Mineral and Vitamin Nutrition for Beef Cattle

Minerals and vitamins account for a very small proportion of daily dry matter intake in beef cattle diets and can sometimes be overlooked in a herd nutritional program. Although minerals and vitamins are needed as a very small percentage of dietary nutrients, they are very important in beef cattle nutritional programs for proper animal function, such as bone development, immune function, muscle contractions, and nervous system function. Cattle growth and reproductive performance can be compromised if a good mineral program is not in place.

A good mineral and vitamin supplementation program costs approximately $30 to $55 per head per year. With the annual cost of production per cow generally being several hundred dollars, the cost of a high-quality mineral and vitamin supplement program is a relatively small investment. Many free-choice mineral and vitamin mixes are formulated for 2- or 4-ounce daily consumption rates.

For illustration purposes, if a beef cow consumes 4 ounces (¼ pound) of a supplement per day for 365 days, she consumes 91.25 pounds of the supplement in a year. Many mineral and vitamin supplements are packaged in 50-pound bags, so a beef cow consumes almost two 50-pound bags of this supplement annually at a 4-ounce daily consumption rate. Doubling the price of one bag of these minerals and vitamin supplements approximates the annual cost of the supplement on a per-head basis.

Macrominerals and Microminerals

Beef cattle require at least 17 different mineral elements in their diets. Required minerals are classified as either macrominerals (major minerals) or microminerals (trace minerals), based on the quantities required in beef cattle diets. Macrominerals are required in larger quantities (grams per day) than microminerals (milligrams or micrograms per day).

Macrominerals required by beef cattle include calcium, magnesium, phosphorus, potassium, sodium, chlorine, and sulfur. Required microminerals include chromium, cobalt, copper, iodine, iron, manganese, molybdenum, nickel, selenium, and zinc. Nutrient requirements of specific mineral elements vary, depending on animal age, weight, stage of production, lactation status, breed, stress, and mineral bioavailability (the degree to which a mineral becomes available to the target tissue after administration) from the diet.

Macromineral requirements are typically expressed as a percentage (%) of the total diet while micromineral requirements are generally expressed as milligrams per kilogram (mg/kg), which is the equivalent of parts per million (ppm). To convert percent to ppm, move the decimal four places to the right (e.g., 0.2500% = 2,500 ppm).

Table 1. Macromineral requirements in beef cattle.

	Requirements			
Mineral*, %	**Growing and Finishing Cattle**	**Stressed Calves****	**Dry, Gestating Cows**	**Lactating Cows**
Calcium	0.31	0.6–0.8	0.18	0.58
Magnesium	0.10	0.2–0.3	0.12	0.20
Phosphorus	0.21	0.4–0.5	0.16	0.26
Potassium	0.60	1.2–1.4	0.60	0.70
Sodium	0.06-0.08	0.2–0.3	0.06-0.08	0.10
Sulfur	0.15	0.15	0.15	0.15

*Research data are inadequate to determine chlorine requirements.
**Suggested range.
Source: NRC, 2000. Adapted from NRC Nutrient Requirements of Beef Cattle, 7th revised edition.

Table 2. Micromineral requirements in beef cattle.

	Requirements			
Mineral*, ppm	**Growing and Finishing Cattle**	**Stressed Calves****	**Dry, Gestating Cows**	**Lactating Cows**
Cobalt	0.10	0.1–0.2	0.10	0.10
Copper	10.00	10.0–15.0	10.00	10.00
Iodine	0.50	0.3–0.6	0.50	0.50
Iron	50.00	100.0–200.0	50.00	50.00
Manganese	20.00	40.0–70.0	40.00	40.00
Selenium	0.10	0.1–0.2	0.10	0.10
Zinc	30.00	75.0–100.0	30.00	30.00

*Research data are inadequate to determine chromium, molybdenum, and nickel requirements.
**Suggested range.
Source: NRC, 2000. Adapted from NRC Nutrient Requirements of Beef Cattle, 7th revised edition.

Table 3. Mineral and vitamin levels of feedstuffs commonly used in Mississippi.

Feedstuff	Calcium %	Phosphorus %	Magnesium %	Potassium %	Sulfur %	Copper ppm	Zinc ppm	Vitamin A, 1,000 IU/kg
Bahiagrass pasture	0.46	0.22	0.25	1.45	0.00	0.00	0.00	304.20
Bahiagrass hay	0.50	0.22	0.19	0.00	0.00	0.00	0.00	0.00
Bermudagrass pasture	0.26	0.18	0.13	1.30	0.21	9.00	20.00	136.20
Ladino clover hay	1.45	0.33	0.47	2.44	0.21	9.41	17.00	33.00
Tall fescue hay	0.51	0.37	0.27	2.30	0.18	0.00	22.00	0.00
Corn silage	0.25	0.22	0.18	1.14	0.12	4.18	17.70	18.00
Cracked corn	0.03	0.32	0.12	0.44	0.11	2.51	24.20	1.00
Corn gluten feed	0.07	0.95	0.40	1.40	0.47	6.98	73.30	1.00
Cottonseed meal, 41% CP	0.20	1.16	0.65	1.65	0.42	16.50	74.00	0.00
Cottonseed hulls	0.15	0.09	0.14	0.87	0.09	13.00	22.00	0.00
Dried distillers grains with solubles	0.32	1.40	0.65	1.83	0.40	83.90	94.80	1.20
Soybean hulls	0.53	0.18	0.22	1.29	0.11	17.80	48.00	0.00
Soybean meal, 44% CP	0.40	0.71	0.31	2.22	0.46	22.40	57.00	0.00
Whole cotton-seed	0.16	0.62	0.35	1.22	0.26	7.90	37.70	0.00

Source: NRC, 2000. Adapted from *NRC Nutrient Requirements of Beef Cattle*, 7th revised edition.

Mineral Interactions

Minerals interact with each other in the body. The many interactions can result in mineral elements tying up or making other mineral elements unavailable for essential body functions. In practical beef cattle nutrition programs, the interaction between calcium and phosphorus is the classic example of two minerals that affect the required levels of each other in the diet. Calcium and phosphorus recommendations are commonly expressed as a ratio (Ca:P) of calcium to phosphorus.

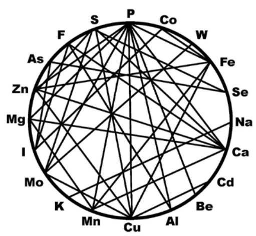

Figure 1. Potential mineral element interactions

Macrominerals

Calcium (Ca)

Calcium is the most abundant mineral in the body and is involved in many vital body functions, including bone formation and maintenance, development and maintenance of teeth, blood clotting, membrane permeability, muscle contraction, nerve impulse transmission, heart regulation, milk secretion, hormone secretion, and enzyme activation and function.

