INFO SHEET
Veterinary Services

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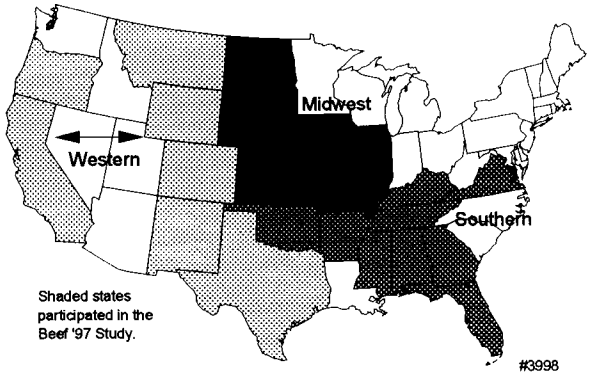
Serum Zinc Concentrations of U.S. Beef Cattle

Zinc has been known to be an essential trace mineral for many years. It is required for the proper functioning of many cellular processes throughout the body. Zinc has roles in the structure and activation of many enzyme systems, particularly for the synthesis of DNA, RNA, and proteins, and is important in normal carbohydrate metabolism. The National Research Council[1] (NRC, 1996) recommended 30 ppm (mg/kg) as the dietary requirement of zinc on a dry matter basis for beef cattle.

A ***severe*** zinc deficiency often results in a decreased growth rate, decreased feed intake and efficiency, listlessness, increased salivation, decreased testicle size, scaly skin conditions, wounds that take longer than normal to heal, and hair loss. Effects of a ***moderate*** zinc deficiency are harder to recognize and cause significant economic losses through impaired immunity and decreased growth, rate feed efficiency, and fertility. Consequently, severe and moderate zinc deficiencies result in substantial losses to the U.S. cattle industry each year. Importantly, the producer does not generally recognize these losses in many, if not most, instances.

The USDA's National Animal Health Monitoring System (NAHMS) collected blood-serum samples from cattle during the NAHMS Beef '97 study. This study included 2,713 operations from the 23 leading cow-calf states (Figure 1).[2] Serum samples were collected from cattle on 411 operations with five or more cows, and a maximum of 10 samples were collected from each herd. A total of 3,902 serum samples were analyzed for zinc content.

Figure 1
NAHMS Beef '97 Regions for Trace Mineral Analysis



Categories used to describe the adequacy of serum zinc concentration for individual animals or operation means were[3]:

- *Adequate* (1.0 ppm and greater)
- *Moderately deficient* (0.7 ppm and greater, but less than 1.0 ppm), and
- *Severely deficient* (less than 0.7 ppm).

It should be noted that serum zinc concentrations are quite variable; they can fluctuate quickly due to stress or recent change in dietary zinc supplementation. These facts should be taken into consideration when interpreting these results.

Beef '97 study results showed no evidence of regional variation in mean serum zinc concentrations at the operation level. The mean serum zinc concentration of operations in the Western, Midwest and Southern regions were 0.97, 0.97 and 0.98 ppm, respectively.

Approximately 25.6 percent of operations had at least one severely zinc deficient animal, whereas 93.9 percent of operations had at least one moderately or severely zinc deficient animal.

[1] National Research Council. 1996. Nutrient Requirements of Beef Cattle. Washington, DC: National Academy of Sciences.

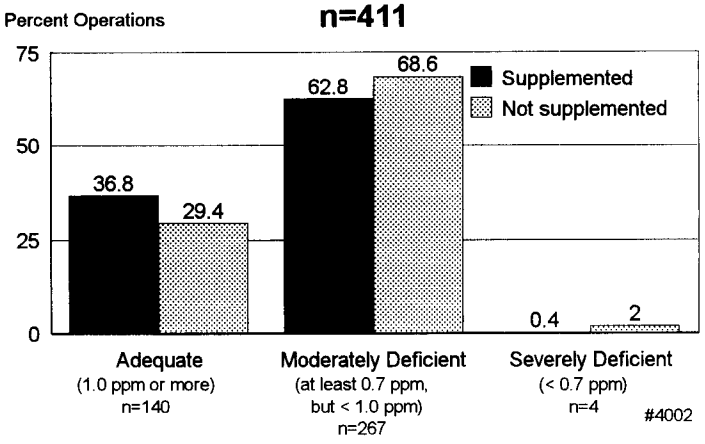
[2] Alabama, Arkansas, California, Colorado, Florida, Georgia, Illinois, Iowa, Kansas, Kentucky, Mississippi, Missouri, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Tennessee, Texas, Virginia and Wyoming.

