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Selenium Related Disorders in Washington Livestock

Introduction

Selenium is an essential mineral for growth, reproduction, and disease prevention in all animals. Its primary function is to protect cell membranes and proteins from damaging chemicals that are formed during normal animal metabolism. Body selenium concentrations are directly related to dietary intake of selenium in plant products normally fed to livestock. Plant concentrations are directly related to soil selenium concentrations and pH.

Soil, Water, and Plant Selenium

Selenium is widely distributed in the earth's crust. Soil concentrations vary and depend on the rocks from which the soil was derived. Regions such as the Northwest, Southeast, and Great Lakes states have low (<.05 ppm) soil selenium concentrations because their soils were derived from volcanic deposits or well-washed coastal deposits. Soils developed from cretaceous shale, such as found in South Dakota, Montana, Wyoming, Nebraska, Kansas, Utah, Colorado, and New Mexico, tend to have high (2 to 10 ppm) soil selenium concentrations.

Forms of selenium commonly found in soils include: selenides, elemental selenium, selenites, selenates, and organic selenium. Of these, selenate and selenite are the most available for absorption by plants. They are generally found in alkaline, well-aerated soils. The insoluble selenide and elemental selenium are the least available and are found in acidic, poorly aerated soils.

Plant selenium levels are influenced by the plant species involved as well as the form and amount of selenium in the soil. Selenium accumulator plants grow well in seleniferous areas and may accumulate several thousand parts per million (ppm) selenium. Other plants, such as white clover, buffalo grass, and gramma grass, are poor accumulators of selenium. The plant products fed to livestock generally reflect soil concentrations. Thus, most feedstuffs produced in the Northwest are low in selenium and most livestock need supplemental selenium.

Concentrations of selenium in groundwater, wells, lakes, and rivers are generally low and not significant sources. Water from seleniferous areas contains higher levels of selenium, but even these levels do not reduce the need for selenium supplements.

Physiological Role of Selenium

Selenium's primary function in the animal body is as a component of an enzyme called glutathione peroxidase. This enzyme is important in protecting the integrity of cell membranes. During normal metabolism, the cell produces reactive forms of oxygen (peroxides) which, if not altered, will damage the unsaturated fatty acids found in the cell membrane. Membrane damage will disrupt cell function and adversely affect animal health. Glutathione peroxidase is found in red and white blood cells, heart muscle, brain, fat, lungs, liver, kidney, and skeletal muscle. Insufficient dietary selenium results in a glutathione peroxidase deficiency throughout the body.

In this role as a cell membrane protector, selenium works in conjunction with vitamin E. Vitamin E is also a potent antioxidant. Many disease conditions that result from a selenium deficiency may also be associated with a vitamin E deficiency.

Selenium Sources

The primary form of organic selenium found in forages and grains is the very available selenomethionine. Forages and grasses also contain small amounts of selenocysteine. Supplemental sources include sodium selenite and sodium selenate. Both of these and the organic selenium sources are considered to have 100% bioactivity for ruminant animals.

Selenium Responsive Diseases

It is important that livestock producers in the Northwest understand the effects of selenium deficiency in farm animals. Severe selenium deficiency frequently causes significant sickness and death loss in livestock. While not causing a direct disease effect, moderate selenium deficiency does result in lower reproductive efficiency. Table 1 lists the various selenium-related syndromes known to affect cattle and sheep.

Table 1. Selenium Responsive Diseases

Syndrome	Major Clinical Signs
x White Muscle Disease (nutritional myodegeneration)	Acute onset: stiffness, skeletal, and/or cardiac muscles affected. Signs vary from sudden death to chronic lameness.
x Retained placenta	x Retained placenta.
x Abortions, stillbirths	x Late pregnancy abortions and stillbirths.
x Neonatal weakness	x Calves and lambs born weak.
x Diarrhea	Diarrhea, usually profuse, and weight loss in x young and adult cattle.
x Unthriftiness	x Decreased feed efficiency, decreased weight gains, and unthrifty appearance.

- x** **Compromised immune system** **x**
Suppressed immune response to vaccines and environmental microorganisms.
- x** **Infertility** **x**
Decreased conception rate, irregular estrus cycles, early embryonic death.
- xx**

Selenium Situation in Washington

Most Washington soils are moderately to severely deficient in selenium. A survey of the selenium status in Washington cattle was conducted in 1988-89. Blood samples were collected from over 700 cattle in 87 herds in 17 counties. All herds supplemented at 20 ppm selenium in trace mineral salt had severe selenium deficiency: 63% of the herds supplemented at 88-100 ppm had blood selenium values in the normal range. Seventy-nine percent of nonsupplemented herds on native range were also deficient. Of all herds tested, 51% were receiving no selenium supplements and 82% of these were selenium deficient. Overall, 77% of the herds tested were selenium deficient. In summary, the survey showed that:

1.	x A high percentage of Washington cattle producers fail to accept or understand the serious consequences of selenium deficiency in cattle. x
2.	x Many Washington cattle producers do not understand how to approach the selenium problem in their own herds. x

Determining Selenium Status

The only reliable method to determine the selenium status of live animals is by analyzing blood. Blood samples collected from 10-20% of the animals in a herd will provide satisfactory information to determine the selenium status of the entire herd. Blood samples should be collected by a veterinarian and submitted to an animal disease diagnostic laboratory for analysis. Test results are used to determine if selenium supplementation is needed and the approximate level of supplementation required. You should retest whenever you make major changes in feedstuffs, principally forage.

Methods of Selenium Supplementation

There are two ways to supplement selenium in livestock.

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<p>1. Injectable Selenium</p>	<p>Several commercial selenium products are available which, when injected into animals by hypodermic syringe, provide an immediate source of metabolizable selenium. Such products are particularly useful in herds where clinical selenium-responsive disease has been diagnosed, and the immediate need for selenium is urgent. Injectable selenium products provide increased selenium levels in treated animals for about 45 days; thus, the duration of treatment is fairly short. In addition, injectable products are relatively expensive and labor intensive. In summary, injectable selenium is not a feasible method of year-round selenium supplementation for the entire herd.</p> <p>x</p>
<p>2. Trace Mineral Salt with Selenium</p>	<p>x</p> <p>Adding selenium to trace mineral salt is undoubtedly the most practical and least expensive way to increase selenium intake in livestock. The Food and Drug Administration has approved up to 120 ppm in salt for cattle and up to 90 ppm in salt for sheep. These levels generally appear to be adequate. Loose trace mineral salt is recommended. Extremely hard block salt limits intake to unacceptably low amounts. When block salt is used as a matter of convenience under range conditions, semi-soft blocks offer an advantage over loose salt or hard block salt. Semi-soft trace mineral salt blocks with selenium are now available in Washington.</p> <p>x</p>

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