Most calcium supplies in the body are found in the bones and teeth. Bones can supply short-term dietary deficiencies of calcium. However, long-term dietary calcium deficiencies can cause severe production problems. Vitamin D is required for calcium absorption. Diets high in fat can reduce calcium absorption.

Calcium deficiency interferes with normal bone growth in young cattle and can cause rickets (weak, soft bones that are easily fractured) and retarded growth and development. In adult cattle, calcium deficiency can cause osteomalacia, a condition characterized by weak and brittle bones. Milk fever, a condition usually associated with dairy cattle, can also occur in beef cattle as a result of calcium deficiency and leads to cows that go down soon after calving. Milk fever is described in detail in the nutritional disorders section of this publication.

Forages are generally higher in calcium concentrations than concentrate (grain-based) feedstuffs, with legumes (such as clovers and alfalfa) typically providing higher calcium levels than grasses. Calcium content in forages varies with species, plant part, maturity, quantity of calcium available in the soil for plant uptake, and climate.

Cattle can tolerate high concentrations of dietary calcium if other mineral levels are adequate in the diet. Calcium recommendations are expressed in terms of a calcium-to-phosphorus ratio (Ca:P), where approximately 1.6:1 is ideal, with a range of 1:1 to 4:1 being acceptable.

Supplemental calcium sources include calcium carbonate, feed-grade limestone, dicalcium phosphate, defluorinated phosphate, monocalcium phosphate, and calcium sulfate. Feed-grade limestone is approximately 34 percent calcium and is commonly added to beef cattle diets to increase the calcium levels of the diet. Dicalcium phosphate is approximately 22 percent calcium and 19.3 percent phosphorus and is added to beef cattle diets to help balance the calcium-to-phosphorus ratio. It adds both calcium and phosphorus to the diet.

Phosphorus (P)

Similar to calcium, most phosphorus is in the bones and teeth, but some phosphorus is in soft tissues as well. Phosphorus is required for skeletal development and maintenance, normal milk secretion, muscle tissue building, cell growth and differentiation, energy use and transfer, efficient food use, membrane formation, function of many enzyme systems, osmotic and acid-base balance maintenance, and rumen microorganism growth and metabolism. Most phosphorus losses are through the feces, while urinary phosphorus losses are lower but increase on high-concentrate diets.

Phosphorus requirements are often presented in terms of the calcium-to-phosphorus ratio described earlier. The most critical aspect is that phosphorus levels meet cattle requirements. Most phosphorus losses are through the feces, while urinary phosphorus losses are lower but increase on high-concentrate diets. Excessive phosphorus intake can lead to increased fecal output of phosphorus into the environment and have environmental implications. Too much phosphorus in the diet can also result in urinary calculi, a condition detailed in the nutritional disorders section of this publication.

Phosphorus deficiency has tremendous implications for beef cattle performance. Not meeting animal phosphorus requirements reduces growth and feed efficiency, decreases dry matter intake, lowers reproductive performance, depresses milk production, and causes weak and fragile bones. Mature cattle can draw on phosphorus reserves in bones when needed, but skeletal phosphorus supplies must be replenished to avoid a phosphorus deficiency situation.

Forages are generally low in phosphorus in comparison to concentrate feedstuffs such as cereal grains and oilseed meals (cottonseed meal, soybean meal). Drought conditions and increased forage maturity further deplete forage phosphorus concentrations. This suggests that higher phosphorus supplementation may be needed to supply increased dietary phosphorus levels when grazing or feeding stored mature forages or during periods of drought. Dicalcium phosphate, defluorinated phosphate, monoammonium phosphate, and phytate phosphate are sources of supplemental phosphorus for ruminants. Recommended phosphorus levels in a mineral supplement are generally between 4 and 8 percent, largely depending on forage conditions and other levels of dietary sources of phosphorus.

Magnesium (Mg)

Approximately 65 to 70 percent of magnesium in the body is found in bone, 15 percent in muscle, 15 percent in other soft tissues, and 1 percent in extracellular fluid. Magnesium is important for enzyme activation, glucose breakdown, genetic code transmission, membrane transport, nerve impulse transmission, and skeletal development.

In general, magnesium toxicity is not a problem in beef cattle, with concentrations up to 0.4 percent being tolerated. Yet excessive magnesium intake can result in severe diarrhea, sluggish appearance, and reduced dry matter digestibility.

Magnesium deficiency, on the other hand, can be severe in beef cattle. Signs of magnesium deficiency include excitability, anorexia, increased blood flow, convulsions, frothing at the mouth, prolific salivation, and soft tissue calcification. Young cattle can mobilize large amounts of magnesium from bone, but mature cattle are unable to do this, and they must receive regular and adequate magnesium supplies from the diet. Grass tetany, a condition common among lactating beef cows grazing lush forages, is characterized by low magnesium levels. Grass tetany is discussed in detail in the nutrition disorders section later in this publication.

Forage magnesium concentrations depend on plant species, soil magnesium levels, plant growth stage, season, and environmental temperature. Legumes usually contain higher magnesium levels than grasses. Cereal grains contain approximately 0.11 to 0.17 percent magnesium, and plant protein sources contain roughly double these amounts. Magnesium sulfate and magnesium oxide serve as good supplemental sources of magnesium. Recommendations for magnesium supplementation are magnesium offered at 2 to 4 percent of the supplement when cattle consume low and intermediate forages, respectively. Raise this level to at least 10 percent of the supplement to avoid grass tetany on lush forages.

The USDA National Animal Health Monitoring System (NAHMS) reported in a 1996 survey that, by U.S. geographic region, beef cattle operators in the southeastern U.S. were most likely to supplement magnesium to their beef cattle herds than any other region. Seventy-four and a half percent of southeastern beef cattle operators reported supplementing magnesium compared to the U.S. average of 63.5 percent. The production of lush forages in the southeast coincides with calving season on many southeastern U.S. cattle operations, and many producers recognize these conditions as increasing grass tetany risk. Increasing magnesium supplementation is a common producer action to prevent grass tetany.

Potassium (K)

The third most abundant mineral in the body is potassium. Potassium is in intracellular fluid and is involved in acid-base balance, osmotic pressure regulation, water balance, muscle contractions, nerve impulse transmission, oxygen and carbon dioxide transport in the blood, and enzyme reactions. Potassium prevents tetany, convulsions, and unsteady gait.

Potassium deficiency is indicated by reduced feed intake, depraved appetite, lowered weight gains, rough hair coat, and muscle weakness. Body stores of potassium are low, so potassium deficiency can begin quickly. Potassium is mainly excreted in the urine of cattle, and potassium secretion in milk is relatively high.

