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# MINERALS FOR FARM ANIMALS



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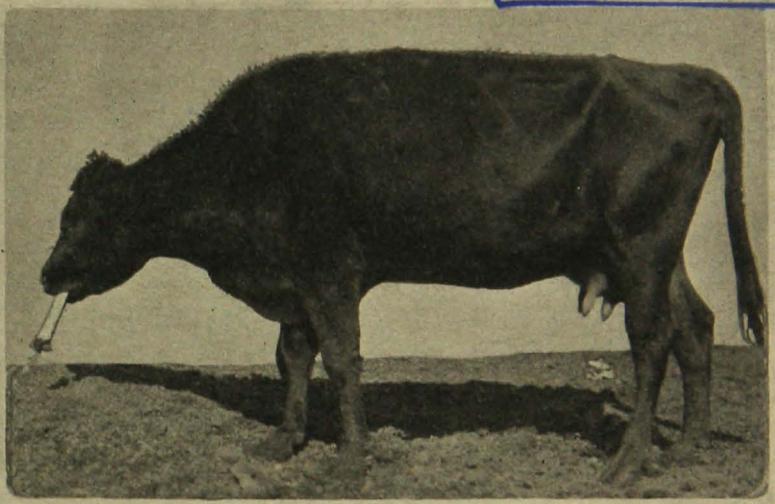

Fig. 1. This cow, suffering from lack of minerals, is eating a bone.

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1. Under what conditions is a lack of mineral elements likely to occur in feeding livestock?
2. How may the lack of minerals be recognized?
3. When are such deficiencies benefited best by mineral supplements?
4. What kind of mineral supplements should be used?
5. How should these supplements be fed?

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## CONDITIONS INVOLVING MINERAL DEFICIENCY

The mineral supplement question is greatly simplified by the fact that only five mineral elements are ever likely to be lacking in farm rations. These are **sodium, chlorin, iodin, phosphorus,** and **calcium.** There is, as yet, no scientific evidence to indicate that any other elements need ever be supplied on the farm in the form of mineral supplements except perhaps under pathological conditions. As no intelligent farmer who has livestock fails to provide the sodium and chlorin by means of common salt (sodium chloride), the possible deficiencies are narrowed still further to the elements iodin, phosphorus, and calcium.

**Iodin.**—It has been definitely determined that an iodin deficiency in the soil, water, and crops is a matter of geographical location. The Northwest and Great Lakes states are, in general, iodin-deficient regions. However, the evidence so far available hardly warrants the general use of iodin as a mineral supplement in these regions, altho it should be supplied wherever there is definite evidence of a deficiency.

**Phosphorus.**—The conditions causing a phosphorus deficiency are somewhat more complicated. There may be either an actual shortage of phosphorus in the ration or there may be a failure to use all the phosphorus supplied.

It is somewhat difficult to fix a limit for the phosphorus content of foods below which the food can be said to be deficient. Nevertheless, there seems to be good evidence that if the dry matter of the food contains less than 0.2 per cent of the element phosphorus, it may be classed as a phosphorus-deficient food, and if more than 0.5 per cent it may perhaps be classed as phosphorus rich. On this basis, the common livestock foods may be listed as follows:

| Phosphorus-poor | Phosphorus in moderate amounts | Phosphorus-rich |
|---|---|---|
| Pearl hominy | All cereal grains | Wheat bran |
| Polished rice | (corn, wheat, oats, rye) | Wheat middlings |
| Beet pulp | Alfalfa hay | Wheat germ |
| Corncobs | Corn stover | Red dog flour |
| Red clover hay | Corn silage | Legume seeds |
| Timothy hay | Sweet clover hay | (soybeans, cowpeas) |
| Millet hay | Vetch hay | Cottonseed meal |
| Cottonseed hulls | Rape hay | Linseed meal |
| Oat hulls | | Dried milk |
| Cereal straws | | Tankage |

While these facts are useful, in general, in determining whether a ration is deficient in phosphorus, they can not be used as the sole guide. Practically all grasses are low in phosphorus. Yet, when animals are on fresh grass they readily store phosphorus, apparently because of something in the grass, as well as because of some effect of sunlight on animals in open pasture. Cod liver oil and other fish liver oils rich in fat-soluble vitamins produce the same effect.

