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Understanding Commercial Free-Choice Mineral Mixes for Beef Cattle[1]

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Beef cattle require a number of dietary minerals for optimal growth, reproduction, and health. There are several important minerals that are often deficient in forages and pasture. To make up for these deficiencies, beef cattle are often offered a mineral mix ad libitum or "free-choice."

Selecting the correct free-choice mineral supplement product is important for maintaining healthy animals and optimizing growth and reproduction. Producers should select supplements that will meet animal requirements and avoid excesses that reduce profits and lead to unnecessary mineral excretion. A good mineral program for beef cattle is one of the best investments that cattle producers can make.

Selecting a mineral mix

There are many commercial mineral supplements available with different formulations. A free-choice mineral supplement should provide the following minerals: calcium, phosphorus, sodium and chloride (salt), magnesium, copper, zinc, iodine, cobalt, and selenium. Mineral requirements for beef cattle are shown in Table 1. Iron and manganese are also essential and are included in many mineral supplements; however, the concentrations of these minerals in forages are usually more than adequate in the lower Southeastern U.S.

The most important considerations when purchasing mineral mixes are phosphorus level, calcium to phosphorus ratio, salt level, bioavailability of "trace" minerals (especially copper), and the presence or absence of a high level of magnesium. An example mineral mix is presented in Table 2.

Mineral concentrations in forages and feeds

Average concentrations of important minerals of several forages and common concentrate feeds are shown in Table 3. Mineral concentrations in various feeds and forages will vary; thus it would be desirable to test for concentrations of minerals, especially phosphorus, calcium, magnesium, potassium, copper, and zinc. Mineral concentrations in forages and concentrate feeds can be used as a guide in selecting a proper mineral mix.

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Two multiyear surveys have been conducted in North Florida to measure mineral concentrations in pasture forage. For beef cattle grazing warm-season bahiagrass pastures, sodium concentration in the pasture forage was found to be very deficient[a]; copper, selenium and cobalt were deficient; calcium and zinc were slightly deficient; phosphorus was marginally deficient to marginally adequate; magnesium, iron, and manganese were adequate; and potassium was in excess when compared to requirements for beef cattle. For cattle grazing cool-season annual grass pastures, sodium in the pasture forage was very deficient; copper, selenium, and cobalt were deficient; calcium was slightly deficient; zinc was marginally deficient; magnesium was marginally deficient to adequate; phosphorus was marginally adequate to adequate; iron and manganese were adequate; and potassium was in excess. Please note that iodine and chloride were not measured in the above surveys.

Phosphorus concentration

Phosphorus is expensive and there is concern about excessive phosphorus excretion by cattle into the environment. Phosphorus, however, can be marginally deficient in grass forages, especially warm-season grasses such as bahiagrass. Phosphorus is often discussed in conjunction with calcium because the two minerals function together in bone formation.

Phosphorus concentration in a commercial free-choice mineral mix can vary from 0 to 12%. Since phosphorus is typically the most expensive component in a mineral mix, purchasing a supplement based on price alone may result in inadequate phosphorus supplementation. The level of phosphorus that should be in a supplement will be dependant upon what forages and/or other feedstuffs the cattle are grazing or being fed (Table 3).

Because of the variation in phosphorus level among various commercial free-choice mineral products, the product name on the tag will often have a number on it that indicates the phosphorus level. For example, "Beef 8 Plus" would indicate that the mineral mix contains 8% phosphorus. If two numbers are present, the first will be the concentration of calcium and the second, phosphorus. If ingredients other than mineral sources are included, such as a protein source, the tag will give information about the added ingredient(s) instead of phosphorus content (e.g., crude protein content if a protein source is added).

Some general guidelines on choosing a mineral mix with the proper phosphorus concentration:

1. For beef cattle grazing warm-season grass pastures (e.g., bahiagrass) and/or are fed grass hay, 4 to 8% phosphorus is suggested in the mineral mix (in fact this level is adequate for most situations in Florida). In instances where grass forage is consistently lower than 0.2% phosphorus, 6 to 10% phosphorus is suggested. However, the best advice would be to have the forage tested for phosphorus concentration to be sure.

2. For cattle grazing cool-season pastures (e.g., annual ryegrass), 2 to 4% phosphorus in the mineral mix is suggested.

3. For cattle supplemented with co-product feedstuffs, such as corn gluten feed or distillers grains, 0 to 4% phosphorus in the mineral mix is preferred (various co-products are high in phosphorus; for example, corn gluten feed contains about 1% phosphorus—refer to Table 3. An exception is citrus pulp, as it is quite high in calcium and low in phosphorus; soy hulls are low in phosphorus as well).