Forages are good sources of this mineral, often ranging from 1 to 4 percent potassium. Potassium content can be very high in lush pasture, potentially contributing to grass tetany onset. Mature and stockpiled forage contain lowered concentrations of potassium.

Cereal grains are typically low in potassium content, while oilseed meals are generally good sources. High-concentrate diets likely require potassium supplementation if forage or protein sources containing adequate potassium levels are not provided. Generally, potassium supplementation on pasture is not critical. Supplemental potassium sources include potassium chloride, potassium bicarbonate, potassium sulfate, and potassium carbonate, which are all readily available dietary forms for beef cattle.

Sodium (Na) and Chlorine (Cl)

Sodium and chlorine are components of common white salt. Sodium and chlorine are each in the body in extracellular fluid. They are important for maintaining osmotic pressure, controlling water balance, regulating acid-base balance, contracting muscles, transmitting nerve impulses, and carrying glucose and amino acids. Sodium is necessary for the operation of some enzyme systems. Heart action and nerve impulse transmission depend on some sodium and potassium. Chlorine is needed for hydrochloric acid production in the abomasum (true ruminant stomach) and activation of amylase, an enzyme critical for normal starch digestion. Chlorine also aids in respiratory gas exchange.

Cattle crave sodium and will consume more salt than needed when it is supplied free choice. High concentrations of salt are sometimes used to regulate feed intake. Cattle consume approximately 0.1 pound salt per 100 pounds of body weight in salt-limited feeds (0.5 pounds per day for a 500 lb. calf; 1.1 pounds per day for a 1,100 lb. cow). These high dietary intake levels of salt are generally tolerated by cattle when adequate water is available. Dietary salt levels of 6.5 percent have been shown to reduce feed intake and growth. The maximum tolerable concentration for total dietary salt is estimated at 9 percent. Recommended salt content of a mineral and vitamin supplement is in the range of 10 to 25 percent of the supplement.

When salt is present in the drinking water of cattle, salt toxicity risk increases. Salt concentrations in drinking water of 1.25 to 2.0 percent can result in anorexia, reduced weight gain or increased weight loss, lowered water intake, and collapse. Even lower levels of salt in drinking water can result in reduced feed and water intake, decreased cattle growth, digestive disturbances, and diarrhea.

In Mississippi, beef cattle producers in coastal regions should be particularly cautious of fresh water supplies for cattle that may become contaminated with salt in the aftermath of a tropical storm or hurricane.

A chlorine deficiency is not probable under most production conditions. Sodium deficiency signs include reduced and abnormal feed intake, retarded growth, and decreased milk production.

Forage sodium content varies considerably, and cereal grains and oilseed meals are typically not good sources of sodium. Sodium can be supplemented as sodium chloride or sodium bicarbonate, both of which are highly available forms for beef cattle.

Sulfur (S)

Sulfur is a building block in several amino acids (methoinine, cysteine, and cystine) and B vitamins (thiamin and biotin) along with other organic compounds. Sulfur functions in the body in detoxification reactions and is required by ruminal microorganisms for growth and normal cell function.

Sulfur toxicity is characterized by restlessness, diarrhea, muscle twitching, and labored breathing. In protracted cases, inactivity and death may follow. High sulfur levels are associated with polioencephalomalacia, a condition discussed in detail in the nutritional disorders section of this publication.

Lower sulfur intakes can reduce feed intake, depress growth, and decrease copper levels. Lowered feed and water intake can occur when high levels of sulfur are consumed in drinking water. Reported sulfur deficiency signs are anorexia, weight loss, weakness, emaciation, profuse salivation, and death. Less severe sulfur deficiencies can reduce feed intake, digestibility, rumen microorganism numbers, and microbial protein synthesis. Lactate accumulation in the rumen and blood can then develop with disruption of rumen microbe populations.

Sulfur in feedstuffs is found largely as a component of protein. In diets containing high levels of 1) sorghum forages; 2) mature forages; 3) forages produced in sulfur-deficient soils; 4) corn silage; 4) rumen-bypass proteins; or 5) where urea or other non-protein nitrogen sources replace plant protein sources, dietary sulfur requirements or supplementation needs may be increased. Potential sulfur supplements include sodium sulfate, ammonium sulfate, calcium sulfate, potassium sulfate, magnesium sulfate, or elemental sulfur.

Microminerals

Chromium (Cr)

Chromium is a trace mineral involved in glucose clearance. Immune response and growth rate in stressed cattle has been shown to improve with chromium supplementation. Chromium can be supplemented as chromium picolinate or chromium polynicotinate. However, beef cattle producers do not need to be concerned about chromium supplementation under normal circumstances.

Cobalt (Co)

Cobalt functions as a component of vitamin B12 (cobalamin). The microbes of ruminants are able to synthesize vitamin B12 if cobalt is present.

Cattle can tolerate approximately 100 times their dietary requirement for cobalt, so cobalt toxicity is not likely unless a mineral supplement formulation error is made. Cobalt toxicity signs include decreased feed intake, reduced weight gain, anemia, emaciation, abnormal increase in the hemoglobin content of red blood cells, and weakness.

Young, growing cattle appear to be more sensitive to cobalt deficiency than mature cattle. Initial cobalt deficiency signs are depressed appetite and reduced growth performance or weight loss. In cases of severe cobalt deficiency, cattle display severe unthriftiness, swift weight loss, liver breakdown, and anemia. Cobalt deficiency has also been demonstrated to compromise immune system problems and disruption of microorganism production of propionate (a volatile fatty acid important for glucose production).

Legumes are usually higher in cobalt than grasses. Soil pH is a major determinant of cobalt availability in the soil. Cobalt sulfate and cobalt carbonate are examples of supplemental cobalt sources for beef cattle diets. For a mineral supplement with an expected 4-ounce daily intake, the supplement should include 15 ppm cobalt.

Copper (Cu)

Copper is an essential component of many enzymes including lysyl oxidase, cytochrome oxidase, superoxide dismutase, ceruloplasmin, and tyrosinase.

Supplementing with too much copper or contaminating feeds with copper could result in copper toxicity. Copper accumulates in the liver before toxicity occurs. Large releases of copper from the liver cause red blood cell breakage; elevated methemoglobin levels in the blood, impairing oxygen transport; abnormally high hemoglobin content in the urine; jaundice; widespread tissue death; and, finally, death. Young cattle are more susceptible to copper toxicity than older cattle. Cattle with a mature rumen do not absorb copper well, but the liver can store significant quantities of copper. Molybdenum, sulfur, and iron levels in the diet affect copper levels required to induce toxicity.