The amount of calcium in the ration is closely associated with the proper use of phosphorus. A ration deficient in calcium may result in phosphorus starvation even when there is enough phosphorus in the ration. Other mineral elements also may aid or retard the use of phosphorus by the animal body. The only practical way to meet such a situation is to be sure that the ration contains enough phosphorus and that all the known agencies which aid in its use are also supplied.

Still another factor causing a possible lack of phosphorus is the extent of the mineral strain to which the animal is subjected. For example, a ration may contain enough phosphorus for an animal giving a moderate amount of milk, or for a mature animal not milking, but result in a loss of phosphorus by another animal giving liberally of milk, or being forced for rapid growth, even tho the other nutrients are supplied in full quantity. In most cases, however, a ration containing enough protein and energy-giving nutrients to support the milk flow will also contain an ample quantity of phosphorus, unless it is composed of foods grown in phosphorus-poor soil.

**Calcium.**—Calcium deficiency is caused by conditions in many respects similar to those causing phosphorus deficiency, but calcium-poor foods are more common among livestock feeds than are phosphorus-deficient foods. The danger of calcium deficiency is in general much greater.

There is no definitely fixed calcium content of foods below which it can be stated with certainty that calcium deficiency will result. One method of considering the matter is to assume that the calcium requirement is one and one-half times that of phosphorus, because the bodies of animals contain phosphorus and calcium in such proportion. On this basis, the livestock foods would be classified as follows:

| Calcium-poor | Calcium on border line | Calcium-rich |
|---|---|---|
| Cereal grains (corn, wheat, oats, rye) | Bluegrass | Alfalfa |
| All cereal grain by-products | Millet | Red clover |
| Roots | Linseed meal | Tankage |
| Legume seeds | Cottonseed meal | Dried milk products (skimmilk, buttermilk, and whey) |
| Timothy hay | | |
| Prairie hay (and nearly all wild and tame grass hays) | Calcium in moderate amounts<br>Dried beet pulp | |
| Cereal straws | Corn silage | |
| | Corn fodder | |

Commercial feed mixtures, especially those designed for dairy cattle, are likely to be lacking in calcium unless they contain liberal amounts of legume hay or calcium-containing mineral supplements. Analyses of 48 different mixtures, recently published, show that 44 per cent contained less than 0.3 per cent calcium and 63 per cent less than 0.5 per cent. On the other hand, only 5 out of 46 commercial poultry feeds and 2 out of 11 swine and pig feeds were short in calcium.

The factors affecting the use of calcium by animals are similar to those described for phosphorus. Animals store calcium better when on fresh green grass than when on dry hay. Even the calcium-rich legume roughages are apparently better calcium supplements if cured under caps rather than in windrows. Direct sunshine promotes calcium storage through the effect of the ultra-violet rays in the sunlight. It is especially important for poultry. An adequate phosphorus supply is also essential for calcium storage. Crops grown on lime-poor, acid soils are sure to be abnormally low in calcium.

Most of the factors mentioned operate in any region. Magnesium may interfere with calcium storage in localities in which magnesium salts are found in drinking water in excessive amounts and the crops have a magnesium content proportionally too high for their calcium content.

The possibility that magnesium is interfering with the best use of calcium in certain regions of Minnesota is being investigated by the station at this time, because magnesium sulfate (Epsom salt) is widely distributed in well waters and drainage waters over a considerable area of the state. The Division of Agricultural Biochemistry will gladly test any samples of water submitted by farmers to determine whether magnesium sulfate is present in excessive amounts.

