



Beef Cattle Nutrition, Minerals

Troy D. Cooper, Extension Associate Professor, Duchesne County
Darrell Rothlisberger, Extension Associate Professor, Rich County
Dale ZoBell, Professor, Extension Beef Specialist, Utah State University

Beef cattle require a number of dietary mineral elements for regular bodily maintenance, growth and reproduction. Minerals that are essential in larger amounts are labeled as major or macro elements. Those needed in smaller amounts are called micro, minor or trace minerals. These terms, have no relationship to the metabolic significance of a mineral in the diet. A trace mineral can be as crucial to the health and performance of an animal as a major mineral. The major minerals include calcium, phosphorus, magnesium, potassium, sodium, chlorine and sulfur. Among those required in trace amounts include iron, zinc, manganese, copper, iodine, cobalt and selenium (Hale and Olson, 2001).

Mineral requirements can vary from as much as 1.0% calcium for young, growing animals to as little as .000010% (.10 ppm) for selenium. Minerals are obtained by the animal from feed, water, soil or mineral supplements. The source is not important as long as the animal receives adequate supplies to meet mineral requirements (ZoBell, 2000).

Major Minerals

Calcium

Calcium is necessary for the formation and maintenance of bones and teeth, development of enzymes, hormones and muscle. Calcium requirements change depending on animal age and production status. Forages are usually good sources of calcium, while cereals are at best a marginal



Figure 1. Calcium

source. Calcium deficiency is commonly manifested as “Milk Fever” in high producing lactating cows. Abnormal bone growth, reduced milk production, retained placentas, stillborn calves and poor reproductive performance are common symptoms of a calcium deficiency.

Phosphorus

Phosphorus works in combination with calcium in the formation of bone. Grains are considered a good source and forages are a subsidiary supplier of phosphorus. Because of their mutual role in bone metabolism, calcium supplementation and phosphorus supplementation are usually considered at the same time. The recommended calcium-to-phosphorus ratio in ruminant diets is 2:1 to 1.2:1. Significant deviation from this ratio can result in abnormal bone growth and a condition known as water-belly (Hale and Olson, 2001). Phosphorus deficiency can result in low conception rates, reduced feed intake, poor feed efficiency, lower growth rate, reduced milk production, reproductive failures and skeletal abnormalities. A common symptom of phosphorus deficiency is often seen as the unusual habit of an animal eating or chewing foreign substances such as dirt or wood. Since the body pool of phosphorus is low, phosphorus deficiencies of this mineral are very quickly expressed physiologically. A Vitamin D deficiency or an excess in dietary calcium will reduce the absorption of phosphorus.



Figure 2. Red phosphorus

Magnesium

Magnesium is an activator of many metabolic enzymes. Since high levels of calcium and phosphorus intake may decrease the accessibility of dietary magnesium, care should be taken to correct any deficiencies resulting from this problem. Grass Tetany is a magnesium deficiency occurring when animals graze flourishing green pasture. This disease is expressed by nervous twitching



Figure 3. Magnesium oxide

and lack of muscle coordination. A simultaneous clinical symptom may be a calcium deficiency. High potassium levels and nitrogen fertilization of pastures may cause increased incidences of this condition. Magnesium oxide supplied in the mineral mix will prevent this deficiency.

Potassium

Potassium is everywhere in the body of mammals because it is required in large amounts by most organ systems for normal function. Forages usually have sufficient potassium to meet animal needs; however, cereal grains can be low in this nutrient. Potassium is of major importance in osmotic balance, acid-base balance, and in maintaining body water balance. Growth retardation, unsteady gait, general overall muscle weakness



Figure 5. Potassium sulfate

and eating or chewing of foreign substances is associated with potassium deficiencies. Under certain growing conditions (drought, cool growing temperatures, high levels of soil fertility), cereal crops can accumulate very high levels of potassium. Excessive levels of potassium can impair calcium and magnesium absorption.

Sodium and Chlorine (Salt)

The requirement for sodium and chlorine is commonly expressed as a salt requirement. Both sodium and chlorine function to regulate body pH and the amount of water retained in the body (Lawton, 2013). Sodium is involved in muscle and nerve function. Chlorine is essential for hydrochloric acid production in the abomasum and for carbon dioxide



Figure 6. Granulated salt

transport (Hale and Olsen, 2001). Deficiency symptoms display themselves as a poor appetite and reduced performance of the animal. Salt is the only mineral that animals show a particular desire to consume and therefore is a useful carrier for the other essential minerals. Salt can also be used to regulate the intake of minerals and feedstuffs.

