



Reproduction and Immune Impacts from Vitamin or Mineral Deficiencies: Determining if Your Herd Is Deficient

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Introduction

Recognizing if, or when, your herd has a vitamin or mineral deficiency can be frustrating for cattle producers. Often clinical signs are vague or subtle and may mimic other more talked about diseases, with

decreased reproduction and immune function being the most serious for the producer. Table 1 outlines common deficiencies and their clinical signs. Confusion exists as to which is the best sample to submit if a producer suspects an issue with vitamins or minerals, or would like to assess herd status.

Table 1. Common Bovine Vitamin and Mineral Deficiencies, Clinical Signs, and Normal Values (Table created from Hall, 2010)

Deficient Element	Possible Clinical Signs from Deficiency	Best Sample to Use
Copper	Reduced growth, decreased feed conversion, abomasal ulcers, lack of hair color (achromotrichia), and decreased reproduction	Liver tissue. Serum should be used only for screening purposes
Manganese	Decreased reproductive function, skeletal abnormalities and decreased growth rate. Neonates may be weak, small, and develop enlarged joints or limb deformities	Liver tissue or serum
Selenium	Reduced growth rates, poor feed efficiency, poor immune function, impaired reproductive performance, and muscle damage (i.e., White Muscle Disease)	Liver, whole blood (glutathione peroxidase), or serum (recent intake)
Zinc	Reduced growth, poor immune function, diminished reproductive performance, and poor offspring viability as well as skin lesions in severe cases	Liver or serum
Vitamin A	Poor growth rates, poor feed intake, poor immune function, poor reproductive performance, and increased incidences of diarrhea in calves	Liver or serum (store samples frozen and protected from light)
Vitamin E	Poor growth rates, poor immune function, poor reproductive performance, poor muscle function, poor cardiovascular function, and "white muscle disease."	Serum or liver (store samples frozen and protected from light)

Reproduction

Vitamins and minerals play a major role in reproduction. All of the vitamins and minerals listed in Table 2 can cause reproductive issues if supplied in inadequate amounts. As an example, Vitamin E and selenium work

to detoxify free radicals and can be called antioxidants. Without adequate Vitamin E and selenium, retained fetal membranes are commonly seen. While not 100%, if you have abnormally high numbers of retained placentas (fetal membranes), Vitamin E and selenium could be deficient in the herd.

Table 2. Role of micronutrients in reproduction (adapted from Smith and Akinbamijo, 2000)

Micronutrient	Mechanism/metabolic function	Deficiency consequences
Vitamin A	Steroidogenesis, embryonic synchrony	Delayed puberty, low conception rate, high embryonic mortality, reduced libido
Vitamin E	Intra-membrane free radical detoxification	Low sperm concentration and high incidence of cytoplasmic droplets, retained fetal membranes
Selenium	Component of GSH-Px	Reduced sperm motility and uterine contraction, cystic ovaries, low fertility rate, retained fetal membranes
Copper	Enzyme component and catalyst involved in steroidogenesis, and prostaglandin synthesis	Low fertility, delayed/depressed estrus, abortion/fetal resorption.
Zinc	Constituent of several metallo-enzymes; steroidogenesis, carbohydrate and protein metabolism	Impaired spermatogenesis and development of secondary sex organs in males, reduced fertility and litter size in multiparous species

Immune Function

Vitamins and minerals play a major role in developing and maintaining an adequate immune response. Copper, selenium, Vitamin E and cobalt deficiencies in cattle reduce the ability of white blood cells (i.e., neutrophils) to kill pathogens. Copper deficiency reduces antibody production, but cell-mediated immunity is generally not altered. However, copper deficiency appears to reduce production of immune signal chemicals (i.e., interferon and tumor necrosis factor) by white blood cells (i.e., mononuclear). Vitamin E and/or selenium deficiency have been linked to increased susceptibility of dairy cows to mastitis (Spears 2000). Knowing the vitamin and mineral status of your herd is paramount for an effective preventative health program. Deficiencies may result in a suboptimal immune response to vaccination programs.

Sampling

With the exception of the vitamins discussed in Table 1, liver is consistently the best sample choice to use to determine the mineral status of an animal or herd. Whole blood, while easiest to obtain and prepare, is often not the best choice. Blood and serum levels may not reflect the true status of the animal. This is due to the animal's body wanting to maintain as high a blood or serum level at the expense of organ levels. For example, the animal may be in a plane of nutritional deficiency such that the liver is deficient, but there is still adequate levels present to reflect a normal blood or serum range. In this example, sampling that particular cow with blood or serum may indicate a normal status when in fact she is deficient. Copper is a good example of this phenomenon.

Liver sampling can be performed on a properly restrained animal with minimal risk to producer or animal. After restraining the animal in a squeeze chute and surgically preparing a small area on the right side of the rib cage, the veterinarian uses a true-cut biopsy instrument to obtain two small samples of the liver for submission. This minimally invasive procedure is tolerated remarkably well by the animal. Utah State University extension has trained Utah practicing veterinarians on liver sampling and has produced an instructional video illustrating the procedure.

Vitamins can degrade rapidly with heat and exposure to sunlight. Samples for vitamin analysis need to be frozen and stored away from light until analysis is performed. To prepare serum samples, the whole blood should be spun down within 1 to 2 hours of collection. The lubricant in a red topped tube may contain the mineral zinc. The optimal sample tube to use for vitamin and mineral assessment is a royal blue topped tube.

Number of Animals to Sample

Collect and submit samples from 10% of your herd or 10 animals, whichever number is smaller, to determine herd status. Randomly select the animals to reflect all the different animals and different stages of production. When any animals die or are custom slaughtered on your ranch, cut a small (1inch square) piece of liver and freeze to submit.

Cost

The nationally accredited Utah Veterinary Diagnostic Laboratory (UVDL) is partially state funded. As such, diagnostic testing is often very economical when compared to private laboratories. For mineral testing, the laboratory offers a 28 element screen for \$43 (includes accession and setup fee). Call the lab for a price quote for large numbers.

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Summary

Vitamins and minerals are important nutritional requirements of cattle. Deficiencies often are vague and difficult to determine, yet can cause tremendous production losses. Knowing the vitamin and mineral status of your herd is part of the process in determining the optimum supplementation program. Liver is often the preferred sample choice for minerals. Serum is the choice for vitamins. A standing liver biopsy can be performed in the field by trained veterinarians. Animal vitamin and mineral status should be used in determining your herd's nutritional needs.

References

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