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Minerals for Farm Animals

J. R. HAAG

Oregon State System of Higher Education
Agricultural Experiment Station
Oregon State College
Corvallis

SUMMARY

1. Mineral salts constitute one of the groups of nutrients that play an important part in livestock feeding.

2. Mineral supplements should not be accepted as blanket remedies for underfeeding, mismanagement, or disease control.

3. Good nutrition and the economical production of livestock call for the use of only those mineral supplements for which there appears to be a reasonably indicated need.

4. The need for mineral supplements, particularly for complex mixtures of unknown composition, has been overemphasized.

5. The value of mineral mixtures should be judged primarily on the basis of the elements they contain that are likely to be lacking in the particular rations with which they are to be fed to farm animals.

6. Practical farm rations are most likely to be deficient in common salt, iodine, calcium, and phosphorus.

7. Livestock should always be allowed free access to common salt.

8. In goitrous regions, iodine should be supplied as directed in this bulletin, especially to pregnant animals.

9. Sterilized bonemeal or bone flour supplies calcium and phosphorus in about the proportions these elements are stored in the animal body. Where calcium only is needed, high-grade limestone will prove more economical than bonemeal.

Minerals for Farm Animals

By

J. R. Haag, Chemist (Animal Nutrition)

INTRODUCTION

FARM ANIMALS require an abundance of palatable feed stuffs as a source of energy, proteins, minerals, and vitamins. These feed stuffs must be suitable for the kind of livestock maintained and, in addition, must be available at a cost that will permit profitable livestock production.

The mineral salts constitute only one of the groups of nutrients that play important parts in animal nutrition. Some mineral elements, like calcium and phosphorus, are needed in large amounts, while others, like iodine, are required only in very minute traces.

Mineral deficiencies that occur naturally may vary from relatively harmless disturbances to acute deficiencies that cause death. Livestock producers frequently have been misled into believing that the routine use of mineral supplements should be universally accepted as a necessary part of good feeding practice. *In the interests of the livestock producer, however, it should be emphasized that the indiscriminate feeding of mineral supplements is not a blanket remedy for underfeeding, unthrifty livestock, miscellaneous diseases, or reproductive disturbances. Good nutrition and the economical production of livestock call for the use of only those mineral supplements for which there appears to be a reasonably indicated need. An accurate description of the kind and amount of feed stuffs you are using will often enable your experiment station to make valuable suggestions concerning the probable need for mineral supplements.*

ESSENTIAL MINERAL SALTS AND ELEMENTS

Chemists recognize the existence of 92 elements, many of which are found in plants and animals. Certain of these elements are recognized as being essential to normal nutrition. About others there is considerable speculation as to whether they are essential or merely accidentally present. While it is not now possible to give a final list of the essential mineral elements, such a list should include at least sodium, potassium, calcium, magnesium, phosphorus, chlorine, sulphur, iron, copper, cobalt, manganese, iodine, and zinc.

Common salt. Common salt is made up of the elements sodium and chlorine and is known to chemists as sodium chloride. The craving for salt varies with the species of animal and the diet. Just what factors are responsible for this craving is not clearly understood. It is recognized, however, that for practical purposes the appetite of the animal is a helpful guide in determining salt requirements. The daily salt requirements of farm animals are said to vary from about ¼ ounce for calves and sheep to perhaps 3 ounces for high-producing cows. While it is a common practice to add salt to grain mixtures and mineral licks, it is considered wise to allow farm animals *free access to salt at all times.* This will assure an abundant supply and lessen the danger of overeating, often encountered where salt is not supplied regularly. Animals that have been denied salt for some time and then are given free access to it may eat such large quantities as to cause digestive disturbances and even death. Animals hungry for salt should be given small quantities daily until the intense craving for salt has largely disappeared. The importance of allowing *free access to common salt at all times* is frequently overlooked.

Salt is not as poisonous to chickens as is popularly believed. Rations containing enough salt to be distinctly harmful to chickens are unpleasantly salty to the taste. The salt requirements of poultry are met by adding not more than ½ of 1 per cent of salt to the total ration (1 per cent of the mash when approximately equal amounts of mash and scratch grain are fed).

Iodine. Iodine is recognized as an essential element. A deficiency of iodine is usually a *regional* problem. Parts of Oregon are mildly to severely goitrous for farm animals.

A deficiency of iodine results in disturbances of the thyroid gland. These disturbances take the form of goiter, "big neck," and "hairlessness," and are usually most severe in the new-born animal. Calves, foals, kids, lambs, pigs, and other species may be affected. In the case of foals, general weakness may be a dominant symptom, even though enlargement of the thyroid gland may be hardly noticeable. An adequate supply of iodine is particularly important during the gestation period.

