

UNIVERSITY OF KENTUCKY

COLLEGE OF AGRICULTURE

Extension Division

THOMAS P. COOPER, Dean and Director

---

CIRCULAR NO. 326

---

MINERALS FOR LIVESTOCK

---

Lexington, Kentucky

November, 1938

---

Published in connection with the agricultural extension work carried on by cooperation of the College of Agriculture, University of Kentucky, with the U. S. Department of Agriculture and distributed in furtherance of the work provided for in the Act of Congress of May 8, 1914.

19638

Vault No. 3  
 639.2  
 K3786ec  
 EXT. CIT, 326-350

Table 1. Pounds of calcium and phosphorus in 100 pounds of some commonly used feed stuffs. Average analyses.\*

	Calcium lbs.	Phosphorus lbs.
Dry Roughage		
Alfalfa hay, all analyses .....	1.43	0.21
Clover hay, red, all analyses .....	1.21	0.18
Clover and timothy, all analyses .....	0.65	0.17
Corn stover, medium in water .....	0.41	0.08
Cowpea hay, all analyses .....	1.13	0.25
Lespedeza hay, all analyses .....	0.99	0.19
Oat hay .....	0.22	0.17
Orchard grass hay .....		0.17
Soybean hay .....	0.96	0.25
Timothy hay, all analyses .....	0.27	0.16
Green Roughage		
Alfalfa, all analyses .....	0.40	0.06
Clover .....	0.43	0.07
Lespedeza .....	0.41	0.08
Silage		
Corn silage .....	0.07	0.06
Sorghum silage .....	0.07	0.04
Concentrates		
Barley .....	0.05	0.38
Corn, No. 2 .....	0.01	0.27
Cottonseed meal 41% protein .....	0.20	1.19
Linseed oil meal, O. P. ....	0.33	0.86
Oats .....	0.09	0.33
Peanut oil meal .....	0.17	0.55
Rye .....	0.04	0.37
Soybean oil meal, hydraulic or expeller process, all analyses .....	0.28	0.66
Tankage or meat meal, 60% protein .....	6.21	3.42
Wheat .....	0.03	0.43
Wheat bran, all analyses .....	0.12	1.32
Wheat middlings .....	0.09	0.72

\* Taken by permission of the Morrison Publishing Company, Ithaca, New York, from Feeds and Feeding, 20th Edition, by F. B. Morrison.



9556  
12

**MINERALS FOR LIVESTOCK**

**GENERAL OBSERVATIONS**

Research at this Experiment Station and elsewhere has shown that certain mineral elements in feeds are essential to the proper nourishment and growth of animals; and that an otherwise good feed may not contain enough of some essential mineral element to supply the need of the animal for that particular element. This makes it important to use an appropriate mineral supplement in connection with certain feeds.

*The Minerals Needed in the Largest Quantities.* Four mineral elements are needed in rather large amounts by all farm animals, including poultry. They are sodium, chlorine, calcium, and phosphorus. Common salt which is a compound of sodium and chlorine, is a necessary supplement to all feeds. Salt should be in common use on every farm. Stockmen may fail to salt animals regularly, not because they do not recognize the need, but because they forget. It is becoming a practice of animal husbandmen to keep salt before all farm animals at all times. There are two reasons for this. One is that it eliminates the danger of forgetting to salt; the other is that animals need salt every day just as humans do. If it is kept in a container sheltered from rain and dust, farm stock will take what they need daily and thus prevent a craving and consequent over-eating when too long a time elapses between saltings. Sheep and hogs, if kept without salt for too long, are inclined to overeat and may die from salt poisoning.

The other two very essential mineral elements needed in animal metabolism are calcium and phosphorus. These two minerals constitute a large percent of the mineral material of the bones and teeth of domestic livestock. Deficiency of calcium results in weakening the bones, lameness, or even fractures of the bones, while phosphorus deficiency causes stiffness and soreness of the joints, listlessness and lack of appetite and even depraved appetite manifested by eating dirt, chewing bones or wood. Milder symptoms of the deficiency of one or both of these minerals are slow growth,

\* This circular was prepared by members of the staff of the Animal Industry Group.

poor condition, or unsatisfactory milk production in lactating animals.