Sulfur

Sulfur is present in protein, certain vitamins (thiamin and biotin), enzymes and other compounds. Excessive sulfur interferes with the metabolism of selenium, copper, molybdenum and thiamin. Sulfur deficiency symptoms include decreased feed intake, unthrifty appearance, drabness of the hair coat and hair loss.



Figure 7. Sulfur

Trace Minerals

Iron

Iron functions in oxidative enzyme systems involved in energy metabolism. It also enables the hemoglobin in red blood cells to carry oxygen to the tissues of the body. Milk is low in iron, so young animals are likely to have “nutritional anemia” from a deficiency of iron caused by an exclusive milk diet; however, iron deficiency is rarely seen in calves raised in a pasture setting (Hale and Olsen, 2001). Other iron deficiency symptoms include reduced feed intake and pale mucus membranes. A deficiency of iron is not likely to occur with adult cattle that have been provided with reasonable parasite control.



Figure 4. Iron sulfate

Zinc

Enzymes for protein and carbohydrate metabolism require zinc. The immune system also requires zinc to function correctly. Deficiency symptoms of zinc include failure to grow and gain weight, scabby skin on the legs, slow wound healing, excessive salivation, loss of hair, and dermatitis over the entire body. A deficiency of zinc is not likely to occur under normal feeding conditions; however, high calcium in the diet has been shown to interfere with zinc absorption in the gut.



Figure 8. Zinc oxide

Manganese

Manganese functions as a part of numerous enzyme systems. High levels of dietary calcium and phosphorus may interfere with manganese metabolism, causing the dietary requirement for manganese to increase. Deficiency symptoms include reduced fertility in cows and crooked calf syndrome in



Figure 9. Manganese

young calves. Crooked calf syndrome is typified by weak legs and swollen joints in newborn calves.

Copper

Copper deficiencies are fairly common among cattle that



Figure 10. Copper sulfate

consume forages as a major portion of their diet. Deficiency symptoms include poor health, bleaching of the hair coat, and anemia. If a copper deficiency is suspected, it may be advisable to have the diet analyzed for sulfur, molybdenum and iron content in addition to copper. These minerals are known to interfere with copper

absorption, thus increasing the copper requirement. Just as levels of molybdenum, iron and sulfur influence the copper requirement, they also influence the level of copper needed to elicit toxicity symptoms. Copper toxicity symptoms include hemolysis (breakdown of red blood cells), hemoglobin urea (hemoglobin in the urine) and jaundice. Death may result after extended periods of toxicity (Hale and Olsen, 2001).

Iodine

Iodine is essential for production of thyroxin, a hormone



Figure 11. Iodine crystals

that regulates metabolic rate. A deficiency in iodine causes a condition called goiter, which is characterized by an enlarged thyroid gland. Other deficiency symptoms include weak or hairless calves, reduced reproductive performance and retained placentas. Beef rations that are high in nitrates interfere

with the uptake of iodine by the thyroid gland.

Supplementation with iodized salt is recommended for cattle consuming high-nitrate feeds and for pregnant cows. Adequate iodine is extremely important in pregnant cow diets to ensure normal development of the calf. Calves born to severely deficient cows may be blind, hairless, weak or stillborn. Calves born to cows that are even slightly deficient may have goiter. In nearly all instances, iodized salt is an acceptable iodine supplement for beef cattle.

Cobalt



Figure 12. Cobalt blue

Cobalt is required for synthesis of vitamin B12. Since vitamin B12 synthesis occurs in the rumen, cobalt must be consumed in the diet. Deficiency symptoms for cobalt include loss of appetite in the early stages of deficiency, followed by muscle wasting and

anemia. Vitamin B12 levels in the liver are a useful indicator of cobalt status. Cobalt supplementation is advisable for beef cows wintered on low-quality roughages of all types.

Selenium

The potential of selenium deficiency has been widely recognized throughout the U.S.



Figure 13. Selenium granules

Unlike most other essential trace nutrients, selenium supplementation offers a narrow range between deficiency and toxicity (Boyles, S.L.). Occasional soil and feed tests are necessary to determine if selenium deficiency may be a problem on a particular

farm. One of the most familiar symptoms of selenium deficiency is white muscle disease, a muscular degeneration in young calves. A deficiency of selenium in gestating cows may cause retained placentas. Selenium toxicity, which occurs primarily in cattle and sheep grazing on alkali soils in the West, is called “blind staggers,” alkali disease, or forage poisoning. Selenium and vitamin E have similar metabolic activities. As a result, they tend to spare one another so that the selenium requirement of beef cattle depends on the amount of vitamin E in the diet. Selenium is generally added to mineral mixtures in the form of sodium selenite. Selenium is very toxic and should be used in a premixed form only (Lawton, reviewed 2013).

