrawal period for slaughter cattle treated with these products.

Salt mixes can provide a good vehicle for selenium supplementation. Assuming salt consumption at 1 oz/head/day, a 20-ppm selenium salt mix provides about 25 percent of the daily requirements of an adult cow. A 90-ppm selenium salt mix provides almost the entire daily requirement of an adult cow. Problems with salt mix supplementation include (1) sporadic intake dependent on palatability, location, pasture conditions and time of year; (2) variable intake of individuals within a herd; (3) the need to keep fresh salt mix available at all times and (4) mixing and solubility difficulties. Intake of salt mixes is usually limited because of the salt itself, so toxicosis is unlikely. Salt-mineral mixes are inexpensive, but they tend to be labor intensive. An advantage is that other nutrients can be added to these mixtures, which allows for multiple supplementation.

Generally, veterinarians initially prescribe a 90-ppm selenium salt mix, then monitor salt consumption and the selenium status of the animals in the herd and, if necessary, make appropriate adjustments. The level of supplemental selenium needed depends on the baseline level in the feed and the amounts of interfering elements or compounds that may cause a secondary selenium-deficiency condition.

Supplementation of the total ration or a large portion of it with selenium is also an excellent method. This requires a ration in which feed additives are easily dispersed, e.g., corn silage, grain mixes with supplemented pellets, haylage, etc. This type of supplementation better guarantees a uniform daily intake.

Trade Names

To simplify information, trade names have been used. No endorsement of named products is intended nor is criticism implied of similar products not mentioned.

About the Authors

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