*Rarer Minerals.* Iodine is another essential mineral but only needed in small quantities as compared with the four already mentioned. Usually feeds contain all the iodine needed in animal metabolism. There are, however, areas in the United States in which the grains and herbage do not get enough iodine out of the soil to meet the needs of animals. In such areas iodized salt is used by livestock and humans and is a very efficient and inexpensive method of preventing goiter and other disturbances that often develop on a feed consumption deficient in iodine. Kentucky is not an iodine deficient state. Some sections of the eastern coal fields do not have as much iodine as other parts of the state but as far as is known the feeds grown in the areas contain enough iodine to meet the needs of the animals which consume them.

There are many other minerals needed by farm animals which, almost without exception, are found in abundance in grains and herbage and as a consequence are usually no problem to the feeder. Some of these minerals are iron, copper, sulfur, magnesium, boron, manganese, zinc and cobalt.

Some mineral elements are injurious to farm animals. If selenium is found in abundance in a soil, grains and grasses grown on it, may contain enough selenium to produce in animals the "alkali disease." The hair falls out, lameness, loss of appetite and finally death results from selenium poisoning. Fortunately selenium poisoning is no problem in Kentucky.

Fluorine, even in small quantities, is injurious. It causes bones and teeth to lose their normal color and to soften. In addition to the effect on the bones and teeth, too great an amount of fluorine interferes with food consumption and growth. The usual grains and grasses fed to farm animals do not contain enough fluorine to be injurious. The danger usually comes from feeding ground raw rock phosphate as a phosphate supplement. There is enough fluorine in raw rock phosphate to injure the animals, if much of it is consumed over a period of time. For this reason, ground raw rock phosphate should not be used as a phosphate supplement.

The first principle of good animal husbandry is to feed liberally and to feed nutritious, appetizing feeds containing the right proportion of carbohydrates, fats, proteins and minerals. After a



liberal supply of feed is given, the next concern of the feeder is to see that clean water and salt are always available. If this is done no conditioners, tonics or complex mineral mixtures are needed. They are more likely to be harmful than beneficial.

*The Source of Minerals in Plants.* The mineral content of grains and herbage depends on the mineral content of the soil. The growing plants cannot store mineral nutrients unless the minerals are in the soil in a form available for the plants. There is a great variation in the farm lands of the United States in their content of calcium and phosphorus. Those soils which are deficient in calcium and phosphorus to any great extent will grow herbage and grains which will be more or less deficient in these two mineral nutrients. For example, Korean lespedeza grown on certain limestone soils had .32 percent of phosphorus and 1.28 percent of calcium; but grown on soil outside the limestone area had .14 percent of phosphorus and .89 percent of calcium. This is a difference so great that under some conditions animals using the lespedeza with the smaller content might be improperly nourished. The careful feeder provides in palatable feeds, the mineral nutrients needed by his animals. If hays, stover, and grains grown on soil containing limited amounts of calcium and phosphorus are fed they should be supplemented by feeds grown on soil containing an abundance of minerals. Otherwise, ground limestone will be needed as a supplement for calcium, or steamed bone meal for both calcium and phosphorus.

*Methods of Feeding Mineral Supplements.* The best method of feeding mineral supplements is "free choice." Keep each mineral in a self-feeder, the ground limestone in one compartment and the bone meal in another. This "free choice" allows the animals to satisfy their needs. If the mineral elements are mixed with salt, animals may be forced to eat more of the minerals than is good for them in order to satisfy their appetite for salt. It is not good practice to add the supplementary minerals to the mixed grain feed. The amount added may be too little or it may be too much; and in buying grain mixture it is not necessary to pay grain prices for limestone or bone meal.

#### MINERAL SUPPLEMENTS FOR BEEF CATTLE

Salt should be available at all times.

*Young Calves.* Young calves should have an adequate supply

of calcium and phosphorus to meet the needs of their growing bones. They require more of these materials than do older cattle. If calves are nursing or getting skim milk they need no additional calcium. If the soil of the pasture where they are kept is not deficient in phosphorus, no additional phosphorus will be needed as long as the pasture is adequate. If the soil is deficient in phosphorus, the calves should have access to steamed bone meal.

Occasionally, confined calves develop rickets. Rickets in calves can best be prevented or beginning stages cured by feeding a well-balanced ration made up of a good grain mixture and a good, sun-cured legume hay, and giving them access to some sunlight during a part of the day.

*Cows and Calves.* Cows nursing calves while on early spring pasture may need calcium which can be given in the form of ground limestone. If as much as 6 or 7 pounds of good legume hay daily, in addition to grass hay or corn stover, is fed to beef cows in calf, during the winter, it will furnish sufficient calcium but not enough phosphorus even if some grain is fed. The phosphorus should be supplied by allowing the cattle free access to steamed bone meal.

