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Feeding Minerals to Livestock Important

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Minerals have many important functions in the body and their needs in livestock rations have been known for many years. Bone and teeth are composed chiefly of minerals which are necessary for their proper growth and development. In addition to these functions, minerals are necessary constituents of soft tissue and body fluids and play important roles in the regulation of body processes.

In spite of the known need for minerals for a long time, much remains to be learned about specific requirements, mineral content of feeds, mineral balances and factors affecting these. It is recognized that the requirements of an animal will vary depending upon such factors as age, sex, rate of gain, pregnancy and milk production. The mineral content of feeds is influenced by the kind of crop, soil upon which grown, and the fertilizer used. These facts make the problem of supplying the proper amount of minerals to livestock by no means simple.

The common concept of a "balanced ration" is one supplying enough of all essential nutrients. Often little, if any, consideration is given to the possibility of having too much. This is important with some minerals and not only must the requirement for a particular mineral be considered but also the effect of an excess and its relation to other minerals. A deficiency of one may be produced by having too much of another. Thus "add for insurance" against a possible deficiency may not be sound practice, unless a person has reason to suspect that the minerals added may be approaching borderline levels in the feeds and that he will not be adding any excess.

Although mineral requirements and mineral metabolism of livestock is rather complex, much has been learned about their requirements and their functions. This information can form the basis of rather sound practices in supplying minerals to livestock.

The Essential Minerals

The minerals required by animals are commonly divided into "principal" or "major" minerals and "trace" minerals. There are seven "major" minerals required by animals and they are: sodium, chloride, calcium, phosphorus, magnesium, sulfur and potassium. At least six "trace" minerals are essential for one or more species of animals. These trace minerals are' iodine, cobalt, copper, iron, manganese and zinc. Some investigators now include fluorine as an essential mineral since in small amounts it appears to favor development of better teeth.

A number of minerals other than those named are found in the body. These are not known to serve any essential function but are present because they are consumed in the feed and water.

Mineral Needs of Beef Cattle

Beef cattle and sheep appear to have quite similar mineral requirements and their needs for most minerals are not as great as those of other farm animals. This is because of the nature of their feeds and partly because they are not ordinarily put under stress of production to the same degree as poultry, hogs and dairy cattle. Beef cattle are large consumers of forage and, except when managed under feed-lot and show-herd conditions, their rations con-

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sist largely of pasture and harvested roughages. In general, roughages contain more minerals than grains with the exception of phosphorus. There are some minerals that are likely to be deficient in many cattle rations and a discussion of the individual minerals will point out these conditions.

Salt (Sodium and Chlorine)

Sodium and chlorine are low in most plant material and they should be supplied for all classes of livestock. Sodium is probably the more critical of the two in most cattle rations.

Common salt is composed of sodium and chlorine and is an effective and cheap source of these two elements. Its value to livestock is well known and the practice of providing salt to all classes either free choice, in mineral mixes, or mixed with other feeds is a commonly accepted one.

In view of the fact that salt is a cheap and effective source of sodium and chlorine, recommended requirements for these two elements are usually stated in terms of the salt requirements. Cattle can consume large quantities of salt without any harm provided they are accustomed to it gradually and are provided a plentiful supply of good water. Salt starved animals should have their appetites for salt satisfied gradually before being offered it free choice.

A deficiency of salt is shown by a craving for salt, low production, "rundown" appearance, and a rough hair coat. Deficient cows have been noted to lick or consume dirt, feces, urine and other objects apparently in an attempt to get salt.

Salt consumption by cattle will vary depending upon the type of ration fed. Consumption will be higher on a heavy roughage ration than on one high in concentrates. Consumption is also higher on green lush pasture in early spring than in late summer and fall when the forage is drier and more mature. The actual consumption may vary from less than an ounce to over four ounces daily and does not always appear to be associated with the requirement. One ounce daily appears to be ample. Under pasture conditions, the consumption may amount to 2.0 to 2.5 pounds per cow monthly in early season and 1.0 to 1.5 pounds monthly in late season when the forage begins to dry up. Several times these levels do not appear harmful. Over one pound of salt daily has been fed to cattle in experiments on self-feeding of protein supplements mixed with high levels of salt. This level did no apparent harm when the cattle were accutsomed to it gradually and had access to a good supply of water.