Copper deficiency is a widespread problem in U.S. beef cattle herds. Cattle experiencing copper deficiency exhibit anemia, reduced growth, loss of pigmentation in hair, changes in hair growth and appearance, heart failure, easily fractured bones, diarrhea, compromised immune system function, and impaired reproduction, particularly estrous cycle disruption. Breed composition of cattle also affects copper requirements. For example, Simmental and Charolais require more copper than Angus, and copper supplement levels may need to be increased by as much as 25 to 50 percent for these breeds. In cattle grazing toxic endophyte-infected tall fescue, tall fescue toxicosis may be confused for copper deficiency, based on hair coat changes. In some cases, these conditions can occur together.

Copper is more available in concentrate diets than in forage diets. Forages vary greatly in copper content and may contain variable levels of molybdenum, sulfur, and iron, which reduce usable copper levels. Molybdenum, sulfur, iron, and zinc reduce copper status in the body can impact copper requirements. Legumes typically contain higher copper concentrations compared to grasses. In addition, oilseed meals generally contain higher levels of copper than cereal grains. Copper supplements include sulfate, carbonate, oxide, and organic forms. Copper oxide is poorly available compared with other the copper forms listed. General copper supplementation recommendations are 1,250 ppm copper for a supplement consumed at a rate of four ounces per day.

Iodine (I)

Iodine is a key component of thyroid hormones involved in energy metabolism rate regulation in the body. Iodine is rarely deficient in cow herds in the Southeast U.S. Calves born hairless, weak, or dead; irregular cycling, reduced conception rate, and retained placenta in breeding age beef females; and depressed libido and semen quality in bulls are classic iodine deficiency signs. Onset of deficiency signs may be delayed well beyond the actual initial period of iodine deficiency.

Iodine deficiency is characterized by enlargement of the thyroid (goiter). Goitrogenic substances in feeds suppress thyroid function and can affect iodine requirements. In white clover, thiocyanate is derived from cyanate and impairs iodine uptake by the thyroid. Some Brassica forages, such as kale, turnips, and rape, contain glucosinolates with goitrogenic effects, but most reports of problems are in sheep and goats. Soybean meal and cottonseed meal are also reported to have goitrogenic effects.

Iodine toxicity affects cattle by reducing weight gain, lowering feed intake, and causing coughing and undue nasal discharge.

Dietary iodine supplement sources include calcium iodate, ethylenediamine dihydroiodide (EDDI), potassium iodide, and sodium iodide. The calcium iodate and EDDI forms of iodine are very stable and have high bioavailability in cattle, while the potassium and sodium iodide forms are relatively unstable and can break down when exposed to other minerals, heat, light, or moisture. A supplementation rate of 50 ppm iodine in a 4-ounce per day intake mineral supplement is recommended.

The EDDI form is an organic form that has been used for foot rot prevention. Levels of EDDI necessary for foot rot control are much higher than nutrient requirement levels. Currently, the maximum legal supplementation rate of EDDI is 50 mg per head per day. This level is not effective for foot rot control, and the Food and Drug Administration (FDA) does not allow claims of EDDI supplements to treat or prevent any animal disease.

Iron (Fe)

Iron is a critical component of hemoglobin and myoglobin, two proteins involved in oxygen transport and use. More than half of the iron in the body is in hemoglobin. This element is also an essential component of several cytochromes and iron-sulfur proteins involved in the electron transport chain. In addition, some enzymes either contain or are activated by iron.

Iron toxicity manifests as diarrhea, acidosis (digestive tract disturbance), hypothermia (lower than normal core body temperature), reduced weight gain, and depressed feed intake. Iron depletes copper in cattle and can contribute to copper deficiency if copper supplementation levels are not adjusted to compensate for copper losses. Iron deficiency causes anemia, lethargy, lowered feed intake, reduced weight gain, pale mucous membranes, and shriveling of the raised tissue structures on the tongue. Conditions that cause chronic blood loss, such as severe parasite infestations, can lead to iron deficiency. Evidence suggests iron requirements are higher for young cattle than for mature cattle. Calves raised in confinement exclusively on milk diets are more prone to iron deficiency.

Iron sources include forages, cereal grains, oilseed meals, water, and soil ingestion. However, forage iron content varies greatly, and bioavailability of iron from forages is low relative to supplemental sources. Common supplemental sources include ferrous sulfate (iron sulfate), ferrous carbonate (iron carbonate), and ferric oxide (iron oxide or "rust"). Bioavailability rank of these iron sources from most to least available is sulfate, carbonate, and then oxide form. Iron oxide has very little nutritional value. Iron is generally not needed from sources other than those provided by other mineral compounds commonly found in complete mineral supplements.

Manganese (Mn)

Manganese usefulness in the body is as a constituent of the enzymes pyruvate carboxylase, arginase, and superoxide dismutase and as an activator for many other enzymes, including hydrolases, kinases, transferases, and decarboxylases. Manganese is important for normal skeletal development, growth, and reproductive function.

At extremely high levels of manganese intake, growth performance and feed intake are reduced. Cattle deficient in manganese exhibit skeletal abnormalities, including stiffness, twisted legs, joint enlargement, and weak bones in young cattle. Older cattle display depressed or irregular estrus, low conception rate, abortion, stillbirths, and light birth weights when manganese intake is inadequate.

Forage manganese levels vary with plant species, soil pH, and soil drainage, but forages usually contain adequate manganese levels. Corn silage manganese content is generally low. Feed-grade manganese forms include manganese sulfate, manganese oxide, manganese methionine, manganese proteinate, manganese polysaccharide complex, and manganese amino acid chelate. Bioavailability ranking from most to least available is manganese methionine, manganese sulfate, and, lastly, manganese oxide. A recommended manganese level is 2,000 ppm in a 4-ounce daily intake mineral supplement.

Molybdenum (Mo)

The enzymes xanthine oxidase, sulfite oxidase, and aldehyde oxidase contain molybdenum. This element may improve microbial activity in the rumen under certain conditions.

There is no proof cattle experience molybdenum deficiency under normal production circumstances, so molybdenum supplementation is not a practical concern. Molybdenum toxicity, on the other hand, results in diarrhea, anorexia, weight loss, stiffness, and hair color alterations. Other potential effects of molybdenum toxicity include increased heifer age at puberty, decreased weight of heifers at puberty, and reduced conception rate. Calf growth performance is also slowed by excessive molybdenum levels. Copper and sulfur work against molybdenum in the body. Molybdenum contributes to copper deficiency, and copper can reduce molybdenum toxicity.

Forage molybdenum concentrates fluctuate with soil type and soil pH. Increased soil moisture, organic matter, and pH improve forage molybdenum levels. Molybdenum content in cereal grains and protein sources is more consistent.

