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Minerals for Livestock

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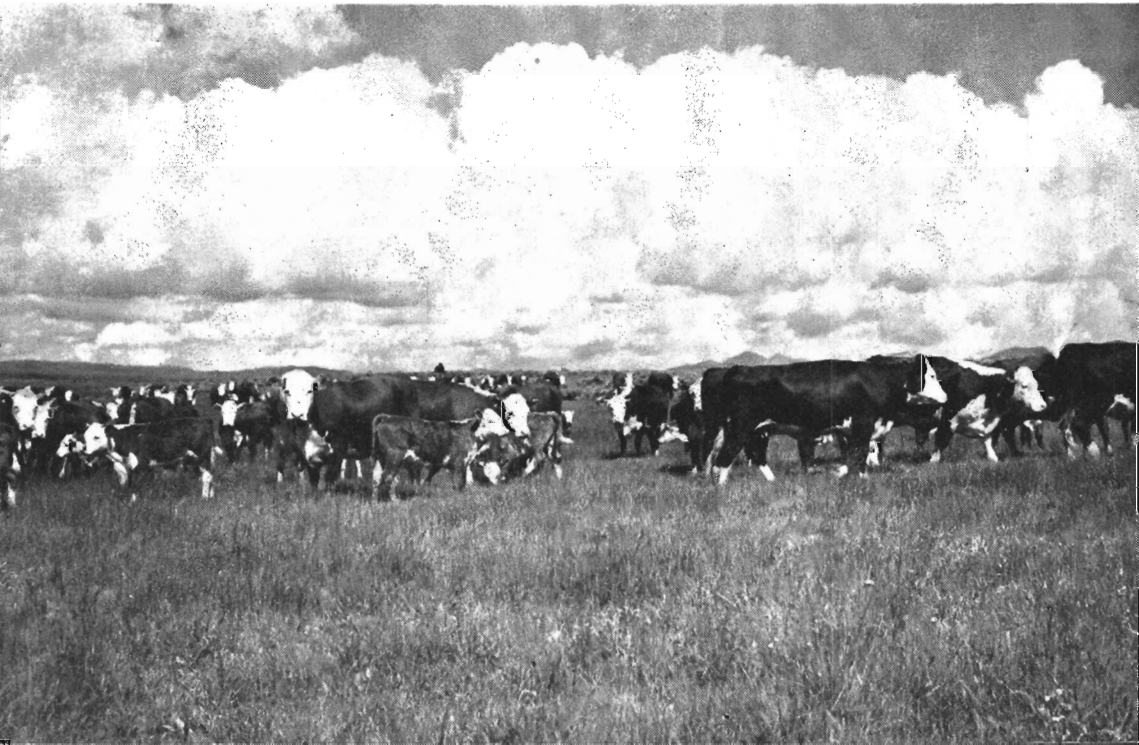

Foreword

Oregon livestock producers are aware of the need for additional information on the use of mineral supplements. These materials frequently are purchased when not needed with the particular rations that are being used. The intelligent use of minerals pays dividends. Over-use may be harmful.

This bulletin has been revised to give livestock producers and feed dealers the latest available information that will assist them in selecting and feeding only such materials as may be needed to supplement the natural supply already available in their feedstuffs.

Although noteworthy progress is being made we believe that research must be intensified in Oregon to provide more complete information on the adequacy of minerals in feed produced in the various areas of the State. Evidence being accumulated by our research staff indicates that deficiencies peculiar to certain areas are causing serious losses among livestock.

F. E. Price

Dean and Director

Minerals for Livestock

By

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FARM animals require an abundance of palatable feedstuffs as a source of energy, fats, proteins, minerals, and vitamins. These feedstuffs 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 accepted universally 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 feedstuffs that are being used often will 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 essential to normal nutrition. About others there is considerable uncertainty as to whether they are essential or present accidentally in the animal body. While it is not possible now to give a final list of the essential mineral elements, such a list should include sodium, potassium, calcium, magnesium, phosphorus, chlorine, sulphur, iron, copper, cobalt, manganese, iodine, fluorine, and zinc.

Note: This Bulletin is revised from and is to supersede Station Circular 153, Minerals for Farm Animals, by the same author.

Common salt

Common salt contains 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 understood clearly. It is recognized, however, that for practical purposes the appetite of the animal is a helpful guide in meeting salt requirements. The daily salt requirements of farm animals are said to vary from about $\frac{1}{4}$ to $\frac{1}{2}$ 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 it largely has disappeared. The importance of allowing *free access to common salt at all times* is overlooked frequently. Salt-hungry animals are much more likely to consume harmful materials such as paints, spray materials, weed killers, and wood preservatives. Where block salt is used, ample time must be allowed for animals to consume the desired amount.

Salt is not as poisonous to chickens as is believed popularly. 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 $\frac{1}{2}$ 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 important particularly during the gestation period.