4. For cattle grazing legume pasture or fed legume hay (e.g., perennial peanut), 8 to 12% phosphorus is suggested for the mineral mix (legumes are low in phosphorus but high in calcium, averaging 1.2% calcium).

Also be aware that the phosphorus need of the beef cow is greatest during lactation, especially early lactation.

Calcium to phosphorus ratio

In addition to phosphorus level, the ratio of calcium to phosphorus is also important in a mineral mix. The preferred ratio is 1 to 1 to 2 to 1 of calcium to phosphorus, but cattle can tolerate a ratio of up to 7

to 1 (NRC 2000). Generally, the ratio should not exceed 5 to 1 in a mineral mix except in situations in which cattle are supplemented with various co-product feeds while grazing or are fed hay (see no. 3 phosphorus guideline above).

Zinc to copper ratio

As mentioned above, forages in the lower Southeastern U.S. are quite low in copper; thus it may be tempting to purchase a mineral mix high in copper. High copper can interfere with zinc absorption by the animal. The ratio of zinc to copper should be at least 2 to 1, preferably, 3 to 1.

Amount of salt

The mineral mix should contain 15 to 30% salt (sodium and chloride). Salt is the only mineral that animals will crave. Salt level in a mix has a significant effect on the intake of the mineral mix when offered free choice. Salt must be provided continuously as salt is not stored in the animal's body. Sodium is almost always deficient in forages and feeds for cattle, but chlorine (chloride) is usually adequate.

Bioavailability of a mineral

Minerals used in a mineral mix are available in many forms. Typically oxide forms are poorly absorbed by the animal. For example, copper oxide is poorly absorbed; a better choice would be copper sulfate or copper chloride. Iron oxide is also poorly absorbed but is commonly added to give the mineral mix a desirable red color. Iron is an essential trace mineral but is seldom deficient in cattle on pasture. However, the oxide forms of magnesium, zinc, and manganese are highly absorbable.

Some minerals may be included in a mineral mix as an organic complex (i.e., associated with or bound to an organic compound—examples include amino acids like lysine, or proteinate, which is partially hydrolyzed protein). Often times these organic mineral complexes are generically referred to as chelated minerals, which is not correct as mineral chelates are just one form of organic mineral complexes. The organic compound acts as a carrier for the mineral. Organic complex minerals are generally slightly more "bioavailable" to the animal than inorganic sources of a mineral (e.g., copper sulfate). Organic complex minerals are generally more expensive.

High magnesium mineral mixes

Extra magnesium is typically added to mineral mixes provided to cattle grazing lush grass pasture in early spring. Magnesium is essential for proper enzyme and nervous system function and for efficient carbohydrate metabolism. A magnesium deficiency is uncommon except for cows grazing lush growth grass pastures, especially small grain pastures, during the late winter and early spring. During this time, the high potassium present in the forage can interfere with magnesium utilization by the animal. This deficiency is commonly called "grass tetany." A high rate of nitrogen and potassium fertilization of pastures can contribute to grass tetany. Mature lactating cows are particularly susceptible to grass tetany. A mineral mixture containing 10 to 14% magnesium consumed at about 2 to 4 ounces per day should provide adequate magnesium. Please note that magnesium oxide is not well liked by cattle, and steps may have to be taken to ensure adequate intake, such as mixing in some ground grain into the mineral mix.

Vitamins in mineral mixes

Vitamins A, D, and E are sometimes included in mineral mixes. Typically, these vitamins are not needed when cattle are grazing green pastures. These vitamins, especially vitamin A, would be desirable when cattle are fed grass hay or are grazing mature, dried forage; crop residue; or stockpiled forage.

Targeted intake of free-choice mineral mixes

Most commercial free-choice mineral mixes (supplements) will indicate the target intake of the supplement (typically 2 to 4 oz per head per day) on the tag. Be aware that salt-based mineral mixes with more than 10% phosphorus may have poor palatability. Therefore, steps may be needed (such as mentioned above for hi-mag supplements) to ensure targeted intake.

Research conducted in South Florida at the Range Cattle Research and Education Center in Ona have noted that beef cows will often overconsume salt-based mineral supplements during the summer and underconsume during the winter. The best advice is to routinely monitor mineral feeders to estimate intake. Added salt can be used to counter overconsumption. Ground grain or a protein source (e.g., cottonseed meal) can be mixed in with the mineral supplement to encourage consumption.

Summary

Since phosphorus is the most expensive component of a mineral mix, be aware that buying a commercial free-choice mineral mix for beef cattle based on price alone may result in inadequate phosphorus intake for optimal heath, growth, and reproduction. One instead should buy a reasonably priced supplement that provides adequate levels of phosphorus and other important minerals.