## RECOGNITION OF MINERAL DEFICIENCIES

**Iodin.**—Iodin deficiency is recognized by goiter (big neck) in new-born calves, lambs, and foals and by the birth of dead, hairless pigs. Goiter may also occur in fowls. As goitrous animals frequently die, the deficiency may lead to serious results. Iodin deficiency also causes other reproductive disturbances, but these can not be recognized.

Farmers who have such losses should prevent their recurrence by giving iodin to pregnant animals, using the method recommended below.

**Calcium and phosphorus.**—Except in the case of very young animals, the lack of calcium or phosphorus is not readily recognized until it is serious and of long standing. Mature animals possess a reserve of these elements which can be drawn upon in a remarkable way for many months. In time, however, the animals will exhibit a craving for bones as shown by the cow in Figure 1. This may degenerate into a desire to eat dirt, chew mangers or fence posts, or devour any sort of rubbish. Such a depraved appetite is almost certain to be caused by a serious lack of calcium or phosphorus or both. In swine, however, the possibility of worm infestation should first be eliminated.

Young, growing animals show a lack of calcium and phosphorus in rickets. Pigs often exhibit a paralytic condition of the joints of either the fore legs or hind legs, as shown in Figure 2. In chickens, the legs are weak and often deformed.

A lack of calcium or phosphorus also affects production. This is not often recognized by the average farmer even when moderately severe, until a more liberal diet of calcium or phosphorus or both begins to pay dividends in more milk, better egg production, or more rapid growth and fattening. Calcium shortage for laying hens results in soft shelled eggs as well as decreased egg production.

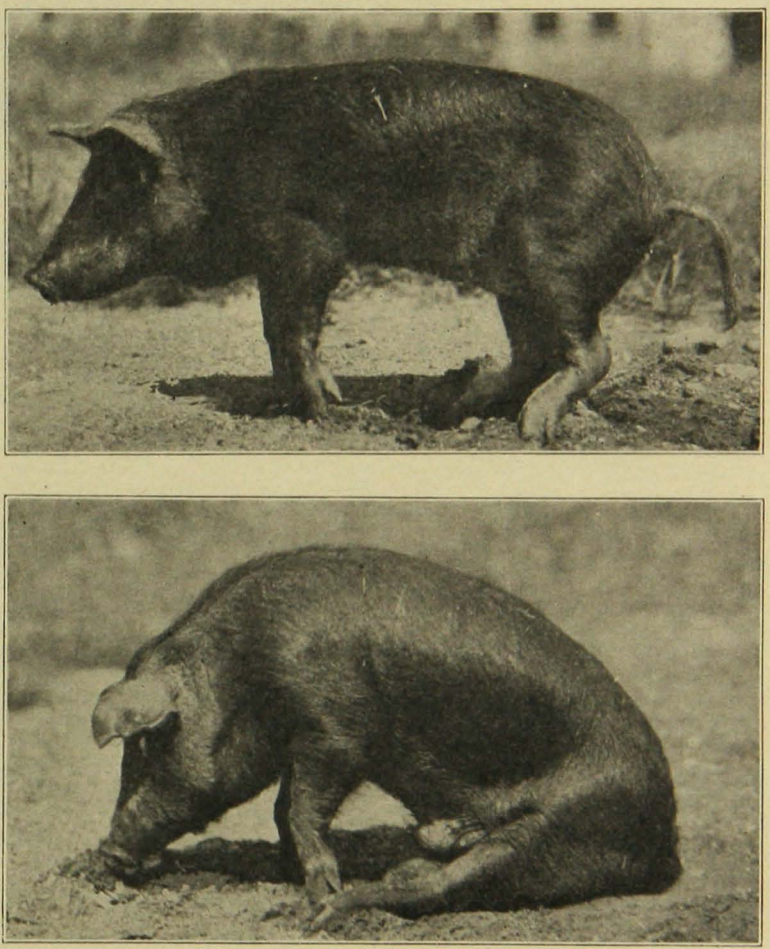

Fig. 2. These pigs are suffering from a serious shortage of calcium due to feeding too heavily on grain without a calcium supplement in the form of alfalfa hay or bonemeal or the mineral mixture given on page 8. Any of the calcium supplements would have prevented this condition. The old adage that an ounce of prevention is worth a pound of cure is particularly applicable here, because it would not be easy to bring these pigs back to normal.