*The Bull.* Bulls need adequate supplies of calcium and phosphorus. If fed grain and mixed hay during winter there will be no need of a mineral supplement. In case no legume hay is fed, calcium should be supplied by ground limestone, free choice. It would be well to provide limestone in a self-feeder when grain is fed the animals running on pasture.

*Stockers and Feeder Cattle.* Beef cattle that are fed an adequate amount of a well-balanced feed made up of a grain mixture and good legume hay need no calcium or phosphorus added to their ration. Nor will calcium or phosphorus supplements be needed when beef cattle are on abundant pasture of mixed grasses and legumes.

Cattle wintered on straw and cottonseed meal, or on corn or sorghum silage and cottonseed meal, should have ground limestone before them at all times. Even if grain is added to any of these feeds, for fattening, the animals should have access to ground limestone.

*Feeding Beef Cattle on Distillery Slop.* In Kentucky, large numbers of beef cattle are fed distillery slop which is a by-product of



distillation. Analyses made at the Experiment Station show that distillery slop is lacking in carbohydrates and has too great a proportion of phosphorus as compared to the calcium. Instead of the normal ratio as found in a balanced ration of two parts of calcium to one of phosphorus, it contains from 4 to 10 times as much phosphorus as calcium. This disproportion of the two mineral nutrients often produces in cattle stiffness, soreness of the joints and a condition of unthriftiness. With the cooperation of feeders, supplements have been suggested and used which prevent the ill effects. It has been found that 6 to 8 pounds of alfalfa fed to each steer, per day, furnishes enough calcium to balance the phosphorus; or 2 to 3 ounces of finely ground limestone, per day, gives the same results. Limestone made accessible to the cattle in the feed lots was eaten by them at the above rate and it was sufficient to balance the phosphorus. To get desired gain from feeding slop some corn or other grain should be fed also to supply at least a part of the deficiency of carbohydrates.

#### MINERAL SUPPLEMENTS FOR DAIRY CATTLE

Salt should be available at all times.

*Growing Heifers.* Young dairy stock on pasture or legume hay do not generally need any supplementary mineral matter except salt. However, it is good practice to keep a sheltered box containing bone meal where they can always have ready access to it.

*Producing Cows.* Recent investigations show that a cow producing twenty to twenty-five pounds of milk daily, requires about one ounce of phosphorus and one to two ounces of calcium per day. Sufficient quantities of these elements are furnished, however, in a well-balanced ration, without any mineral supplement. For example, a ration consisting of alfalfa hay, corn silage and seven pounds of a 4-2-1 mixture of corn, wheat bran, and cottonseed meal, furnishes 2.7 ounces of calcium and 1.4 ounces of phosphorus daily which actually exceeds the requirements of a cow, for these essential minerals. This ration has proved successful in many Kentucky herds, for a period of several years.

*High-Producing Cows.* High-producing cows and cows in the early stage of lactation may need more calcium and phosphorus than they receive in an otherwise balanced ration. Liberal feeding during a six to eight weeks' dry period does much toward fortifying

the cow's body with a store of these elements with which to withstand the hard work of heavy production. However, many more dairy cows suffer from insufficient feed and poorly balanced rations than from a lack of minerals.

*Bone meal, fed free choice, eliminates practically all the possibility of any mineral deficiency in a herd of high-producing cows.*

#### MINERAL SUPPLEMENTS FOR HORSES

Salt should be available at all times.

*The Mare and Foal.* The mare in foal and the stallion in service have extra demands for calcium and phosphorus which can and should be given them in their feed of oats, bran, corn, barley and legume hay. If the farmer has only corn, and grass hays to feed, the pregnant mare will need a protein concentrate and should have access to steamed bone meal. Mares nursing foals and doing farm work should have oats or bran with corn supplemented with some legume hay or protein concentrate and be allowed free access to steamed bone meal.

*Weanlings.* The weanlings, during their first winter, when fed oats, bran, ground barley or cracked corn with mixed hay, at least one-half of which is legume, need no mineral supplement.

*Yearlings.* Yearlings and two-year-olds kept on bluegrass pasture in the summer and given oats and bran when the grass is drying, need no mineral supplement; nor will they need a mineral supplement if fed in winter on oats, bran, crushed barley or cracked corn with legumes as a part of the roughage.