Good mixed pastures and concentrates supply calcium and phosphorus for dairy cattle. Provision should be made for free access to salt.

The exact requirements for iodine are not known. The quantity required, however, is known to be very small. Iodine may be supplied most conveniently in the form of iodized salt (common salt containing 1 part of potassium iodide in 10,000 parts of salt). For practical purposes this amounts to 1 ounce of potassium iodide evenly distributed in 625 pounds of salt. There is no substantial evidence that warrants the routine feeding of iodine supplements in regions where goiter does not occur.

Reasonable precautions should be used in preventing prolonged exposure of iodized salt to the weather and unfavorable storage conditions.

Sulphur

Sulphur is an essential element, but apparently is useful largely in the organically combined form as it occurs in proteins. There is no evidence to indicate that ordinary farm rations are improved by 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 an essential element also, 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 assumption that such disturbances are due to regional magnesium deficiencies. Feedstuffs obtained from such areas seem to have normal magnesium contents.

Manganese

Manganese is an essential element, but under practical conditions known 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 true particularly when they are fed rations high in calcium and phosphorus. The addition of about $\frac{1}{4}$ pound of 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

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 utilize the iron in their rations properly unless a trace of copper also is present.

Suckling pigs, reared in strict confinement, frequently will become anemic. This condition is most severe at about 3 to 6 weeks of age. The little pigs become pale and weak, show labored breathing, and may die. Iron and copper salts may be given to the little pigs by painting the sow's udder with a saturated solution of a technical grade of ferrous sulphate (commercial green vitriol or copperas). The ordinary commercial grades of iron salts contain enough copper as an impurity. It frequently is sufficient merely to allow the little pigs access to clean sod and soil.

Copper

There are regions in which forages are known to be so low in copper as to have a serious effect on cattle and sheep. Prominent

symptoms may include anemia, scouring, a faded appearance of the hair coat or of dark colored wool, and brittle bones. Copper-deficient forages have been encountered in limited areas in Oregon. The knowledge that such areas may exist does not justify the widespread, routine use of copper supplements. Copper salts are poisonous and should not be used without specific directions.

Cobalt

Cobalt is known to be an essential element. The requirements for cobalt are most striking for cattle and sheep. Symptoms of cobalt deficiency are difficult to distinguish from those resulting from underfeeding and consequent malnutrition. Scattered low cobalt forages have been encountered in Oregon. As yet these low values have not fallen into a pattern which warrants the routine use of cobalt supplements.

Fluorine

Minute traces of fluorine appear to be essential for normal tooth formation. Larger amounts, such as may be consumed in the feeding of rock phosphate, are distinctly harmful. Not all "defluorinated" phosphates are equally desirable.

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 are 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 connected closely 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. Under practical conditions cattle suffer most frequently from phosphorus de-

ficiency, 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 than those of cattle. The requirements for sheep appear to be much 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 feedstuffs

It is obvious that feedstuffs should be chosen with some attention to their calcium and phosphorus contents. It is usually most economical (except in the case of poultry and sometimes pigs) to combine easily available feedstuffs 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 feedstuffs. Table 1 is designed to show the calcium and phosphorus contents of some representative types of feedstuffs.

It will be noted that the grains are low in calcium but moderately rich in phosphorus. Wheat byproducts 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.

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 contents of some representative mineral supplements. It will be noted that some of these supplements are sources of calcium or of phosphorus

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

Table 1. APPROXIMATE CALCIUM AND PHOSPHORUS CONTENTS OF THE DRY MATTER OF CERTAIN COMMON TYPES OF FEEDSTUFFS.

Material	Calcium	Phosphorus
	Per cent	*Per cent*
Roughages		
Alfalfa hay	1.25	.22
Oat-vetch hay	.73	.22
Oat hay	.34	.17
Wild hay	.61	.18
Wheat straw	.22	.06
Pastures and succulents		
Good mixed pasture	.70	.30
Ladino clover pasture	1.57	.39
Bunch grass, green	.34	.19
Bunch grass, bleached	.30	.07
Corn silage	.36	.18
Kale	1.62	.47
Pea-vine silage	1.17	.18
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
Soybean oil meal	.30	.70
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

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

Material	Calcium	Phosphorus
	Per cent	*Per cent*
Oyster shell	38	....
High-grade limestone	38	....
Calcium carbonate	40	....
Bonemeal, variable	30	14
Defluorinated rock phosphate, variable	29	13
Tri-calcium phosphate	39	20
Di-calcium phosphate	23	18
Mono-calcium phosphate	16	24

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. Not all "defluorinated" phosphates are equally available.

Determining need for calcium and phosphorus supplements

It often is difficult to determine the need for mineral supplements because mineral deficiencies are associated so frequently 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 feedstuffs 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 feedstuffs 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 commonly are grainfed, 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 rarely, if ever, will need calcium and phosphorus supplements unless restricted largely 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, always are rich in calcium.