As already stated, the rational solution of the problem is to maintain as nearly as possible a plentiful supply of minerals. This should be continuous throughout the useful lifetime of the animal.

**Mineral elements are not to be regarded as medicines to be fed in doses, but as foods to be supplied daily.**

## WHEN TO FEED MINERAL SUPPLEMENTS

**Iodin.**—In iodin-deficient regions, this element can be supplied as a supplement in either food or water. Purchase of foodstuffs from seaboard states, where there is no iodin deficiency, is impractical.

**Phosphorus.**—It is preferable to supply phosphorus in the form of a phosphorus-rich food, because by doing so the animal will also be given the advantage of other valuable food substances. Phosphorus-rich foods are generally also rich in valuable proteins and vitamins. It is especially logical to supply the phosphorus for the production of milk, eggs, pork, and beef in some such phosphorus-rich protein concentrates as **bran, linseed meal,** and **tankage.**

The need for phosphorus in the form of mineral supplement seems to be definitely limited to a few conditions only. (1) When animals are confined largely to grass (both fresh and dry) in regions where there is a serious shortage of phosphorus in soil and crops, they have been found to respond remarkably to phosphate supplement. (2) Milk cows having large production have been benefited greatly by phosphate additions during a dry resting period. (3) When a mineral supplement containing calcium is fed, it is well to feed some phosphate with it unless the animal is already supplied with an abundance of that element.

**Calcium.**—It is desirable to supply as much of the calcium needs of animals as possible in the form of calcium-rich roughages and concentrates, namely, alfalfa hay (fresh or properly cured), milk products, or tankage.

Mineral supplements containing calcium are called for (1) for laying hens; (2) for hogs fattened largely on grains and cereal by-products, or brood sows on similarly limited diets; (3) for animals confined largely to grass and grass hays and which show an abnormal appetite for bones, and rubbish of various kinds.

**The pasture season is the best season of the year for feeding calcium and phosphorus supplements to build up the mineral reserves, because of the sunlight and vitamins received at this time.**

## KIND OF MINERAL SUPPLEMENTS TO FEED

Only the simplest kind of supplements is called for. There is no conclusive evidence that Epsom salt (magnesium sulfate), Glauber's salt (sodium sulfate), copperas (ferrous sulfate), and sulfur, found in some proprietary mixtures, are of any feeding value.

**Iodin.**—This should be fed as sodium or potassium iodide, preferably the former, or as sea salt from which the iodin has not been removed by refining, or as commercially iodized common salt.

**Phosphorus.**—When it is necessary or advisable to feed phosphorus as a mineral supplement, bonemeal, spent boneblack from sugar refineries, or raw rock phosphorus floats, may be used. These are also

rich in calcium. The finely pulverized raw rock phosphate has the same general mineral composition as bonemeal and bone charcoal, but is regarded by some authorities as less palatable. Palatability is not a problem in supplying mineral supplements to swine, however, because the animals will take any kind of mineral supplement when diluted with about 10 per cent tankage. Rock phosphate after treatment with sulfuric acid to convert it into fertilizer (ordinary acid phosphate) is not recommended because it contains a large amount of calcium sulfate (gypsum). The acid treble superphosphate is not generally advocated for animal feeding. It is highly recommended by the manufacturers and has given good results in some localities suffering from phosphorus shortage in soil and crops.

Calcium.—Mineral supplements which can be used to supply calcium are bonemeal, spent boneblack, raw rock phosphate floats, precipitated calcium carbonate, whiting, chalk, air-slaked lime, limestone, marl, or crushed oyster or clam shells. Gypsum is not a logical calcium supplement for animals.

