

Mineral Nutrition: Advancements Over Time



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The use of minerals in livestock feeds is constantly evolving. The English word *mineral* comes from the Latin word *minerale*, which means “to be mined from the earth”. The first livestock minerals were rocks mined from

the earth, then ground up, processed, and fed to animals. These minerals are referred to as inorganic minerals and they are still used in livestock feed; however, they have limitations. Due to scientific advancements, many minerals are now available in multiple forms beyond mined rock. One of the most advanced types of livestock minerals, chelated minerals, have many benefits. As a farmer and producer, it sometimes can get overwhelming when looking for the right feed and mineral to choose for your livestock. This article will address many commonly asked questions regarding mineral sources and nutrition, as well as provide guidance when reading feed tags.

Mineral Classes: Macro and Micro Minerals

Minerals are categorized by the amount needed by the animal: macro and micro minerals.

Macro minerals are required by an animal in large quantities. These minerals include calcium, phosphorus, magnesium, sodium, potassium, chloride, and sulfur. In a cow’s diet, macro mineral requirements are described as a percent of the diet.

Micro, or trace minerals are needed by the animal in much smaller quantities but are still very important. There are up to 20 different trace minerals known, but the most important ones for livestock are copper, manganese, zinc, selenium, iron, iodine, and cobalt. Their requirements are listed in ppm (parts per million).

Bioavailability

Bioavailability is defined as the percentage of minerals that can be absorbed out of the feed into the bloodstream to be utilized by the body.

Minerals are chemically viewed as inorganic ions, very often they are metals. These ions can be found in stable inorganic compounds within the earth. When plants and microorganisms absorb these minerals from the ground they get incorporated into their cells and with this biologically bound. In this bound form, the minerals now move up the food chain as they get consumed by larger animals. Biologically bound minerals are easier to digest and absorb than the original, inorganic form. They have a higher bioavailability.

One of the most complex processes of the biological binding of minerals is chelation. With chelation, minerals are getting bound multiple times to organic components to create a ring-formed molecule. The English word *chelate* comes from the Greek word *chela* which translates into *crab’s claw*. The organic component grabs onto the metal ion much like the way a crab pincer would grasp food.

Macro minerals are generally not chelated as it is not cost-effective, however strong economic return has been shown when using chelated trace minerals in a variety of livestock species.

Chelated trace minerals bring two main advantages for the animal. First, the ‘organic ring’ protects the mineral within from reacting or binding with other inorganic minerals in the GI tract and becoming completely unavailable to the animal. And secondly, the organic portion of the chelated molecule can easily be absorbed by the animal’s body, absorbing the metal part with it. Therefore, the bioavailability of chelates is much higher than that of inorganic mineral complexes. For example, the commonly used inorganic zinc oxide has less than 10% of the fed zinc bioavailable to the animal. While polysaccharide-chelated zinc has a bioavailability of over 90%.

Why Is It Important to Me as a Livestock Producer, to Use Chelated Trace Minerals?

Feeding a diet that contains chelated trace minerals has a strong economic return on investment. Providing livestock with a ration that meets all their requirements for minerals not only keeps them healthy but also helps them to be most productive and thrive to their full genetic potential.

For example, goats and cattle both have a high requirement for supplementary copper in their feed. Their diet should contain between 80 and 100 ppm of copper. Lower copper values, or high molybdenum contents that bind copper, will lead to copper deficiency. Goats show a copper deficiency in the form of neurological symptoms.

Another great example is selenium. Many soils in the US are very low in selenium, especially in the Midwest. Due to that, the selenium supply from forage is usually below the required need for livestock. Selenium deficiency can lead to unthrifty calves and white muscle disease. At the same time, overconsumption of selenium poses a health

risk to the animal. The FDA has regulated a maximum of 0.3 ppm of selenium in a diet. To make sure the offered selenium in the feed can be used at its best, a selenium source with a high bioavailability like yeast-bound selenium should be chosen.

How Do I Know What Is in the Mineral I Am Feeding?