Nickel (Ni)

The function of nickel in cattle is unknown. Yet nickel deficiency has been experimentally induced in animals. Nickel plays a role in ureolytic bacteria function as an essential component of the urease enzyme that breaks down urea (a common nonprotein nitrogen source in cattle diets). In general, nickel supplementation is not a concern on beef cattle operations under normal circumstances.

Selenium (Se)

Selenium is an important part of the enzymes glutathione peroxidase and iodothyronine 5′-deiodinase. Glutathione peroxidase helps prevent oxidative damage to tissues. The latter enzyme is involved in thyroid hormone metabolism. The functions of vitamin E and selenium are interrelated. Diets low in vitamin E may require selenium supplementation.

Signs of chronic selenium toxicosis include lameness, anorexia, emaciation, sore feet, cracked and deformed hooves, liver cirrhosis, kidney inflammation, and tail hair loss. In severe toxicity cases, difficulty breathing, diarrhea, muscle incoordination, abnormal posture, and death from respiratory failure are observed.

Selenium deficiency can lead to white muscle disease, a condition discussed in detail later in the nutritional disorders section of this publication. Calves may experience compromised immune response even when no other clinical signs of selenium deficiency are present. Unthriftiness, weight loss, and diarrhea are other deficiency signs.

Feed-grade selenium is often supplied as sodium selenite or sodium selenate, while selenomethionine is the common form in most feedstuffs. Selenium yeast is also a selenium source approved for use in cattle feed. Because of the high toxicity of selenium, it should be supplemented in a premixed form only. The FDA allows sodium selenate or sodium selenite as sources of selenium for selenium supplementation of complete feeds at a level not more than 0.3 ppm. The FDA permits up to 120 ppm selenium to be included in a salt-mineral mixture for free-choice feeding. Selenium injections are another way to provide selenium.

In some regions of the U.S., chronic selenium toxicity (alkali disease) occurs as a result of cattle's consuming forages grown on high selenium soils. Other regions of the U.S., including the southeastern U.S., are predisposed to selenium deficiency risk based on low soil and forage selenium content. In selenium-deficiency-prone areas, use the maximum legal selenium supplement level in the feed and note that when purchasing feedstuffs from areas known to be deficient in selenium, selenium supplementation may need to be considered.

Zinc (Zn)

Zinc is a crucial component of many important enzymes and is also needed to activate other enzymes. These enzymes function in nucleic acid, protein, and carbohydrate metabolism. Zinc plays an important role in immune system development and function as well.

Quantities of zinc needed to cause toxicity are much greater than animal requirements. Signs of zinc toxicity include reduced weight gain, feed intake, and feed efficiency. Severe cases of zinc deficiency include listlessness, excessive salivation, testicular growth reduction, swollen feet, scaly lesions on feet, tissue lesions (most often on the legs, neck, head, and around the nostrils), slow healing of wounds, and hair loss. Less dramatic zinc deficiencies can cause decreased growth and lower reproductive performance.

Similar to several other minerals, zinc concentrations in forages depend on many factors, and zinc concentration in legumes is greater than in grasses. Plant proteins are typically higher in zinc levels than cereal grains. Supplemental sources of zinc include oxide, sulfate, methionine, and proteinate forms. The oxide and sulfate forms appear to have similar bioavailabilities, indicating no advantage to using zinc sulfate over zinc oxide. Zinc should be supplemented at a rate of 4,000 ppm in a supplement designed for 4 ounces of intake per head per day.

Nutritional Disorders Related to Mineral Imbalances

Mineral imbalances (toxicities or deficiencies) can trigger nutritional disorders such as grass tetany, urinary calculi, polioencephalomalacia, white muscle disease, and milk fever in cattle. While these disorders can produce dramatic signs in affected cattle, mineral imbalances are often overlooked because only subclinical signs are present.

In the NAHMS 1996 survey, relatively few operations (5.2 percent) reported any known mineral deficiencies in the previous five years. However, these percentages likely severely underestimate the true magnitude of mineral deficiencies in cow-calf herds. A 1993 cow-calf study indicated that the extent of marginal and severe deficiency for copper and selenium is much more widespread.

In the absence of clinical signs, a mineral imbalance may be suspected if blood and tissue sample analysis or forage and diet mineral analysis suggests a problem. Compare levels of dietary mineral sources with cattle requirements detailed earlier in this publication to identify significant potential mineral imbalance problems. These are not always definitive for identifying mineral imbalances, though. It is important to be alert for "red flags" in animal behavior and appearance to catch a problem early and minimize losses. Veterinarians should be familiar with mineral-related disorders common in their areas and can assist with prevention and treatment. Reduced cattle performance from mineral imbalances is preventable with a good mineral nutrition program.

Grass Tetany

Cause. Grass tetany is associated with low levels of magnesium or calcium in cattle grazing annual ryegrass, small grains (such as oats, rye, and wheat), and cool-season perennial grasses (such as tall fescue) in late winter and early spring. Grass tetany in Mississippi usually occurs February through April, when spring-calving cows graze on lush annual ryegrass or tall fescue. During this time of year, there is often a flush of new forage growth. This is also the time of year many spring calves are born and nursing. Grass tetany most commonly affects lactating cattle, particularly the highest-milking animals in the herd. Magnesium and calcium requirements of lactating cattle are far greater than those of nonlactating cattle. This predisposes cattle to grass tetany during lactation. Grass tetany results when magnesium and calcium levels in forages are too low to meet the requirements of cattle and cattle do not get enough magnesium and calcium supplementation. Clinical signs of grass tetany include nervousness, muscle twitching around the face and ears, staggering, and reduced feed intake. An affected animal may go down on its side, experience muscle spasms and convulsions, and die if not treated.

Prevention. Forages grown on soils deficient in magnesium, wet soils, or soils low in phosphorus but high in potassium and nitrogen may contain very low levels of magnesium and calcium. Lime magnesium-deficient pastures with dolomitic lime, which contains magnesium. This may not prevent grass tetany on waterlogged soils, because plants may not be able to take up enough magnesium under wet conditions.

Phosphorus fertilization may also improve forage magnesium levels. However, environmental concerns associated with excessive soil phosphorus levels should be considered. High levels of nitrogen and potassium fertilization are associated with increased grass tetany, so fertilization plans should consider this. Legumes are often high in magnesium and may help reduce the risk of grass tetany when included in the forage program. The most reliable method of grass tetany prevention is supplemental feeding of magnesium and calcium during the grass tetany season. Both can be included in a mineral mix as part of a mineral supplementation program. Initiate high-magnesium (at least 10 percent Mg and preferably 13 to 14 percent Mg) mineral feeding at least one month before grass tetany season.