*Workstock.* The usual grain fed to horses and mules at work, in Kentucky, is corn or oats, or a combination of the two. If either of these grains is fed with grass hay the workstock should have a protein concentrate and, in addition, may need ground limestone free choice. If any good legume hay is fed with the grain, no mineral supplement is needed. Idle workstock, grazing on abundant pasture which contains legumes, need no calcium or phosphorus supplements.

Horses at work in unusually hot weather lose a large amount of water and salt thru excessive sweating. The water and salt must be replaced more frequently than in moderate temperatures. Horses should be given all the clean fresh water they will drink, three or four times during the day and when at work on hot days should be



watered, by pail, if necessary, about every two hours and should have access to salt at every feeding.

#### MINERAL SUPPLEMENTS FOR HOGS

Salt should be available at all times.

Hogs should have free access to clean, fresh water.

*Brood Sow and Pigs.* Pigs and brood sows not running on pasture should be self fed a good sun-cured legume hay to provide calcium and vitamins A and D. This is especially advisable during the winter when pastures are not available.

Deficiencies of iron and copper in the rations of sows with young pigs may be manifested by the appearance of anemia in the pigs. If, however, the pigs have access to sod or soil, anemia rarely occurs. Pigs kept in pens floored with concrete should be supplied with soil or sod, at frequent intervals. The sod or soil should be taken from premises not used for hogs. Pigs running on pasture will not suffer from a lack of either iron or copper.

*Boars.* Boars fed tankage, fish meal, or milk by-products in sufficient quantity to balance the ration need no additional minerals.

*Fattening Hogs.* Hogs on full feed require no calcium or phosphorus supplement if fed a sufficient quantity of tankage, fish meal or milk by-products to balance the ration. If fed a concentrate mixture made up entirely of feeds of vegetable origin, hogs should get finely ground limestone or bone meal or both, fed free choice.

Hogs fed distillery slop should have access to finely ground limestone in a self-feeder.

Lye and hard-wood ashes are injurious to hogs and should not be fed to them.

#### MINERAL SUPPLEMENTS FOR SHEEP

Salt should be available at all times.

*The Flock.* Sheep should have free access to clean water and salt in containers sheltered from rain and snow and so constructed that the sheep cannot get their feet into them. Coarse barrel salt is preferable to block salt for sheep. Free choice of salt for sheep after they become gradually accustomed to it is much better than salting once a week. If sheep are deprived of salt for too long an

interval, they will overeat of it, resulting in salt poisoning and death.

If sheep are grazed on abundant forage on fertile soil, or fed in winter a liberal amount of legume hay and a good grain mixture, they need no mineral supplement except salt.

*Ewes and Lambs.* Ewes nursing lambs in early spring and grazing on small grain or bluegrass pasture, without legume hay being fed, may need some additional calcium which can be supplied by a high-grade ground limestone in a self-feeder.

If ewes are carried thru the winter mainly on legume hay, with little or no grain, they may need phosphorus which can be supplied by steamed bone meal in a self-feeder. If ewes are wintered on a good grain mixture with a non-legume roughage they will likely need a calcium supplement given in the form of ground limestone.

If ewes are kept too long on sparse pasture to dry up the milk flow after weaning their lambs, they should have access to steamed bone meal. This will not be needed when they are turned on luxuriant grass for flushing before breeding.

#### MINERAL SUPPLEMENTS FOR CHICKENS

Grains and their by-products which constitute the major portion of poultry rations do not contain sufficient calcium, phosphorus, sodium and chlorine (salt) to meet the requirements for growth, high egg production and good hatchability. Consequently, such rations must be supplemented with these elements for best results, but these materials should not be fed greatly in excess of the amounts needed. Complex mineral mixtures, aside from being unnecessary and costly, sometimes contain ingredients in such amounts as may prove harmful when added to normal balanced rations.

*Growing Chicks.* Rations should contain approximately 0.8 to 1.0 percent calcium and 0.5 to 0.8 percent phosphorus.

The starting and growing mash should contain one percent salt.

If the mash contains as much as 7½ percent of meat scrap or fish meal, no calcium or phosphorus supplement is required. One pound of bone meal should be added for each 5 pounds of a vegetable protein when one is used to replace meat scrap or fish meal in the mash.



If meat scrap or fish meal is not used in the mash 2 percent of bone meal should be added.

When liquid, condensed or dried milk is used as the sole source of animal protein, 2 percent of steamed bone meal should be added to the mash.