[3] Colorado State University Veterinary Diagnostic Laboratory.

Approximately 63 percent of operations provided supplemental zinc to their cows, and this proportion was similar among regions. Methods of supplementation for cattle (and percent of operations that supplemented using each method) were free choice minerals (93.8 percent), included in the ration (4.3 percent), or included in the ration and free choice (1.9 percent).

Figure 2

Percent of Operations by Serum Zinc Concentration Level and by Supplementation n=411



Cattle provided any zinc supplement had higher blood serum zinc concentrations (0.98 vs. 0.96 ppm). Of the operations that did not provide supplemental zinc, 68.6 and 2.0 percent were considered as moderately and severely zinc deficient, respectively (Figure 2), whereas 62.8 and 0.4 percent of operations that supplemented were classified as moderately and severely zinc deficient, respectively. Therefore, a higher percentage of operations, though not all, had adequate serum zinc concentrations when supplemental zinc was provided to cows.

Why so many of the operations that provided zinc supplements fell in the deficient category is unclear. Likely this outcome was due to a number of factors, such as:

- Not all sources of zinc have equivalent bioavailability (percent of zinc supplied that is actually absorbed from the gastrointestinal [GI] tract and then incorporated into cellular processes.) For example, zinc oxide is reported to be absorbed from the GI tract to a lesser extent than zinc sulfate. The choice of zinc source may have influenced the number of operations that were considered zinc deficient.
- The quantity of supplemental zinc may have been insufficient to adequately overcome a pre-existing deficiency (data not collected.)
- Serum zinc concentrations respond quickly to dietary zinc intake and stressors. Had the supplement been recently removed from the cattle or had they been subjected to adverse stressors, the serum zinc concentration may have been temporarily reduced at the time of sampling.

An important consideration is that ***if no supplementation had been provided to any cattle, the percentage of operations considered deficient in serum zinc likely would have increased.***

Results of the Beef' 97 study showed that 65.9 percent of operations and 59.7 percent of cattle were considered ***moderately or severely*** deficient in zinc. One percent of operations and 4.4 percent of cattle were considered ***severely*** deficient. Importantly, 77.0 percent of forage samples collected as part of the same study and analyzed for trace mineral content were found to have inadequate zinc to meet the requirements for beef cattle.[1] Therefore, it would seem that supplemental zinc provided to the cattle may have been partially successful in improving serum zinc concentrations.

It is well recognized that adequate zinc supplementation as part of a complete mineral program is indicated on a high proportion of U.S. cattle ranches. However, in spite of supplementation, many cattle maintained inadequate serum zinc concentrations. The largest economic losses that result from zinc deficiency are due to problems that are hard to recognize such as decreased growth rate, poor feed efficiency, decreased reproductive performance, decreased concentrations of vitamin A, and adversely affected immune status. For example, zinc deficient males generally have decreased testicular size and semen quality which may result in substantial levels of reproductive failure. Additionally, offspring born to zinc deficient dams have been shown to have a lower level of immunity even if the offspring are fed adequate amounts of zinc.

NAHMS Beef '97 results would suggest that nutritional analyses should include zinc concentration and that, where indicated, adequate quantity and quality of zinc supplementation should be provided to cows.

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N307.0200

[1]USDA:APHIS:VS. 1999. NAHMS Forage Analyses in 23 States, N303.499.