When looking for the right feed for livestock it is important to pay close attention to the label of each feed choice. The guaranteed analysis result tells how much

of which mineral is in the feed, but not in which chemical form it is included. For that information, the ingredient list needs to be consulted. See examples, Figure 1. Here is listed which source of minerals were used to formulate the feed. Minerals that are included as oxides and sulfates have a lower bioavailability. So, if for example zinc sulfate was used, for *Brand X*, only 50% of the listed zinc content can be utilized by the animal. If a chelated polysaccharide-zinc was used, 90% conservatively calculated, can be utilized. All of Crystal Creek's livestock minerals are formulated with highly bioavailable trace minerals like polysaccharide chelates and yeast-bound selenium.

Modern livestock breeds keep improving their genetic potential through breeding and selection techniques. A higher production potential comes with a growing need for nutrients like minerals. To keep up with this growing need it is advisable to choose a feed that sources minerals in the best possible form: highly-bioavailable chelated trace minerals and above-requirement level macro minerals. Chelated minerals are a tool that we can use to meet these needs and continue supporting livestock health and production which in turn supports the end goal of our producer's profitability. To learn more about mineral nutrition and the impact it can have on your operation, call Crystal Creek® to talk to a livestock nutritionist.

References available upon request.

Figure 1 TAG EXAMPLES

Brand X Tag Analysis

GUARANTEED ANALYSIS		FEEDING DIRECTIONS	
Calcium (Ca), Not less than	18.2 %	Feed this product free choice to cattle receiving composed largely of grass hay or to cattle grazing grass pastures. Optimum intake is 4 ounces per day.	
Calcium (Ca), Not more than	19.4 %		
Phosphorus (P), Not less than	4.0 %	Cattle receiving phosphorus deficient diets may consume this product when it is first offered. A mineral feeder near the water supply or in the animal area. Put out fresh mineral at least once per week. free choice salt is not required with this mineral. fresh, clean water near the feeding area.	
Salt (NaCl), Not less than	22.5 %		
Salt (NaCl), Not more than	27.0 %		
Magnesium (Mg), Not less than	1.0 %		
Potassium (K), Not less than	0.1 %		
Zinc (Zn), ppm, Not less than	3,600		
Manganese (Mn), ppm, Not less than	3,600		
Copper (Cu), ppm, Not less than	1,200		
Iodine (I), ppm, Not less than	80		
Selenium (Se), ppm, Not less than	27		
Vitamin A, I.U./lb, Not less than	150,000		
Vitamin D ₃ , I.U./lb, Not less than	15,000		
Vitamin E, I.U./lb, Not less than	150		

INGREDIENTS
 Calcium Carbonate, Salt, Dicalcium Phosphate, Monocalcium Phosphate, Processed Grain By-Products, Potassium Chloride, Manganese Oxide, Mineral Oil, Sodium Selenite, Fish Protein, Phosphorus Oxide, Vitamin E Supplement, Vitamin A Supplement, Manganese Sulfate, Zinc Sulfate, Copper Chloride, Ethylene Diamine Dry Sulfide, Manganese Products, Vitamin D₃ Supplement, Cobalt Sulfate, Yeast, Artificial Flavors.

CRYSTAL CREEK

ROI® Beef Mineral

A Mineral, Trace Mineral And Vitamin Supplement
 For Beef Brood Cows, Calves, Feeders, Replacement Heifers And Bulls

GUARANTEED ANALYSIS		
Calcium	Minimum	16.00%
Calcium	Maximum	17.00%
Phosphorus	Minimum	8.00%
Salt	Minimum	15.00%
Salt	Maximum	16.00%
Sodium	Minimum	6.00%
Sodium	Maximum	7.00%
Magnesium	Minimum	4.00%
Potassium	Minimum	3.00%
Copper	Minimum	880 ppm
Selenium	Minimum	27 ppm
Zinc	Minimum	3,500 ppm
Vitamin A	Minimum	500,000 IU/lb.
Vitamin D ₃	Minimum	70,000 IU/lb.
Vitamin E	Minimum	1,600 IU/lb.

INGREDIENTS
 Monocalcium Phosphate, Dicalcium Phosphate, Calcium Carbonate, Salt, Magnesium Oxide, Potassium Carbonate, Brewers Liquid Yeast, Manganese Polysaccharide Complex, Zinc Polysaccharide Complex, Selenium Yeast, Brewers Dried Yeast, Soybean Oil, Copper Polysaccharide Complex, Vitamin E Supplement, Dried Aspergillus oryzae Fermentation Extract, Vitamin A Supplement, Vitamin D₃ Supplement, Calcium Iodate, Cobalt Sulfate