Remember that it is not enough just to put out a mineral mix. The mineral mix must be consumed by the animal to be effective. If the animal doesn't consume and utilize the mineral mix, optimum performance cannot be achieved.

Related information:

UF-IFAS EDIS publications:

AN190—*Basic Nutrient Requirements of Beef Cows*

AN142—*Average Nutrient Content and Bulk Price of Byproduct Feeds Commonly Available in Florida*

AN117—*Florida Cow-Calf Management, 2nd Edition – Feeding the Cow Herd*

DS137 (SS-AGR-84)—*Grass Tetany in Cattle*

AN224—*Mineral Concentrations in Grazed Cool-Season Annual Grass Pastures in North Florida*

AN128—*Alternative Feeds for Beef Cattle*

AN086—*Essential Trace Minerals for Grazing Cattle in Florida*

AN243—*Forage Mineral Concentrations in Grazed Warm-Season Bahiagrass Pastures in Florida*

Other publications:

Bulletin 895—*Mineral Supplements for Beef Cattle* (Univ. of Georgia Extension Publication available via the University of Georgia Cooperative website—http://www.caes.uga.edu/publications)

References:

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NRC. 2000. *Nutrient Requirements of Beef Cattle* (7th ed., 2000 version), National Academy Press, Washington, DC.

Rossi, Johnny. 2006. *Mineral supplements for beef cattle*. Coop. Ext. Ser. Bul. No. 895, University of Georgia, Athens.

[a] Very deficient = nearly 100% deficient; deficient = 50 to 100% deficient; slightly deficient = 0 to 50% deficient; marginally deficient = 0 to 25% deficient; marginally adequate = less than 5% deficient; adequate = 0% deficient; excess = more than 200% of requirement.

Table 1. Mineral requirements of beef cattle (as % or ppm of dry matter intake)[a]

Mineral	Lactating Cows	Dry Cows	Growing Cattle
Calcium, %	0.30	0.20	0.30–0.40
Phosphorus, %	0.25	0.20	0.20–0.30
Magnesium, %	0.20	0.10	0.20
Sodium, %	0.10	0.10	0.10
Copper, ppm	10	10	10
Cobalt, ppm	0.1	0.1	0.1
Iodine, ppm	0.5	0.5	0.5
Zinc, ppm	30	30	30
Manganese, ppm	40	40	40
Selenium, ppm	0.1	0.1	0.1

[a]Adapted from NRC (2000)

Table 2. Typical free-choice mineral mix specifications for beef cattle

Mineral	Amount in mix[a]
Calcium	10 to 20%
Phosphorus	4 to 8%
Salt (NaCl)	15 to 30%
Magnesium[b]	1%
Copper	0.12% (1200 ppm)
Cobalt	0.001% (10 ppm)
Iodine	0.008% (80 ppm)
Zinc	0.3% (3000 ppm)
Selenium	0.0026% (26 ppm)

[a]Assuming 2 to 4 ounces intake per day per head
[b]Magnesium should be increased to at least 10% when grass tetany is a concern.

Table 3. Typical average composition of common forages and concentrate feedstuffs (dry basis)[a]

Feedstuff	Calcium %	Phosphorus %	Magnesium %	Copper ppm	Zinc ppm
Bahiagrass pasture	0.3	0.2	0.3	4	20
Bermudagrass pasture	0.3	0.25	0.2	8	30
Annual ryegrass pasture	0.35	0.35	0.2	8	30
Oat pasture	0.3	0.35	0.2	8	30
Bahiagrass hay	0.35	0.2	0.3	6	30
Bermudagrass hay	0.4	0.2	0.2	8	30
Perennial peanut hay	1.3	0.2	0.5	6	35
Alfalfa hay	1.3	0.2	0.4	10	30
Corn	0.03	0.3	0.1	5	20
Corn silage	0.25	0.2	0.15	4	20
Corn gluten feed	0.05	1.0	0.4	6	70
Dried distillers grains	0.1	0.9	0.3	5	65
Wet distillers grains	0.1	0.9	0.3	4	60
Cottonseed meal	0.2	1.2	0.6	15	70
Whole cottonseed	0.2	0.6	0.4	8	35
Soybean meal	0.2	0.7	0.3	15	55
Soy hulls	0.6	0.2	0.25	10	45
Molasses	1.0	0.1	0.4	65	20
Wheat midds	0.15	1.1	0.4	8	80
Dried citrus pulp	1.8	0.2	0.15	6	15
Wet brewers grains	0.3	0.65	0.2	12	80
Hominy feed	0.04	0.6	0.2	4	40

[a] Adapted from NRC (2000), Dairy One, Inc. forage library, and surveys done in North Florida