Calcium and Phosphorus

Calcium and phosporus are required in relatively large quantities by cattle and they are closely related in the metabolism of the animal. The ratio of these two minerals recommended in the ration as most desirable is 1 to 2 parts of calcium to 1 part of phosphorus. When legume forage makes up a large part of the ration, calcium may be considerably higher in relation to phosphorus than the above ratios. Cattle and sheep are fairly tolerant to large amounts of calcium and the calcium-phosphorus ratio is not so critical for them. The calcium-phosphorus ratio becomes less important in the presence of an ample supply of vitamin D. Cattle get this vitamin through exposure to sunshine and consumption of sun-cured roughages.

Calcium and phosphorus are essential for proper development and maintenance of bone. About 99 per cent of the calcium and 80 per cent of the phosporus present in the body are found in the teeth and bones. The remaining amounts are widely distributed in various body tissues and organs where they have important functions. The bones serve as a storehouse for calcium and phosphorus and if the ration contains inadequate amounts, they can be withdrawn from the bones to supply other needs. Thus a deficiency of calcium and-or phosphorus result in weak and improperly developed bones. When carried to an advanced stage, it is called "rickets" in the young animal and "osteomalcia" in the adult. These diseases are characterized by stiffness, swollen joints, bent knees and arched back.

One of the first symptoms of a phosphorus deficiency is a depraved appetite characterized by chewing of wood,

bones, dirt, hair and other objects. In severe cases there is loss of appetite.

The calcium requirement recommended for cattle is about 0.30-0.35 per cent of the total ration of calves; 0.20-0.25 per cent for yearlings, pregnant heifers and cows; and about 0.15-0.18 per cent for mature bulls and 2-year-old steers. The phosphorus requirement is about 0.22-0.25 per cent of the total ration for calves; 0.18-0.20 per cent for yearlings, pregnant heifers and cows; and 0.15-0.17 per cent for mature bulls and 2-year-old steers. The actual amount of a mineral supplement needed will depend upon the calcium and phosphorus content of the feeds and in the mineral supplement fed.

There are important differences in the calcium and phosphorus content of feeds that deserve special consideration in the selection of calcium and phosphorus supplements. Roughages are fairly good sources of calcium. Many of them may be too low in phosphorus to supply the needs of cattle and this is particularly true for roughages cut at a late stage of maturity. On the other hand, grains and their by-products are much better sources of phosphorus. These facts are illustrated in the following tables:

Table 1. Calcium and Phosporus Content of Some Common Roughages

Feeding Stuff	Cal. (%)	Phos. (%)
Alfalfa hay	1.47	.24
Brome grass hay	.20	.28
Millet hay	.29	.16
Oat hay	.21	.19
Prairie hay, good	.36	.18
Prairie hay, poor	.28	.09
Barley straw	.32	.11
Oat straw	.19	.10
Corn stalks	.29	.05
Sorghum stalks	.44	.07
Pasture grass, growing, immature, western	.37	.24
Pasture grass, mature, western	.34	.14
Pasture grass, mature and weathered, western	.33	.09
Corn silage (12% moisture basis)	.25	.19
Grass-legume silage (12% moisture basis)	.65	.31

Table 2. Calcium and Phosphorus Content of Some Common Concentrates and Mineral Supplements

Feeding Stuff	Cal. (%)	Phos. (%)
Barley	.06	.37
Corn	.02	.27
Sorghum grain	.02	.31
Oats	.09	.34
Wheat	.04	.39
Wheat bran	.14	1.29
Wheat mids	.09	.71
Linseed meal	.39	.87
Soybean meal	.29	.68
Meat scraps	6.09	3.49
Bone meal	32.00	15.00
Rock phoshate	29.00	13.00
Dicalcium phosphate	26.00	20.00
Limestone	38.00	----

Most of the roughages listed in table 1 contain at least as much calcium as the recommended requirements for cattle. Only a few of the high quality roughages meet the recommended phosphorus needs. Thus it is apparent that a ration high in roughages is more likely to be deficient in phosphorus than in calcium. The type of supplement needed is one high in phosphorus in relation to calcium. Mineral supplements vary in price and in calcium and phosphorus content. The one furnishing phosphorus at the lowest cost per unit of phosphorus is the most economical when the greatest need is for this mineral. This is true whether it is a high phosphorus ingredient or a commercial mineral mixture. Bone meal and dicalcium phosphate are commonly available in this area and are satisfactory sources of both calcium and phosphorus.