Urinary Calculi or "Water Belly" Cause

Urinary calculi (kidney stones) are hard mineral deposits in the urinary tracts of cattle. Affected cattle may experience chronic bladder infection from tissue damage produced by the calculi. In more serious cases, calculi may block the flow of urine, particularly in male animals. The urinary bladder or urethra may rupture from prolonged urinary tract blockage, resulting in the release of urine into the surrounding tissues. The collection of urine under the skin or in the abdominal cavity is referred to as "water belly." Death from toxemia may result within 48 hours of bladder rupture. Signs of urinary calculi include straining to urinate, dribbling urine, blood-tinged urine, and indications of extreme discomfort, such as tail wringing, foot stamping, and kicking at the abdomen. Phosphate urinary calculi form in cattle on high grain diets, while silicate urinary calculi typically develop in cattle on rangeland.

Prevention. Strategies to prevent problems with urinary calculi in cattle include lowering urinary phosphorus levels, acidifying the urine, and increasing urine volume. To lower urinary phosphorus levels, avoid diets high in phosphorus. Maintain a dietary calcium-to-phosphorus ratio of 2:1. This ratio is preferred over the previously mentioned 1.6:1 ratio in situations where urinary calculi risk is of concern. Acid-forming salts such as ammonium chloride may be fed to acidify the urine. Ammonium chloride may be fed at a rate of 1.0 to 1.5 ounces per head, per day. Urine volume may be increased by feeding salt at 1 to 4 percent of the diet while providing enough water.

Polioencephalomalacia

Cause. Polioencephalomalacia is caused by a disturbance in thiamine metabolism. Thiamine is required for a number of important nervous system functions. This disease most commonly affects young, fast-growing cattle on a high-concentrate diet and may result from a thiamine-deficient diet, an increase in thiaminase (an enzyme that breaks down thiamine) in the rumen, or an increase in dietary sulfates.

A thiamine-deficient diet is usually associated with an increase in the dietary-concentrate-to-roughage ratio. When concentrates (feed grains such as corn) are increased and roughage (forage, cottonseed hulls, etc.) are decreased in the diet, rumen pH drops. This increases the numbers of thiaminase-producing bacteria in the rumen. Thiaminase breaks down the form of thiamine the animal normally could use. Some plant species produce thiaminase and can cause a decrease in the useable amount of thiamine when consumed. Examples of these plants include kochia, bracken fern, and equisetum.

A high-sulfate diet can also inhibit an animal's ability to properly use thiamine. Feeds such as molasses, corn gluten feed, and dried distillers grains are often high in dietary sulfates. Some water sources can also contain a high amount of sulfur (such as "gyp" water). When these are consumed in excessive amounts, clinical signs of polioencephalomalacia can occur.

Affected cattle usually show several signs of generalized neurological disease. These signs can include but are not limited to blindness, inconsistent and uncoordinated movements, head pressing, "goose" stepping, lying with full body contact with the ground with the head and legs extended, tetany (muscle spasms), convulsions with paddling motions, and death. These signs usually begin suddenly, with the animals typically having normal temperatures and rumen function.

Prevention. Preventative strategies should focus on the diet. Avoid risk factors such as high-concentrate diets or high-sulfate diets, if possible. Thiamine can also be added to a feed ration or a free-choice mineral supplement at 3 to 10 ppm, but this may not be cost effective.

White Muscle Disease

Cause. "White muscle disease" (enzootic nutritional muscular dystrophy) most commonly affects cardiac or skeletal muscle of rapidly growing calves. It results from vitamin E and/or selenium deficiency and causes muscle breakdown. This metabolic imbalance can be because of dietary deficiency or because of calves' being born to dams that consumed selenium-deficient diets during gestation.

Two distinct conditions of this disease are a cardiac form and a skeletal form. The cardiac form of the disease usually comes on quickly, with the most common clinical signs being sudden death. At first, animals may exhibit an increased heart rate and respiratory distress, but they usually die within 24 hours. The skeletal form of the disease generally has a slower onset. Calves affected by the skeletal form exhibit stiffness and muscle weakness. Although these animals usually have normal appetites, they may not be able to stand for long periods and have trouble breathing if their diaphragm or chest muscles are involved. Some animals may show signs of difficulty swallowing and possible pain while swallowing if the muscles of the tongue are also affected.

Necropsy of an affected animal often reveals pale discoloration of the affected muscle. The texture of the muscle is dry with white, chalky, streaked sections representing the fibrosis and calcification of the diseased tissue. Hence, the name "white muscle disease."

Prevention. Supplementing vitamin E and selenium controls this disease. Salt/mineral mixtures can supplement the deficiencies. A free-choice mineral supplement with an expected intake of four ounces/head/day should contain 27 ppm of selenium. In known selenium deficient areas, it is recommended to administer 25 mg of selenium and 340

IU of vitamin E intramuscularly approximately four weeks before calving.

Milk Fever

Cause. Milk fever (parturient paresis or hypocalcemia) is generally associated with older, high-producing dairy cattle, but it may also occur with beef cattle. Milk fever occurs shortly after calving and the onset of milk production. Milk fever occurs when the lactating cow cannot absorb enough calcium from the diet or has not started mobilizing bone calcium to meet the increased calcium demand of lactation. Calcium losses from lactation coupled with inadequate supply results in a drop in blood calcium level. Because calcium is needed for muscle contraction, cows suffering from milk fever often lose their ability to stand.

Prevention. Numerous steps can be taken to prevent milk fever. The first is to raise the calcium and phosphorus levels of the diet. Too much dietary calcium in late pregnancy could leave the cow unprepared to absorb or mobilize enough calcium from bone to meet elevated requirements when lactation starts. This sometimes occurs with feeding poultry litter because of the high calcium content of the litter.

Feeding low calcium diets a month or two before calving was once thought to be the best prevention because the body would be geared to mobilizing bone calcium. This approach has had limited success and is difficult with hig- forage diets.

If milk fever is a common problem in the herd, feeding an anionic pre-partum diet (a negative dietary cation-anion difference, DCAD) helps prevent milk fever. Adequate vitamin D is also important in preventing milk fever but is not typically a problem with beef cattle on pasture.

Mineral Elements and Levels Toxic to Cattle

Some minerals beef cattle do not require or require only in very small quantities can be toxic when consumed above threshold toxicity levels. The National Research Council defines the maximum tolerable concentration for a mineral as “that dietary level that, when fed for a limited period, will not impair animal performance and should not produce unsafe residues in human food derived from the animal.”

Table 4. Mineral maximum tolerable concentrations in beef cattle diets.