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

Phosphorus deficiency usually results in a poor appetite and is accompanied finally by a depraved appetite for wood and bones. In extreme cases the animals become thin and stiff and even may suffer from broken bones. The craving for bones is an indication of phosphorus deficiency in the ration. Cattle allowed free access to bonemeal usually will consume such amounts as may be required approxi-

mately to balance their rations. In this respect bonemeal 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.

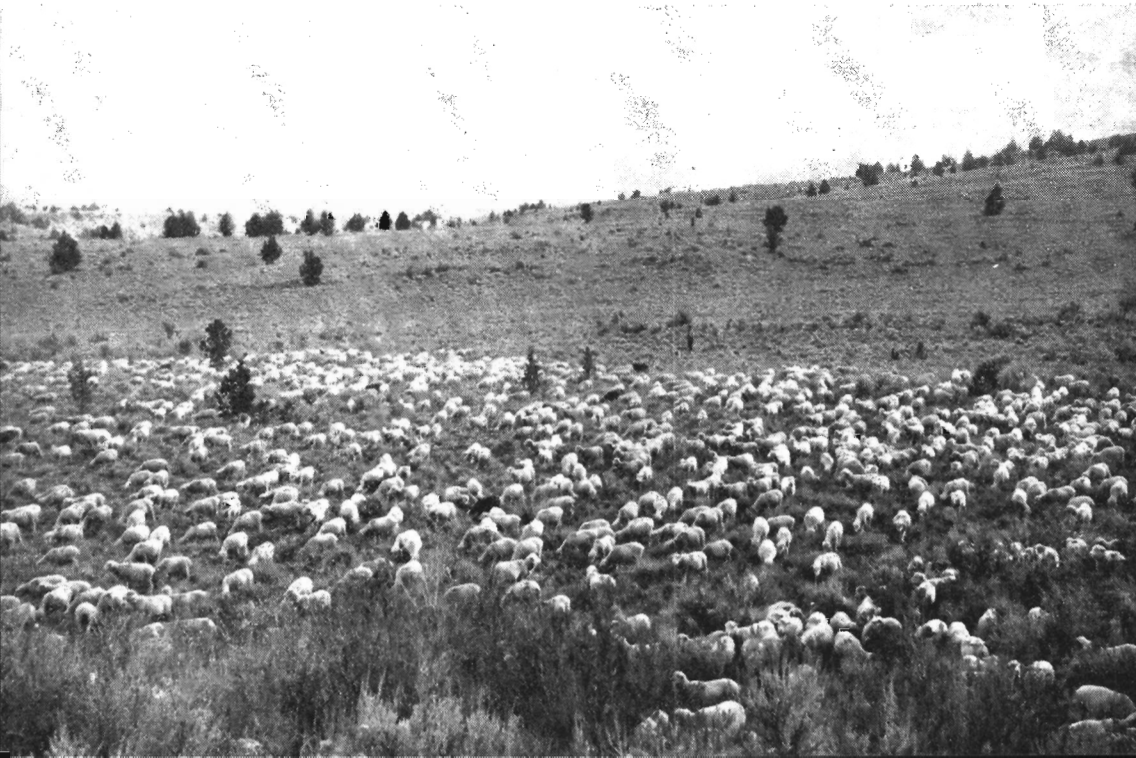
Fluorine is a highly toxic element. For this reason it is desirable to avoid the feeding of rock phosphate or other minerals high in fluorine. While it is true that high fluorine minerals can be fed in limited quantities for limited periods, their use constitutes a hazardous practice. Not all "defluorinated" phosphates are equally desirable.

How to Feed Minerals

In the preceding 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 the supplements 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 satisfactory universally.

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.

The mineral requirements of sheep are ordinarily met by allowing free access to common salt.



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 feedstuffs or with mineral supplements.

The animal's appetite is often a helpful guide in meeting the need for calcium and phosphorus supplements under field conditions. While it is recognized that this 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 used.

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 should be provided

Free access to common salt also should be provided even though one of the mixtures containing salt is used. In many instances the interests of economy and good nutrition will be met most satisfactorily by allowing free access to common salt and bonemeal, kept in separate boxes.

Fertilizers and nutritive value of crops

Farmers naturally are interested in the influence of soil fertility and fertilizers on the composition and nutritive value of crops. It is not uncommon for livestock to show a preference for forages grown on fertile soils. While forage crops frequently may show significant differences in composition and nutritive value which can be traced to soil fertility, seed crops commonly do not show such wide variations. It is a fortunate fact that increased crop yields and improved feeding value often go together. In most instances, however, the use of fertilizers must be justified largely on the basis of increased crop yields. In the case of range lands, supplementary minerals can be supplied economically only by feeding them directly to livestock.