The grains and their by-products listed in table 2 contain less calcium than recommended for cattle. On the other hand, they are better sources of phosphorus than are the roughages. Thus, when feeding a ration composed largely of grain, calcium is likely to be more deficient than phosphorus. The mineral supplement needed with this type of ration should be higher in calcium in relation to phosphorus than with rations composed mostly of roughages. Ground limestone is a common and cheap source of calcium.

Magnesium, Potassium and Sulfur

Natural feeds appear to contain enough of these mineral elements to

meet the needs of cattle. Temporary magnesium deficiency, or mineral imbalance, that responds to magnesium supplementation has been reported. This problem has been confined more to dairy than beef cattle and does not appear to be a problem in this area.

Iodine

There is a large area in the northern part of the United States that is deficient in iodine. A large part of South Dakota is listed in this area. According to surveys, iodine deficiency has been noted in most of the counties of the state.

A deficiency of iodine in cattle results in the young being born weak or dead and in goiter or "big neck" disease of the young. Since most plant material is low in iodine, a supplemental source of iodine is needed. Iodized salt is a cheap and effective source and is recommended for the breeding stock. It is not necessary in fattening cattle for market except in areas seriously deficient in iodine. The recommended level in the salt is 0.007 per cent iodine, or 0.01 per cent potassium iodide, and stabilized to prevent the loss of iodine.

In areas where the salt consumption is low, iodine may be used in the protein supplement. Protein supplements containing about 0.0004 per cent iodine will be satisfactory.

Symptoms of iodine deficiency in cattle are practically always confined to the young. Lumpy jaw in older cattle is an infectious disease and not due to a deficiency of iodine even though iodine is used as a treatment.

Cobalt

Cobalt deficiency is primarily an area problem but several countries and several states in this country have reported deficient areas. Forage containing less than 0.09 ppm of cobalt should be considered borderline to deficient. The Experiment Station Biochemistry Department is collecting samples of grasses in various areas of the state. Some of these samples have been lower than the above value. Therefore, until more work is done and a change in recommendation is warranted, cobalt supplementation of cattle and sheep is recommended. This is probably most advisable for cattle and sheep consuming native pastures and hays.

The cobalt requirement of cattle is extremely small, amounting to about 0.000007 per cent of the ration or about 0.15 mg. per 100 pounds of body weight. However, this small amount may mean the difference between life or death to the animal.

One of the early symptoms of cobalt deficiency is a lack of appetite. The deficiency symptoms, like those of most of the other minerals, are not specific. When cattle are not doing well, one of the best tests to determine whether or not they are suffering from a cobalt deficiency is to feed a cobalt salt. If an improvement in appetite is noted within three or four days, the condition was probably due to lack of cobalt.

When cobalt supplementation is indicated, one ounce of cobalt sulfate or cobalt chloride mixed with each 100 pounds of salt will be sufficient. If cobalt carbonate is used, ½ ounce will furnish nearly the same amount of cobalt. When mixing at home, this amount of cobalt should be finely powdered and accurately weighed. It should be mixed thoroughly with 10 pounds of salt and then this premix mixed with the remainder of the 100 pounds of salt. Cobalt can be purchased from drug stores but many people prefer to buy a trace mineral salt containing cobalt rather than to bother mixing their own.

Copper, Iron, Manganese, Zinc, Fluorine

Natural feeds appear to contain enough of these mineral elements to meet the needs of cattle. Copper deficiency has been reported in some countries but Florida is the only state in this country, to report a copper deficiency in cattle. The range between the copper requirement and the toxic level appears much smaller than for most minerals. Therefore, copper supplementation should be used with caution.