Chicks which are not allowed range from the beginning should have approximately 25 percent of mixed wheat feed (shipstuff) or wheat middlings in their ration in order to supply ample manganese for the prevention of slipped tendons.

*Laying Hens.* All laying mash mixtures should contain 1 percent salt.

Laying hens require approximately 0.8 percent phosphorus and 2 percent calcium for high egg production and good hatchability.

Ground limestone or oyster shell, in hoppers, should be available for the hens at all times.

All-mash mixtures which contain 12 to 15 percent meat scrap require no calcium or phosphorus supplement when ground limestone or oyster shell is fed free choice. For each 5 pounds of a vegetable protein supplement used to replace meat scrap or fish scrap add 1 pound of steamed bone meal.

When the grain and mash are fed separately 2 percent of steamed bone meal should be added to the mash if the mash contains less than 20 percent meat scrap.

#### APPENDIX

*An Example of the Use of a Mineral Supplement.* In an experiment conducted at this Station in comparing coarsely ground wheat with corn meal for fattening steers, it was found that they ate, free choice, 2.24 ounces of ground limestone per head, daily. This was because the ration contained more phosphorus than calcium. In addition to a full feed of corn or wheat, these steers were given cottonseed meal, corn silage and wheat straw. The following year, in comparing alfalfa hay with soybean hay for fattening steers fed a full feed of corn, no ground limestone, free choice, was consumed, the legume hay supplying sufficient calcium.

#### TO COMPUTE THE AMOUNTS OF CALCIUM AND PHOSPHORUS IN A RATION

The following example shows how to calculate the amounts of

calcium and phosphorus in a ration, using percentages taken from table 1.

Ration	Calcium	Phosphorus
10 lbs. alfalfa hay	$10 \times 1.43 \div 100 = .1430$	$10 \times .21 \div 100 = .0210$
30 lbs. corn silage	$30 \times .07 \div 100 = .0210$	$30 \times .06 \div 100 = .0180$
4 lbs. corn meal	$4 \times .01 \div 100 = .0004$	$4 \times .27 \div 100 = .0108$
2 lbs. wheat bran	$2 \times .12 \div 100 = .0024$	$2 \times 1.32 \div 100 = .0264$
1 lb. cottonseed meal	$1 \times .20 \div 100 = .0020$	$1 \times 1.19 \div 100 = .0119$
	Sum	
	.1688 lbs.	.0881 lbs.
	or	1.4 ozs.
	2.7 ozs.	

**Table 2. Recent analyses of some feeds.\***

	Calcium Percent	Phosphorus Percent
Corn and sorghum silage .....	.10	.04
Alfalfa-molasses silage <sup>†</sup> .....	.50	.06
Distillery slop, whole .....	.006	.053
Distillery slop, thin <sup>‡</sup> .....	.004	.050
Distillery slop, settled <sup>**</sup> .....	.008	.057
Distillers' corn dried grains .....	.08	.50
Bluegrass, April 20, 1937, 4"-5" high .....	.20	.20
Bluegrass, June 17, 1937, mature, 12" high	.07	.07

\* Made by G. Davis Buckner and Amanda Harms of the Department of Animal Industry. Calculated on the materials as fed at the Experiment Station.

<sup>†</sup> Analyses of several samples showed only slight differences in calcium and phosphorus content.

<sup>‡</sup> Thin slop is that from which part of the suspended solid matter has been strained out at the distillery.

\*\* Settled slop is the thicker portion of thin slop which has been allowed to settle several hours and the supernatant liquid removed. Analyses of different forms of distillery slop show little difference in calcium and phosphorus content. The ratio of phosphorus to calcium is high in any distillery slop derived from grain mash.

Investigations have shown that the ratio of calcium to phosphorus should be between 1:1 and 2:1. If the quantity of calcium in a ration is greatly in excess of phosphorus, the phosphorus cannot be utilized effectively. On the other hand, if the quantity of phosphorus greatly exceeds the calcium in the ration, then the calcium is utilized less efficiently. However, even if adequate calcium and phosphorus are present and in the right proportion, poor utilization of these two elements takes place unless vitamin D is present. Vitamin D is obtained by animals from the effect of sunlight or from the consumption of sun-cured roughages. This emphasizes the need for sunshine and for feeding livestock sun-cured hays and other sun-cured roughages. Roughages not sun-cured, such as dehydrated alfalfa meal, do not contain vitamin D.