The exact requirements for iodine are not known. The quantity required, however, is known to be very small. Iodine may most conveniently be supplied in the form of iodized salt (common salt containing about 1 ounce of potassium iodide in 300 pounds of salt). In Oregon generally satisfactory results also have been obtained by feeding 5 grains of potassium iodide once a week to pregnant cows, ewes, and sows. This recommendation may be carried out by sprinkling on the feed, once a week, 1 tablespoonful of a solution of 3 ounces of potassium iodide in 1 gallon of water. For pregnant mares this dosage has at times been increased to 2 or 3 tablespoonfuls. There is no substantial evidence that warrants the routine feeding of iodine supplements in regions where goiter is seldom, if ever, known to be present. It now appears that as the knowledge of iodine requirements increases, current dosages are likely to be revised downward. The use of excessive quantities of iodine is harmful; it is also a needless expense.

Sulphur. Sulphur is an essential element, but apparently is useful only in the organically combined form as it occurs in proteins. There is no evidence to indicate any nutritional need for the routine feeding of sulphur in its elemental form (ordinary sulphur) or in the form of some of its compounds, such as Epsom salts or Glauber's salts.

Potassium. Potassium is also an essential element but occurs so abundantly in many crops that a possible deficiency of this element need not concern the livestock feeder.

Magnesium. Magnesium is recognized as an essential element occurring so abundantly in nature that ordinary mixed rations are not likely to be deficient in it. While it is true that there are certain disturbances in which low blood magnesium has been encountered, present evidence does not warrant the routine feeding of magnesium supplements to farm animals.

Manganese. Manganese is an essential element but under practical conditions deficiencies of this element appear to be limited largely to poultry rations. Young birds sometimes suffer from a leg deformity known as perosis or slipped tendon. This is particularly true when they are fed rations high in calcium and phosphorus. The addition of about ¼ pound of a manganese salt per ton of feed quite effectively counteracts the perosis-producing properties of most rations, although manganese is not always the only factor involved.

Iron and copper. Iron has long been recognized as an essential constituent of hemoglobin, the red coloring matter of blood. A marked deficiency of

iron results in nutritional anemia, a condition in which the blood is deficient in red coloring matter. It has been shown that animals cannot properly utilize the iron in their rations unless a trace of copper is also present. There are a few regions in which livestock are known to suffer from a lack of iron or copper or both. There is as yet no substantial evidence that well-fed livestock in this section of the United States will benefit from the feeding of iron and copper salts, except possibly in the case of very young pigs.

Suckling pigs, reared in strict confinement, will frequently become anemic. This condition is most severe at about 3 to 6 weeks of age. The little pigs become pale and weak and may die. While iron and copper salts may be given to the little pigs or painted on the sow's udder, it is usually sufficient to allow the little pigs access to clean sod and soil.

Cobalt. Cobalt recently has been shown to be an essential element. There is at present no reason to believe that a deficiency of this element exists in Oregon.

Zinc. Zinc also is thought to be an essential element but is required in such minute amounts that a possible deficiency need not worry the livestock producer.

CALCIUM AND PHOSPHORUS

Calcium and phosphorus requirements. Calcium (lime) and phosphorus requirements may well be considered together for several reasons. A large percentage of the calcium and phosphorus stored in the body is deposited in the bones in the rather constant ratio of about twice as much calcium as phosphorus. Milk and eggs contain considerable quantities of calcium and phosphorus. The animal body can use calcium and phosphorus independently of each other to only a limited extent. The utilization of both calcium and phosphorus is intimately tied up with vitamin D.

An ample supply of vitamin D (or its equivalent in sunshine) is necessary for the proper utilization of the calcium and phosphorus contained in the ration. Disturbances in calcium and phosphorus nutrition in farm animals are shown in a variety of ways, including rickets and like disorders, retarded growth, decreased milk production, reproductive disturbances, and depraved appetite. Cattle most frequently suffer from phosphorus deficiency, pigs from calcium deficiency, and poultry from vitamin D deficiency.

