

Selenium - A Unique Trace Element

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Selenium is an interesting essential trace mineral that is required in very minute amounts by all animals including pigs. This trace element is especially important to Kentucky because we are in a very selenium deficient area of the United States.

In the early days, selenium was classified as a toxic element rather than an essential nutrient. The reason was that animals (primarily horses and cattle) grazing pastures in the Rocky Mountain states and the Dakotas exhibited toxicity symptoms. In severe selenium toxicity situations, animals lost their hair and hooves.

Clinical signs of selenium toxicity in horses were first reported in 1860 by an army surgeon stationed in South Dakota. It is speculated that the defeat of General Custer in the battle of Little Big Horn in Montana in 1876 may have been caused by lameness in horses that had been affected by selenium poisoning. Clinical signs of selenosis in livestock were also observed by settlers who came to the northern American Great Plains (Nebraska and South Dakota) during the 1890s.

Selenium's beneficial role was first discovered in 1957 when it was found that it prevented liver degeneration in rats. Shortly thereafter, selenium was found to prevent certain clinical diseases in chicks, calves, lambs, and pigs.

In the 1960s, selenium deficiencies in swine were being reported in some areas of the Midwest, mainly in Indiana, Ohio, and Michigan. Typical symptoms of selenium deficiency in pigs are very similar to those of vitamin E deficiency. They include muscular dystrophy, pale muscles, small hemorrhages in heart muscle (called "mulberry heart"), and necrosis of the liver.

At one time, selenium was considered a suspect carcinogen (cancer producing compound), so even though it had major beneficial effects in selenium-deficient areas, it was illegal to add selenium to feed. However, in 1974, the FDA finally allowed feed manufacturers to add selenium to feed at a level of .1 ppm. Eight years later, in 1982, the allowable supplemental level was raised to .3 ppm for young pigs. In 1987, the allowable level was changed to .3 ppm for all weights and classes of swine.

What makes selenium so important to Kentucky is that we are in an area in which the soils are low in selenium and the condition of those soils are such that corn, soybeans, and other crops grown on those soils are extremely deficient in selenium. Michigan, Indiana, Ohio, and Kentucky seem to be the major hog-producing states that are deficient in selenium.

Recently, we participated in a study to assess the selenium content of corn and soybean meal produced in various areas of the midwest. Corn and soybean meal samples were obtained from universities in 13 states over a 3-year period and analyzed for selenium at six different laboratories. Figures 1 and 2 show the range in selenium levels from those states. Note that corn from Iowa, South Dakota, North Dakota, Missouri, and Kansas were quite high in selenium and corn from Illinois, Wisconsin, Indiana, Michigan, Ohio, and Kentucky were exceptionally low. Soybean meal from Nebraska, North Dakota, Iowa, South Dakota, Minnesota, and Kansas were high in selenium and samples from Michigan, Kentucky, Indiana, and Ohio were low. Interestingly, the range from the highest to lowest in both corn and soybean meal was more than a 7-fold difference.

In this same study, we found that the range from the highest to lowest concentrations of other minerals among sources of corn and soybean meal was considerably less. For example, calcium ranged from .04 to .01% in corn and from .45 to .21% in soybean meal. Likewise, phosphorus ranged from .29 to .22% in corn and from .70 to .59% in soybean meal.

The results of this study emphasize the fact that diets of pigs fed cereal grains and soybean meal produced in this part of the country must be supplemented with selenium. The requirement for selenium listed by the National Research Council (1998) is .30 ppm for weanling pigs and .15% for growing-finishing pigs, gestating-lactating sows, and breeding boars. Selenium will generally be included in trace mineral premixes, base mixes, or complete supplements that are sold to producers in Kentucky.

Incidentally, some studies with laboratory species suggest that selenium may help to prevent certain types of cancer, and that it improves immunity to certain diseases. There is also interest in the benefits of supplemental selenium in human diets. Thus, it should not be surprising that selenium is one of the "hot" selling items in health food stores across the country.