According to, Dr. Dale ZoBell, Utah State University Extension Beef Specialist, “To keep your cattle healthy and functioning efficiently it is recommended the following trace mineral mix, or something close to it, be fed year round. This would include all calves, cows and bulls.”

Trace minerals ppm = mg/kg

Zinc 7500 ppm

Manganese 5000 ppm

Copper 2500 ppm

Iodine 70 ppm

Cobalt 40 ppm

Iron 1600 ppm

Selenium 120 ppm

Salt 93%

These levels can vary slightly but should approximate this example.

If macro minerals are required as well they can be added to the mix, assuming it is presented in loose form. Do not feed these copper levels to sheep.

How to Know if Supplementation Is Necessary

Minerals have been deposited in soils over countless years. The amounts and types of each mineral found in Utah soils will vary considerably. The amount of mineral contained in a sample of forage is dictated to a large degree by the concentration of the mineral that was available in the soil as it grew. There is usually a direct correlation between the mineral concentration in the soil and plant material that is grown in that soil (ZoBell, 2000).



Figure 14. Feed core sampler



Figure 15. Core sampling of a round bale

The concentration of a given mineral in a sample of plant material can be determined in a laboratory. Laboratories are available to perform tests conveniently and economically. A sample of plant material should be tested from every field producing feed for livestock. This should be done every 5 to 7 years since mineral levels will vary depending on the soil type and the application of fertilizer. Feed samples should be taken from the feeds that are being fed to the cattle along with clippings from pastures and sent to the laboratory for analysis. Feed

testing will assist in the development of a balanced supplementation program that will provide animals with the nutrients necessary to meet targeted production goals.

Methods of Supplementation

Free choice feeding of minerals is probably the easiest and most wide-spread practice of supplying minerals; however, with this method of supplementation, wide variation of intake can exist. Free choice intake is dependent on several factors: palatability of the mineral preparation, water quality and hardness, mineral content of the feeds, types of feeds, physical location of the mineral and individual animal preferences.



Figure 16. Cattle consuming free choice mineral mix

Mixing salt with the cattle mineral supplement will generally

encourage consumption and tends to prevent excessive intakes. However, where a high salt content exists in the feed or water, this practice may not hold true.

Mineral mixes vary in levels of the macro and micro minerals, as well as price. Inorganic forms of mineral are most commonly blended to form the various products. However, there are other forms of products which include the chelated minerals, which is a complex of minerals tied to an amino acid. Production results for the chelated minerals vary and the price of these products is usually much higher than the inorganic forms. Visit with a livestock nutritionist to determine which mineral and blend is right for you.

References

- Boyles, S.L. Mineral Interactions and Supplementations for Beef Cows, Ohio State University, Extension, <http://beef.osu.edu/library/Mineral.pdf>
- Hale, C., and Olson, K.C. 2001. Mineral Supplements for Beef Cattle, MU Guide, Published by MU Extension, University of Missouri-Columbia. <http://extension.missouri.edu/p/G2081>
- Lawton, S. Reviewed 2013. Mineral Supplements for Beef Cattle, B895, University of Georgia. http://www.caes.uga.edu/publications/pubDetail.cfm?pk_ID=7650
- ZoBell, D. 2000. When and How to Supplement Forage with Minerals. Proceedings of the 20th Annual Beef Cattle Field Day. pp. 23-28. Brigham Young University. Provo, Utah. http://extension.usu.edu/files/publications/publication/pub_356238.pdf

Utah State University is committed to providing an environment free from harassment and other forms of illegal discrimination based on race, color, religion, sex, national origin, age (40 and older), disability, and veteran's status. USU's policy also prohibits discrimination on the basis of sexual orientation in employment and academic related practices and decisions.

Utah State University employees and students cannot, because of race, color, religion, sex, national origin, age, disability, or veteran's status, refuse to hire; discharge; promote; demote; terminate; discriminate in compensation; or discriminate regarding terms, privileges, or conditions of employment, against any person otherwise qualified. Employees and students also cannot discriminate in the classroom, residence halls, or in on/off campus, USU-sponsored events and activities.

This publication is issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Kenneth L. White, Vice President for Extension and Agriculture, Utah State University.