The exact calcium and phosphorus requirements of farm animals are not known. In a general way, these requirements are known to vary with the species of animal, the rate of growth, reproductive requirements, and the production of milk or eggs. For cattle it may be assumed that a ration is not likely to be seriously deficient in calcium and phosphorus unless its dry matter contains less than about 0.3 to 0.4 per cent calcium and 0.2 to 0.3 per cent phosphorus. Even lower levels are adequate in the absence of rapid growth or high milk production. The calcium and phosphorus requirements of pigs are thought to be slightly higher. The requirements for sheep appear to be distinctly lower than for cattle. The minimum requirements for growing chickens are met when the ration contains about 0.8 per cent calcium and 0.5 per cent phosphorus. The calcium requirements for egg production are perhaps twice as high as for growth.

Calcium and phosphorus contents of feed stuffs. It is obvious that feed stuffs should be chosen with some attention to their calcium and phos-

phorus contents. It is usually most economical (except in the case of poultry) to combine easily available feed stuffs in such a manner as to provide adequate amounts of calcium and phosphorus. It is necessary, therefore, to know the approximate calcium and phosphorus contents of the more common types of feed stuffs. Table 1 is designed to show the calcium and phosphorus contents of some representative types of feed stuffs.

It will be noted that the grains are low in calcium but moderately rich in phosphorus. Wheat by-products and the oil meals are rich in phosphorus. Milk is a good source of both calcium and phosphorus. Meat meal, fish meal, and tankage (depending on their bone contents) are very rich in calcium and phosphorus. Legume hays are always rich in calcium but may be relatively poor in phosphorus.

Table 1. THE APPROXIMATE CALCIUM AND PHOSPHORUS CONTENTS OF CERTAIN COMMON TYPES OF FEED STUFFS

Material	Calcium		Phosphorus	
	Per cent		*Per cent*	
Roughages				
Alfalfa hay	1.25		.20	
Red-clover hay	1.00		.16	
Oat-vetch hay	.73		.22	
Oat hay	.34		.17	
Wild hay (good)	.61		.18	
Grass straw (poor)	.15		.10	
Wheat straw	.22		.06	
*Pastures and succulents**				
Good mixed pasture	.70	(.14)	.30	(.06)
Poor grass pasture	.14	(.05)	.13	(.04)
Ladino-clover pasture	1.57	(.40)	.39	(.10)
Bunch grass (green)	.34	....	.19	....
Bunch grass (bleached)	.30	....	.07	....
Corn silage	.36	(.10)	.18	(.05)
Kale	1.62	(.20)	.47	(.06)
Pea-vine silage	1.17	(.30)	.18	(.05)
Concentrates				
Corn	.01		.30	
Oats	.09		.35	
Barley	.05		.37	
Wheat	.05		.36	
Wheat bran	.10		1.25	
Cottonseed meal	.25		1.10	
Linseed meal	.38		.75	
Peanut meal	.15		.50	
Skim-milk powder	1.28		1.00	
Meat scraps (55% protein)	8.70		4.30	
Fish meal (65% protein)	7.40		3.70	
Beet pulp	.50		.07	

* Pastures and silages most commonly contain some 20 to 30 per cent dry matter; very succulent plants may contain only 10 per cent dry matter; the following analyses have been calculated to the dry-matter basis. Analyses in parentheses are calculated to the fresh basis. Since farm animals consume succulent feed stuffs largely for their nutrient (dry matter) content and not for their water content, analyses calculated to the dry basis are more likely to give the layman a correct nutritional picture.

The phosphorus content of forage crops is subject to considerable variation due to the influence of the stage of maturity and rainfall. The phosphorus content of pastures and hays is highest during the early stages of growth and during seasons having adequate rainfall.

Mineral supplements. Table 2 gives the approximate calcium and phosphorus content of some representative mineral supplements. It will be noted that some of these supplements are sources of calcium or of phosphorus only,

Table 2. THE APPROXIMATE CALCIUM AND PHOSPHORUS CONTENTS OF CERTAIN MINERAL SUPPLEMENTS

Material	Calcium	Phosphorus
	Per cent	*Per cent*
Oyster shells	38	....
High-grade limestone	38	....
Calcium carbonate	40	....
Bonemeal (variable)	22-33	10-17
Spent bone black (variable)	(about like	bonemeal)
Di-sodium phosphate	....	8-9
Tri-calcium phosphate	39	20
Di-calcium phosphate	23	18
Mono-calcium phosphate	16	24

while others supply both calcium and phosphorus. All materials used for mineral supplements should be of a grade suitable for animal feeding.

Availability. A question of considerable interest is that of availability. Under practical conditions, the calcium and phosphorus in the supplements listed in Table 2 are all satisfactorily available to farm animals. Claims for the superior availability of this or that mineral are in general very much exaggerated.