Mineral Element	Maximum Tolerable Concentration
Aluminum	1,000 ppm
Arsenic	50 ppm (100 ppm for organic forms)
Bromine	200 ppm
Cadmium	0.5 ppm
Chromium	1,000 ppm
Cobalt	10 ppm
Copper	100 ppm
Fluorine	40 to 100 ppm
Iodine	50 ppm
Iron	1,000 ppm
Lead	30 ppm
Magnesium	0.4%
Manganese	1,000 ppm
Mercury	2 ppm
Molybdenum	5 ppm
Nickel	50 ppm
Potassium	3%
Selenium	2 ppm
Strontium	2,000 ppm
Sulfur	0.4%
Zinc	500 ppm

Source: NRC, 2000. Adapted from NRC Nutrient Requirements of Beef Cattle, 7th revised edition.

Vitamin Nutrition

Vitamins are classified as either water soluble or fat soluble. Water soluble vitamins include the B complex and vitamin C. Fat soluble vitamins include A, D, E, and K. Rumen bacteria can produce the B-complex vitamins and vitamin K in cattle. Vitamin supplementation is generally not as critical as mineral supplementation for beef cattle grazing actively growing forages. However, increased rates of vitamin A and E supplementation may be necessary when feeding dormant pastures or stored forages. For practical purposes, vitamins A and E should receive the most attention when planning cattle vitamin nutritional programs.

Fat Soluble Vitamins

Vitamin A

Vitamin A (retinol) is the vitamin most likely to be deficient in beef cattle diets. It is essential for normal vision, growth, reproduction, skin tissue and body cavity lining cell maintenance, and bone development. It is not in plant material, but its precursors (alpha carotene, beta carotene, gamma carotene, and cryptoxanthin) are present. These carotene and carotenoid precursors are converted to vitamin A in the animal. Vitamin A and beta carotene play a role in disease protection and immune system function.

Exposure to sunlight, air, and high temperatures destroys carotene. Ensiling can help preserve carotene supplies. Corn is one of the few grains that contains appreciable amounts of carotene. High-quality forages, on the other hand, contain large amounts of vitamin A precursors. When forage supplies are limited or low quality, vitamin A supplementation becomes critical. While the liver can store vitamin A, these stored supplies can ward off vitamin A deficiency for only 2 to 4 months.

In practical production scenarios, vitamin A toxicity is rare. Rumen microorganisms can break down vitamin A, and this helps prevent vitamin A toxicity. Vitamin A deficiency is more probable when cattle are fed high-concentrate diets; bleached pasture or hay during drought conditions; feeds excessively exposed to sunlight, heat, and air; heavily processed feeds; feeds mixed with oxidizing materials such as minerals; or feeds stored for long periods. Calves not receiving adequate colostrum and stressed calves are at highest risk of vitamin A deficiency.

Vitamin A deficiency shows up as reduced feed intake, rough hair coat, fluid accumulation in joints and brisket, excessive tear production, night blindness, slow growth, diarrhea, seizures, poor skeletal growth, blindness, low conception rates, abortion, stillbirths, blind calves, low-quality semen, and infections in cattle. Night blindness is unique to vitamin A deficiency. Vitamin A can be supplied by injection or through the consumption of vitamin A precursors in green, leafy forages. In deficiency situations, injections may be more effective.

Vitamin D

Vitamin D forms include ergocalciferol (vitamin D_2) found in plants and cholecalciferol (vitamin D_3) found in animals. Vitamin D is needed for calcium and phosphorus absorption, normal bone mineralization, and calcium mobilization from bone. It may also function in immune response. Toxicity signs include calcification of soft tissues, bone demineralization, decreased appetite, and weight loss. Vitamin D deficiency causes rickets where bones do not use calcium and phosphorus normally. Stiff joints, irritability, anorexia, convulsions, brittle bones, decreased appetite, digestive problems, labored breathing, and weakness are deficiency signs. Cattle do not maintain body reserves of vitamin D. Yet cattle rarely require vitamin D supplementation because vitamin D is made by cattle exposed to sunlight or fed sun-cured forages.

Vitamin E

Vitamin E is in feedstuffs as alpha-tocopherol. It serves as an antioxidant in the body and is important in membrane formation, muscle structure, and muscle function. Disease resistance is tied to vitamin E levels. Selenium is closely linked with this vitamin. Vitamin E requirements depend on concentrations of antioxidants, sulfur-containing amino acids, and selenium in the diet. And high dietary concentrations of polyunsaturated fatty acids found in corn oil and soybean oil can dramatically increase vitamin E requirements. High moisture feeds lose vitamin E quicker than drier feeds, and many other factors contribute to vitamin E breakdown in feeds.

There is less toxicity risk with vitamin E than with vitamins A and D. The margin of safety with vitamin E appears to be great. Signs of vitamin E deficiency, however, are characteristic of white muscle disease described earlier. Cattle displaying deficiency signs often respond to either vitamin E or selenium supplementation. Both may be needed in some instances.

Vitamin Supplementation

Vitamins A, D, and E are often added to mineral mixes or feed supplements as an A-D-E premix package. Many commercial mineral mixes have vitamins A, D, and E added at sufficient levels. However, it is important to review the mineral tag to be sure, particularly when actively growing forage is not available to cattle. Vitamin quantities are expressed as international units (IU), which are set amounts defined for each specific vitamin form. Reasonable rates of vitamin supplementation for cattle consuming a 4-ounce daily intake vitamin supplement are: Vitamin A, 100,000 to 200,000 IU; Vitamin D, 7,500 to 20,000 IU; and Vitamin E, 50 to 100 IU. Vitamins can degrade over time, so supplements purchased and stored for several months before being used may not supply adequate vitamin levels.

Table 5. Vitamin requirements in beef cattle.

Mineral	Growing and Finishing Cattle	Stressed Calves*	Dry, Gestating Cows	Lactating Cows
Vitamin A, IU/kg	2,200	4,000-6,000	2,800	3,900
Vitamin D, IU/kg	275	275	275	275
Vitamin E, IU/kg**	15-60	75-100	---	---

**Vitamin E requirements depend upon concentrations of antioxidants, sulfur-containing amino acids, and selenium in the diet. The growing and finishing cattle requirement presented here is an estimate.

Source: NRC, 2000. Adapted from NRC Nutrient Requirements of Beef Cattle, 7th revised edition.

Interpreting Mineral and Vitamin Tags

Though the amount of information on a mineral and vitamin supplement tag may seem overwhelming at first, the tag contains valuable information about a mineral mix. There are several common sections on most mineral tags.

