Under What Conditions Are Calcium and Phosphorus Supplements Needed in the Feeding of Farm Animals?

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J Anim Sci 1933. 1933:298-302.

UNDER WHAT CONDITIONS ARE CALCIUM AND PHOSPHORUS SUPPLEMENTS NEEDED IN THE FEEDING OF FARM ANIMALS?

G. BOHSTEDT
University of Wisconsin

The occurrence of phosphorus deficiency diseases among ruminants in different parts of the world may make one wonder how consistently phosphorus needs to be added to rations of livestock. In general it is phosphorus rather than calcium which is apt to be lacking in rations of ruminants, which deficiency is frequently exhibited by a depraved appetite. Huffman and coworkers, however, point out that anorexia in cattle, or lack of appetite, for roughages, is a better criterion of phosphorus deficiency in certain rations than is a depraved appetite. As to possible calcium deficiencies, recent work at the Minnesota Experiment Station has shown that cattle can adjust themselves to a very low intake of calcium.

Calcium and phosphorus have usually been studied together or in relationship to each other. Small animal work leads us to assume that only in the presence of a generous amount of vitamin D may the calcium-phosphorus ratio be drastically different from what is considered the normal, and still permit proper growth on the part of the animals. Practical rations of ruminants due to the large amount of sun-cured hay consumed are so well supplied with vitamin D that the two elements, calcium and phosphorus, may safely be present in much lower percentages and may vary more with reference to each other than they may in rations of the smaller animals that subsist almost entirely on concentrates.

Balance studies by Hart and coworkers have shown that the draft with respect to calcium and phosphorus upon a heavily milking cow is at times tremendous. As much as 25 per cent of calcium was in one instance withdrawn from the body, including the skeleton. The work of Forbes at Ohio showed that it was difficult to make cows assimilate calcium and phosphorus rapidly enough to cover the losses when they were in the flush of milk production. Only during the latter part of lactation or during the dry period did they store these minerals within their bodies. Ellenberger, New-

lander and Jones of the Vermont Experiment Station in balance studies covering entire lactation periods were able to show that cows fed timothy hay, corn silage (replaced by grass clippings in summer) and a good concentrate mixture lost calcium during the larger part of the lactation but later stored these minerals consistently.

While the added minerals had their effect on the cows it is seen that in both the Ohio and Vermont experiments cows were bound to sacrifice calcium and phosphorus during the high tide of milk production and to recover during or approaching the dry period. While in some cases, as Theiler has indicated, this periodic heavy sacrifice of these elements may approach a pathological condition, in the vast majority of cows this is a normal cycle that need cause little anxiety so long as the cows have the means of replenishing their store of calcium and phosphorus. Ultimately depleted stores must be replenished thus pointing to the importance of feeding good rations during the dry period. The work of Meigs at Beltsville is of interest where, by feeding sodium phosphate with experimental rations of cows previous to calving, they produced more milk during the succeeding lactation period than cows fed no additional phosphate in their ration.

While in some experimental work there has been an apparently significant response to the addition of one or the other of the two minerals in question, what has painstaking and long-continued work at various experiment stations shown with respect to the need of added calcium and phosphorus to rations of dairy cows in all cases including corn silage and at times green cut forage during the summer? We here have the verdict of at least several years' results at the Massachusetts, Ohio, Michigan and Wisconsin Experiment Stations where bone meal and limestone, also dicalcium phosphate additions, made little or no difference in the milk production of cows, the ability to settle to services, the vigor and thrift of calves produced by such cows, or other evidences, all of them showing that the feeding of additional minerals of this sort was superfluous. The cows used were not necessarily high producing cows, for it may be held that cows producing 10,000 pounds or more of milk might be allowed minerals as a matter of insurance. On the other hand, the rations in most cases were not of

the best and, therefore, might suggest that the addition of calcium and phosphorus would have a good chance to prove their advantage.

While one may conclude from this vast array of experimental data that additional lime and phosphorus are not necessary with practical rations, one should keep open-minded on the point of phosphorus needs and perhaps calcium needs of ruminants and horses, for there are just enough instances of deficiencies of this sort here and there to make one cautious with respect to the mineral needs of animals kept under practical and natural conditions. It may be that livestock here and there are in need of some mineral element and might well be given an opportunity to indicate their craving for it. It would not seem necessary, however, to feed a large number of herds or flocks minerals at all times mixed in the rations, on the chance that one of them might benefit because of having to subsist on rations grown on deficient soil. So far dairy cattle have been considered that are generally fed liberal amounts of hay and especially legume hay in their rations.