Iron deficiency, and also copper, often occurs in young pigs raised in paved lots but does not appear to be a problem with cattle.

Several attempts to produce a manganese deficiency have failed. Most feeds contain much more manganese than appears to be needed by cattle.

Zinc deficiency has not been produced in cattle and there does not seem to be any need of including this mineral in cattle feeds.

Fluorine has been of interest to livestock nutritionists largely because of its toxic effects when present in excess. Some mineral supplements, such as rock phosphate unless defluorinated, may contain harmful amounts of this element.

Mineral Supplements

Of all the mineral elements that are required by animals, calcium, phosphorus, sodium, chlorine, iodine and cobalt are the ones most likely to be deficient in cattle rations in this area. The actual amount of these needed in addition to that present in the feeds, will depend upon the kinds and amounts of various feeds fed. It has also been shown that the proper balance between some minerals is important and that too much as well as too little may be harmful. Thus getting all these minerals in the ration in the proper amount is not a simple problem. To go on the idea of "add for insurance sake" may not be a sound practice. Force feeding of minerals except under certain conditions is not as advisable as feeding free choice. Force feeding may be advisable in areas where free choice consumption of mineral supplements are low because of high salt content of forage or water. When the content of one mineral in the feed is considerably more deficient than others, it would be sound practice to add a part of the needs of this mineral to the feed.

Free choice feeding of mineral supplements appears to suit the needs in most of South Dakota. Providing stabilized iodine salt free choice or in mineral mixtures will take care of the requirements for sodium, chlorine and iodine. One ounce of cobalt sulfate, or cobalt chloride or ½ ounce of cobalt carbonate per 100 pounds of this salt will meet the cobalt needs. Most trace mineral salt available on the market will also contain copper, iron, manganese and zinc. While these do not seem to be needed in this state, they appear to be used in the trace mineral salt in amounts that are well below toxic levels. A trace mineral salt may be used in place of common salt, or salt containing iodine and cobalt.

The amount of calcium and phosphorus in mineral supplements will depend upon the type of ration fed. Listed below are some suggested mineral supplements for free choice feeding to cattle under various conditions. An attempt has been made to keep the supplements simple and the number to a minimum.

1. Bone meal ----------3 parts
   Salt* ----------1 part

   Additional salt free access

Recommended when feeding a ration composed largely of good quality roughages or when on good pasture.

2. Bone meal ----------3 parts
   (or Dicalcium phosphate ---2 parts)
   Salt* ----------2 parts

   No additional salt necessary

Recommended when feeding a ration composed largely of low quality roughages and for winter grazing.

3. Bone meal ----------3 parts
   Limestone ----------1 part
   Salt* ----------1 part

   Additional salt free access

Recommended with rations containing a large portion of grain.

* Salt containing iodine and cobalt or a trace of mineral salt. The additional salt offered free access should be the same kind.

Salt has been suggested in the mixtures to improve their palatability. Additional salt has been recommended in those cases where the actual need and the consumption of the supplement may be low.

Commercial mineral supplements may be used in place of the suggested mixtures. No single one will effectively and economically meet all conditions. It would be desirable for dealers to offer supplements with at least two different phosphorus levels. A commercial supplement designed to replace mixture No. 1 or No. 2 above should contain 10 per cent or more phosphorus. It need not contain any

more calcium than phosphorus. An excess of calcium will not be harmful if there is enough phosphorus. Many high phosphorus ingredients contain even more calcium. A commercial supplement designed to replace the No. 3 mixture should contain about 6-7 per cent phosphorus and 20-30 per cent calcium. It should be cheaper than one with 10 per cent phosphorus since high phosphorus ingredients are more expensive than high calcium ingredients.

Salt may be mixed with commercial supplements at about the same rate as in the suggested mixtures above. Those already containing salt should be cheaper than those without since salt is one of the cheaper ingredients in mineral supplements. An important consideration is the cost per unit of phosphorus and calcium.

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