When calcium and phosphorus are to be fed together, bonemeal, boneblack, or raw rock phosphate floats can be used. Fertilizer bonemeal is not recommended. The bonemeal which is the by-product of gelatin manufacture (special steamed bone), or other edible bone products (called raw bonemeal by some of the packers, altho it is actually thoroly cooked) is the best to use. Spent boneblack is not a uniform product. Only that which has been used by the sugar refineries should be fed. It should be purchased on the basis of a guaranteed calcium phosphate content. Bonemeal contains approximately 50 per cent calcium phosphate. Spent boneblack should contain at least this much if sold at a price equal to that of bonemeal. High-grade rock phosphate floats are in theory about equal to spent boneblack as a calcium supplement. When purchased at a fair price, this product has value, altho it is not very palatable. Some writers say definitely that it should not be fed to cattle. Purchasers of commercial mineral mixtures made up largely of rock phosphate should inform themselves as to the actual commercial value of this ingredient.

The other supplements named are useful for supplying calcium only. Wood ashes, sometimes recommended as a calcium supplement, are not rich in calcium. Crushed oyster and clam shells are used only for poultry. Precipitated calcium carbonate, whiting, chalk, air-slaked lime, marl, and limestone are the same substance—calcium carbonate of varying purity. Neither unslacked nor water-slacked lime is recommended because of its alkalinity. Limestones in Minnesota, however, are with very few exceptions dolomitic; that is, mixtures of calcium and magnesium carbonate. Dolomitic limestones, as a rule, contain from 80 to

85 per cent carbonates, of which 35 or 40 per cent is magnesium carbonate. Magnesium can not replace calcium in nutrition. These facts should be recognized when using native dolomitic limestone as a source of calcium. We have found that dolomitic limestones can be used for hog rations if double the amount is used. We have not yet determined whether it is safe to use this limestone for breeding animals requiring calcium supplements over long periods of time.

## METHOD OF FEEDING SUPPLEMENTS

**Iodin.**—If iodized salt can be obtained, the problem is solved. If sodium iodide must be given, the simplest method is to dissolve it in the drinking water. Add about one ounce of iodide to a gallon of water and feed a tablespoonful of the solution to each animal once a day, either in the drinking water or sprinkled on the grain.

**Calcium and phosphorus.**—The simplest and most practical mineral mixture is one consisting of equal parts by weight of a calcium supplement, a calcium and phosphorus supplement and salt—for example, marl, bonemeal, and salt. If dolomitic limestone mixtures of calcium and magnesium carbonate are used, the proportions would be 2 parts limestone, 1 part bonemeal, and 1 part salt. Such mixtures perhaps come closest to being of general value because they furnish all the elements that need be supplied (except iodin), and in such a proportion that they take care of the greater need for calcium than for phosphorus. In addition, they are available to every livestock breeder. For swine, the addition of 10 per cent tankage will insure the animals consuming the minerals if they are self-fed. Self-feeding is recommended in any case, because livestock seem to have the instinct to supply their needs for calcium and phosphorus just as they do for sodium and chlorin. If the supplement is to be fed directly, it can be mixed with the grain at the rate of 2 or 3 pounds to each 100 pounds of grain. With cattle on pasture or on hay or dry fodder, self-feeding is the only practical method.

For poultry the laying mash should contain 1 per cent sodium chloride and 3 to 4 per cent bonemeal in addition to crushed shells available at all times.

When animals suffering from a deficiency of calcium and phosphorus are offered bonemeal or similar mineral supplement, they will at first eat a large quantity but will later diminish the amount to meet the regular needs. Basing its statement on observation of cattle originally suffering from mineral deficiency, the Division of Dairy Husbandry, of this station, holds that 600 pounds of bonemeal as the sole calcium and phosphorus supplement will be sufficient for 10 or 12 cows for a year.