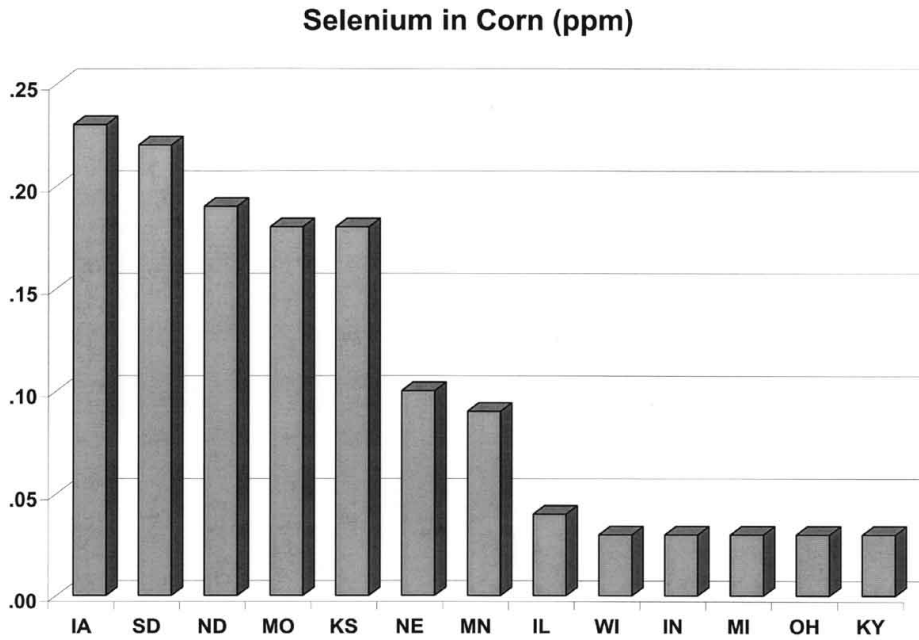


Figure 1. Selenium content of corn obtained from 13 states in the midwest over a 3-year period. The pig's requirement for selenium is .15 to .30 ppm.

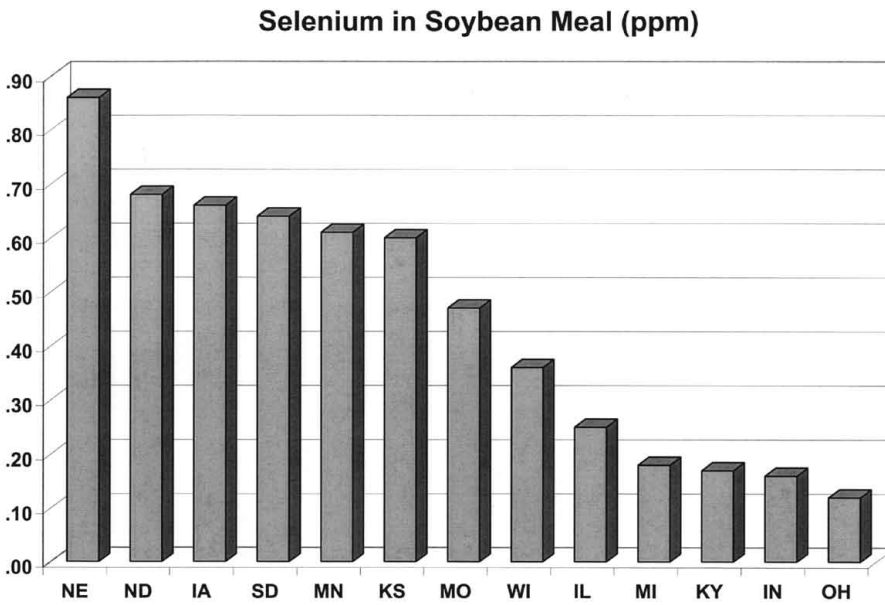


Figure 2. Selenium content of soybean meal obtained from 13 states in the midwest over a 3-year period. The pig's requirement for selenium is .15 to .30 ppm. If soybean meal is included in the diet at 25%, it would need to contain .60 to 1.20 ppm selenium to meet the requirement.