When are calcium and phosphorus supplements needed? It is often difficult to determine the need for mineral supplements because mineral deficiencies are so frequently associated with poor feeding practices. It is not good practice, however, to resort to the routine use of mineral supplements as a blanket remedy for underfeeding.

Under practical conditions therefore it is desirable to understand certain simple rules that are helpful in determining the need for mineral supplements after locally available feed stuffs have been combined to the best advantage.

The need for mineral supplements depends in part on the species of animal, in part on the rate of growth and the amount of production, in part on feeding practices, in part on the characteristic mineral contents of the feed stuffs used, and in part on the existence of regional soil deficiencies.

The use of such materials as oyster shell and bonemeal in poultry rations is common practice and rests on a sound basis. Since pigs are commonly grain-fed, it is obvious that extra calcium must be supplied by such means as legume pastures, alfalfa hay, milk, tankage, fish meal, or perhaps mineral supplements. Sheep will rarely, if ever, need calcium and phosphorus supplements unless largely restricted to roughages of very poor quality.

Cattle will seldom require calcium supplements under otherwise successful practical feeding conditions. There possibly may be a need for calcium supplements where very poor grass or grain hays are fed as the only roughage. For all practical purposes, it is impossible to produce calcium deficiencies where appreciable amounts of legumes are included in the ration. Leguminous plants, such as alfalfa, the clovers, the vetches, soybeans, and peas, are always rich in calcium.

Phosphorus deficiencies occurring regionally among cattle are far more common than calcium deficiencies. Under practical conditions phosphorus deficiencies in cattle are most frequently encountered when the ration consists of low-quality roughage with little or no grain or millfeed. The problem is therefore frequently complicated by underfeeding. There are sections in which phosphorous-deficient roughages are more or less common.

Phosphorus deficiency usually results in a poor appetite and is finally accompanied by a depraved appetite for wood and bones. In extreme cases

the animals become thin and stiff and may even suffer from broken bones. The craving for bones is an indication of phosphorus deficiency in the ration. Cattle allowed free access to bonemeal will usually consume such amounts as may be required approximately to balance their rations. In this respect bone meal has an advantage not possessed by the purified calcium phosphates, since cattle on phosphorus-deficient rations ordinarily crave bonemeal in preference to the highly purified calcium phosphates.

HOW TO FEED MINERALS

In the foregoing pages an attempt has been made to aid in determining when mineral supplements are needed. After their need has been determined, there still remains the question of how to feed them. In general, several methods are available. One is to force the animal to consume them by mixing them with the ration. Another is to mix them with salt. Still another is to encourage their consumption by mixing them with various appetizers. None of these practices is universally satisfactory.

For poultry, the current tendency to use mashes with reasonable contents of salt, calcium, and phosphorus, and to allow free access to oyster shell and perhaps bonemeal, appears to be sound practice.

For pigs, sheep, cattle, and horses there should be *free access to salt at all times*. This is true even though salt is mixed with other feed stuffs or with mineral supplements.

The animal's appetite is often a helpful guide in determining the need for calcium and phosphorus supplements under field conditions. While it is recognized that such a practice is not an exact one, it must be admitted also that the promotion of mineral supplements has gone far beyond actual needs. Even the rather common practice of adding 1 or 2 per cent bonemeal to concentrate mixtures for dairy cattle rests more on the desire to avoid possible calcium and phosphorus deficiencies, associated with poor feeding practices, than on demonstrated necessity.

If it is desired to prepare a simple mineral mixture to meet a specific calcium or phosphorus deficiency or as a concession to an urge to feed a mineral supplement, one of the following formulas may be useful and economical.

1. Two parts limestone and one part salt. This mixture supplies calcium economically and is most useful for hogs.

2. Two parts bonemeal and one part salt. This mixture supplies both calcium and phosphorus.

3. Equal parts limestone, bonemeal, and salt. This mixture is cheaper than No. 2 but is richer in calcium and poorer in phosphorus.

Free access to common salt also should be provided if any of these mixtures are used. In many instances the interests of economy and good nutrition will be most satisfactorily met by merely allowing free access to common salt and bonemeal, kept in separate boxes.

Overfeeding. No mineral supplement, however useful, should be fed in obviously excessive amounts. Such a practice is expensive and it may be decidedly harmful. Overeating of minerals may result from forced feeding or from allowing free access after a period of mineral starvation. This is true of even such materials as common salt and bonemeal.

A number of mineral salts, such as iodine and copper, are distinctly poisonous when fed in excessive amounts. Fluorine, a constituent of rock phosphate, is quite toxic to farm animals. This explains why rock phosphate is no longer considered suitable for animal feeding.