

The Role of Minerals in Dairy Cattle Nutrition

A number of minerals are essential for maintenance, growth, production and reproduction of dairy animals. Those required in large amounts are referred to as macrominerals and include calcium, phosphorus, sodium, chlorine, potassium, magnesium, and sulfur. The macrominerals are important structural components of bone and other tissues and serve as important constituents of body fluids. They play vital roles in the maintenance of acid-base balance, osmotic pressure, membrane electric potential and nervous transmission. Minerals required in smaller amounts are referred to as micro- or trace minerals. This group includes cobalt, copper, iodine, iron, manganese, molybdenum, selenium, zinc, and perhaps chromium and fluorine. The trace minerals are present in body tissues in very low concentrations and often serve as components of enzymes and hormones.

Specific functions of the essential minerals and signs of their deficiency are as follows:

Macrominerals:

Calcium (Ca): A component of body fluids, muscle, bone and the blood clotting mechanism. Regulates heart beat, muscle function and nerve impulses.

Signs of Deficiency: softened, deformed, bones; Rickets and Osteomalacia.

Chlorine (Cl): Responsible for the regulation of fluids and acid-base balance in body systems; secreted as HCl in the abomasum.

Signs of Deficiency: unthrifty appearance, rough coat, rapid weight loss.

Magnesium (Mg): Has a role in skeletal structure, nerve transmission and enzyme function.

Signs of Deficiency: In calves: poor growth and deformed bones. In mature cattle: Grass Tetany.

Phosphorus (P): Responsible for bone formation; constituent of body tissues, blood, phospholipids, nucleotides and enzymes.

Signs of Deficiency: Rickets, Osteomalacia, eating dirt, reproductive problems.

Potassium (K): Maintains fluid balance; responsible for nerve impulses, muscle contraction, oxygen and carbon dioxide transport, acid-base balance and enzyme activation.

Signs of Deficiency: Weight loss and decreased appetite.

...continued

The Role of Minerals in Dairy Cattle Nutrition (continued)

Sodium (Na): Regulation of body fluids and acid-base balance; responsible for the active transport of glucose and amino acids throughout the body; involved in muscle contraction and bile function.

Signs of Deficiency: Same as for chloride.

Sulphur (S): Required in amino acids, vitamins and coenzymes; regulates acid-base balance and carbohydrate and lipid metabolism; found in most body fluids, blood cells and heparin (which regulates blood clotting).

Signs of Deficiency: Decreased weight gain.

Trace Minerals:

Cobalt (Co): Used by rumen microbes to synthesize Vitamin B₁₂.

Signs of Deficiency: Rough coat, scales, anestrus, abortion, emaciation, anemia.

Copper (Cu): A component of enzyme systems.

Signs of Deficiency: Anemia, lack of hair pigment, lesions and hemorrhages.

Iron (Fe): Required in hemoglobin in blood and myoglobin in muscles; a component of enzymes.

Signs of Deficiency: Anemia.

Iodine (I): A component of thyroxine which is secreted by the thyroid gland to regulate basal metabolism, growth, reproduction and lactation.

Signs of Deficiency: When dams are deficient, newborns will have goitre.

Manganese (Mn): Component of bone matrix; responsible for the maintenance of equilibrium; a constituent of enzymes, glycoproteins and transferases; has a role in lipid and carbohydrate metabolism

Signs of Deficiency: Enlarged joints, stiffness, twisted legs, general weakness and reduced bone strength.

Selenium (Se): Enzyme component; works as an antioxidant along with Vitamin E.

Signs of Deficiency: White muscle disease in calves; reproductive problems in adults.

...continued

The Role of Minerals in Dairy Cattle Nutrition (continued)

Zinc (Zn): constituent of enzymes, particularly those involved in carbohydrate metabolism; has a role in the structure of DNA (deoxyribonucleic acid) and RNA (ribonucleic acid); important role in the synthesis of some proteins, especially keratin (the protein of skin, hoof and horn).

Signs of Deficiency: Dermatitis, slowed growth, anorexia, rough coat, bone density, hypogonadism, suppression of secondary sex characteristics, dwarfism, delayed wound healing.