Product name: When a single number is present in the product name, the number represents the phosphorus content. For example, "Pro 8" would contain 8 percent phosphorus. When two numbers are present in the name, the first number typically represents the calcium content, while the second number represents the phosphorus content. In most cases, if the calcium-to-phosphorus ratio is higher than 3:1, cattle will have to eat an excessive amount to get the phosphorus they need. Phosphorus is usually the most expensive component of a mineral supplement. Phosphorus is also very important in beef cattle diets, particularly when grazing low-quality pastures. Instead of purchasing a supplement based on price alone, try to buy a reasonably-priced supplement that provides adequate levels of phosphorus and other important minerals.

Approved animals: This indicates the species and classes of livestock for which the product is intended.

Drug claim: Some labels describe the purpose of any drugs in the product. Consider whether or not the drug is needed and if it is the right time of year to use it. For instance, it may not be worthwhile to include fly control compounds in a mineral mix outside of fly season.

Active drug ingredient statement: This tells the name of the drug and the level added to the product.

Guaranteed analysis: This lists the amounts of individual minerals and vitamins in the supplement. These levels can be compared to cattle requirements to determine if the product matches up well with animal needs. Remember that the percentage or amounts of minerals and vitamins listed on a supplement tag indicate the quantities in the supplement. To compare mineral requirements with supplement amounts effectively, consider the total dietary mineral and vitamin intake. For example, while the phosphorus requirement of lactating cows is listed as 0.26 percent in Table 1, low-quality forage may need to be supplemented with a mineral mix containing 6 percent phosphorus at 4-ounce daily supplement intake rate to achieve the required phosphorus level in the total diet. Make sure the mineral supplement contains enough macrominerals (calcium, phosphorus, magnesium, potassium, sodium, chlorine, and sulfur), trace minerals (chromium, cobalt, copper, iodine, iron, manganese, molybdenum, nickel, selenium, and zinc), and vitamins A and E.

Ingredients: This lists product ingredients in order from the highest to lowest amounts. Look for specific ingredients. For instance, copper oxide is not an ideal copper source, but copper sulfate and copper chloride are typically better sources for copper supplementation. As a general rule, the bioavailability (nutritional value considering the degree of availability to the body tissues) of inorganic mineral sources follows this order: sulfates = chlorides > carbonates > oxides. Organic mineral sources include chelated minerals. Chelated minerals are minerals bound to amino acids. Some researchers have reported greater bioavailability of organic mineral sources as compared to inorganic forms. However variable bioavailability values have been reported with the trace mineral chelates and complexes, suggesting no advantages in using organic forms.

Feeding directions: This lists expected intake, feeding instructions, and the length of any required withdrawal times for specific livestock classes. The mineral and vitamin concentrations in a 2-ounce daily intake rate supplement should be double those in a 4-ounce daily intake rate supplement to achieve the same intake of specific minerals and vitamins from the supplement.

Caution: This warning indicates potential problems, such as feeding an ionophore to horses, a high copper level to sheep, or selenium levels over legal limits.

Mineral and Vitamin Supplement Feeding Problems and Solutions

Fine particle size and the need to mix small quantities into bulk feed supplies make mixing a mineral and vitamin supplement with commodity-based feedstuffs difficult or impractical in some feed mixing scenarios. Unless feed mixing equipment can create a consistent mix and there is not a significant likelihood of the smaller particles in the mineral and vitamin supplement settling out of the finished feed, then consistently supplying a separate free-choice loose mineral mix or top-dressing feed may be more practical for mineral and vitamin supplement delivery in cattle diets.

Excessive intake can be a problem with mineral and vitamin supplements and can be an unnecessary expense. Cattle sometimes overconsume a mineral and vitamin mix when they are first exposed to it but then drop supplement intake to appropriate levels after an adjustment period. Also, if cattle are allowed to run out of mineral and vitamin supplement, they may over compensate by increasing consumption when it is put out again. If intake does not drop to recommended levels after a month of feeding a continuous supply of mineral and vitamin supplement, try adding salt to the mineral and vitamin mix or moving the supplement feeder farther away from water sources.

Inadequate mineral and vitamin intake, on the other hand, can be addressed by adding dry molasses to the mineral and vitamin mix or by moving the supplement feeder closer to a water source or area where cattle congregate. Make sure not to provide salt separately from a free-choice mineral supplement, because cattle may consume the salt supplement and avoid the complete mineral and vitamin mix. Changing mineral mixes is another option that sometimes corrects excessive or inadequate mineral consumption.

One mineral and vitamin supplement formulation may not be ideal year-round. Mineral and vitamin supplements can be used to deliver beneficial drugs, antibiotics, and parasite control ingredients to cattle diets. Adding these products may increase the price of the mineral and vitamin supplement. In addition, these products may need only to be supplied to cattle for defined periods of time or during certain times of year. It is advisable to reformulate the mineral and vitamin supplement to remove these products when they are not needed. Mineral and vitamin composition of supplements should also be adjusted for forage conditions. For example, increased magnesium supplementation is justified during grass tetany season but should be reduced during other periods to match cattle nutrient needs better and avoid unnecessary reductions in supplement palatability often associated with high levels of magnesium.

Many mineral supplements cake and harden when allowed to get wet, causing mineral intake to drop. Magnesium supplements are particularly prone to this problem. Using covered feeders that protect from rain can help minimize mineral hardening. Commercial mineral supplements are available that better withstand rain damage and wind losses. Mineral and vitamin supplement selection should consider mineral and vitamin composition and price of the supplement as first priorities over weather protection. It is a good idea to check the mineral and vitamin supplement supply at least weekly. Break up hardened mineral as much as possible. Checking the mineral supply on a regular basis is also important in monitoring consumption and making sure cattle do not run out.

Many different mineral and vitamin supplement feeder designs are available. Examples are shown below. Consider differences in protection of the supplement from the environment, quantity of supplement the feeder can contain, ease of moving the feeder, and feeder durability. Strategic placement and positioning of open-sided mineral and vitamin supplement feeders can lessen weather effects on the supplement. For illustration, if precipitation most often falls and blows from one direction, then turning open sides of mineral and vitamin supplement feeders away from this direction is warranted.

Mineral and Vitamin Supplementation Summary

Appropriate intake of key minerals and vitamins is essential for beef cattle productivity and health. Many different commercially available mineral and vitamin supplements are marketed to beef cattle producers. Custom blends of minerals and vitamins are another option for mineral and vitamin supplementation. Not all available mineral and vitamin supplements contain enough of the minerals and vitamins beef cattle need. In selecting a mineral and vitamin supplement, consider the class of cattle being supplemented; forage conditions; mineral and vitamin levels in feedstuff and water sources; and expected intake levels of forages, feeds, and mineral and vitamin supplements. Investing in a good mineral and vitamin nutrition program and properly managing mineral and vitamin feeding is highly recommended for both beef cow-calf and stocker operations. For more information on mineral and vitamin nutrition for beef cattle, contact an office of the Mississippi State University Extension Service.

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