Selenium in Beef Cattle Nutrition

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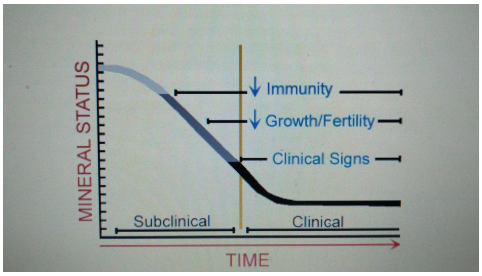
Selenium (Se) was discovered in 1818 but its role in animal nutrition wasn't understood until the 1950's when Se was identified as an essential nutrient. Selenium is thought of as a trace or micro mineral in beef cattle diets. Beef cattle only require 0.10 parts per million (ppm) of Se in the total diet (not the mineral supplement). Although plants in some parts of the country can contain toxic levels of Se, forages grown in many parts of the country do not contain adequate levels of Se for optimum animal performance.

What is Selenium? Selenium is a trace element (mineral) which is incorporated into proteins to make selenoproteins, which are important antioxidant enzymes. One of the most important of these is an enzyme known as glutathione peroxidase. The antioxidant properties of Se-inclusive enzyme systems help prevent cellular damage from free radicals. Free radicals are natural by-products of oxygen metabolism and a functional immune system that may contribute to the development of health problems.

What are the deficiency symptoms? The classic clinical deficiency of Se and Vitamin E is white muscle disease which is myodegeneration of the heart muscle. However, as all good managers know, there are a lot of "unseen" problems in a nutritional deficiency before cattle exhibit clinical signs – such as decreased immunity, growth and fertility.



As indicated in the chart, immunity, growth and reproduction can be impaired before clinical symptoms appear. For example, cattle that have a compromised immune system may not mount an immune response despite being vaccinated for various diseases. Do not wait until clinical signs appear to supply trace minerals to cattle diets.

Dietary sources of selenium Plants (forage and grain crops) are the major dietary source of Se. The Se content of plants is influenced by the concentration and availability of Se in the soil. Feedstuffs grown in Se-deficient areas are poor sources of Se. Areas in the U.S. like the Northwest, Great Lakes Region, West Coast, Eastern Seaboard and the Southeast may have low Se soils where deficiencies can be a problem.

Beef cattle require 0.1 ppm (mg/kg) of Se in the diet to meet their daily requirements. Much of the forages and grain grown in certain areas of the U.S. are at levels which allow those areas to be classified as low (where 80% of all forage and grain contains less than 0.05 ppm of Se). The Southeast (like Kentucky) is classified as low to variable. However, beef cattle operations in this region seem to have a high percentage of Se-deficient (less than 0.08 ppm Se in whole blood) animals.

An important factor affecting Se content of forages is soil pH. In general, plants grown in acid soil will absorb less Se than plants grown in alkaline soils. Another factor is the concentration of sulfur (S) in the soil. Se and S are chemically similar and compete for absorption by the plant. Thus, high levels of S in the soil may lower the Se content of the forage. Sulfate fertilizers can decrease the Se content of plants, which may not hurt the plants but can have a detrimental effect on cattle that graze them.

How do we overcome low dietary levels of Se? Cattle require 0.1 ppm Se in their diet to meet their daily requirement, so supplemental Se is needed for diets grown on low-Se soils. Supplemental Se is generally supplied to cattle in a free-choice salt/mineral supplement. The FDA allows for up to 120 ppm Se, regardless of source, to be added to the mineral supplement for free-choice feeding to provide a maximum of 3 mg per head daily. Feedtags on mineral supplements will generally indicate the expected level of consumption and Se is added to provide 3 mg at that level of intake. For example, at an indicated level of intake of 3 oz per head per day, the mineral supplement may contain 35 ppm Se. At 4 oz intake the Se level would be reduced to 26 ppm to stay for the 3 mg per head daily level.

What about the form of Se? Se is usually added to the feed in inorganic forms as sodium selenite or selenate. Se is usually found in plants combined with amino acids – selenomethionine and selenocysteine so it is logical to wonder if these "organic" forms of Se might not be more available to the animal than the "inorganic" (like sodium selenite) form. Recently, Se enriched yeast, in which selenomethionine is the predominant form of Se, has become available and has been approved for

use by the FDA. Sodium selenite is used primarily because it is less expensive. Organic forms of Se need to be more available and/or effective in order to be an economic alternative to sodium selenite.

Are there any advantages for Organic Se? Researchers at the Kentucky station conducted a trial with individually-fed beef heifers which received no Se, inorganic Se (sodium selenite) or organic Se (Sel-Plex®) at the 3 mg/hd/day rate. More Se was found in jugular whole blood, red blood cells and biopsied liver tissue of the heifers receiving either form of Se than in the unsupplemented heifers. However, organic Se animals had more Se in these tissues than calves which were receiving sodium selenite. Analyses of liver tissue gene expression revealed that the content of at least 80 mRNA was affected by the form of Se. Three Se supplement-dependent gene groups were identified: ISe-dependent, OSe-dependent and Se form-independent. Since the form of Se affects genetic expression differently, it made sense to look at a mixture of the two forms – with 50% of the 3 mg per day coming from each source. Also, all forms of Se were associated with unique liver gene expression profiles.

A long-term trial (224 days) was conducted with growing beef heifers to see what effect an equal blend of ISe:OSe would have on Se tissue concentrations. Calves received no Se, Inorganic Se, Organic Se or 1:1 Mixture of OSe and ISe. More Se was found in whole blood and liver of the calves receiving the mix or the organic Se than those receiving the inorganic Se – and all were greater than the controls.

Additional trials have been conducted including a three year study with cows on pasture with free individual access to one of the following treatments containing 35 ppm of Se – inorganic (sodium Selenite), organic (Sel-Plex®) or a 1:1 mixture of the two. Cow Se treatment differentially affected both cow and suckling calf Se blood concentrations resulting in adequate concentrations for all cows but inadequate concentrations for the calves of cows which received the inorganic Se (sodium selenite).