While ordinarily phosphorus rather than calcium is most likely to be lacking in rations of ruminants, the Kansas Experiment Station has demonstrated that the addition of calcium carbonate made a considerable improvement in baby beef rations made up on the average of, 10 pounds corn, 1.21 pounds cottonseed meal, 8.54 pounds cane silage, and 1.59 pounds prairie hay. So large a proportion of grain in comparison to roughage was fed, however, differing greatly in this respect from rations of dairy cows that lime was the first and important limiting element, as would be appreciated readily if this same ration, with roughages dry and ground up, were fed to pigs.

Hay made up only about 10 per cent of the entire air-dry ration of these baby beeves. Dairy cows, on the other hand, usually eat 30 per cent or more of their ration in the form of hay, and sheep and horses usually 50 per cent, more or less. Due in part to the high vitamin D content of sun-cured hay, animals can make efficient use of limited amounts of calcium and phosphorus in such rations. To the degree, therefore, that hay makes up a large proportion of the ration, unless unusual strain through reproduction or lacta-

tion is put on the animals, they are protected against a calcium and phosphorus deficiency. This is the case under normal conditions, always excepting hays or other roughages grown on soils that are drastically poor in phosphorus.

While phosphorus much more than lime is apt to be lacking in rations of ruminants, the situation is reversed in the case of pigs, as suggested in the discussion of the baby beeves at the Kansas Experiment Station. If rations of growing and fattening pigs or breeding hogs are balanced entirely, or in large part, by tankage, meat scraps, fish meal or skimmilk, no lime and phosphorus deficiency need be feared. This was abundantly proved by the extensive brood sow feeding experiment at the Wisconsin Experiment Station where, altogether, 260 brood sows were fed experimentally from soon after weaning to farrowing time. They answered negatively this question of the need of additional lime or phosphorus. Good practical rations were fed which included tankage, linseed meal and ground alfalfa hay in the winter and tankage on pasture in the summer. Whether the gilts were fed simple or complex mineral mixtures with these good rations, they did not gain any faster or any cheaper, and they did not produce any thriftier pigs than where they were fed the rations without additional minerals other than salt or iodized salt.

Any time rations are fed that are balanced from grain by-products or cereal sources, such as a ration made up of corn, wheat middlings and linseed meal, or comparable feeds, naturally the first deficiency of this ration quickly asserts itself, which is the deficiency in lime. There is a vast array of experimental work proving this point. There is, however, no convincing evidence that phosphorus is necessary for improving practical hog rations whether balanced with animal protein feeds or with mill stuffs and oil meals. If there is enough protein in the ration, ordinarily there is also enough phosphorus in the ration, for there is a fairly close relationship between the amount of protein and phosphorus in feed mixtures.

To summarize the lime and phosphorus feeding situation, it is plain that the vast majority of mineral feeding experiments using practical rations as control rations have not shown a need for additional calcium and phosphorus.

Dairy cows and other cattle are much more frequently in need of additional phosphorus than calcium, and it is well appreciated that phosphorus may be easily supplied through wheat bran, cottonseed meal, linseed meal or other high protein concentrates, which phosphorus feeds from the mineral standpoint balance the lime of the mixed legume and grass hay, or legume hay, which most dairymen strive to feed. Even without a first-class hay it has in most cases been found difficult to prove the need of phosphorus and lime in addition to those inherent in the ration itself. Where with respect to hogs as well as ruminants and horses, the several ingredients which make up the ration are clearly deficient in either or both lime and phosphorus, nutritional difficulties should be anticipated through mixing suitable carriers of either or both of these elements in the ration. Where there may be doubt as to the adequacy of the lime and phosphorus content of rations, having in mind the animals, or the purpose for which they are fed, it will be advisable to let the stock have access to these minerals in suitable containers. However, animals should be fed salt in a separate container apart from a mineral mixture, for they should not depend on a mineral mixture for the salt that may be contained in it and which they may crave more than the other minerals. In our intensively cultivated and cared-for farm lands, a phosphorus deficiency in the crops grown on such land should not be prevalent, merely as a matter of good farm management, for the economical thing to do would be to apply phosphate fertilizer where needed, in order to produce larger and, with respect to phosphorus, richer crops. This happily was done in the Door County peninsula of Wisconsin where the writer recently was unable to locate any cattle suffering from osteophagia or pica, as exhibited through bone chewing. After learning the cause of it years ago, farmers had applied the remedy through phosphate fertilization of the land. In the more sparsely populated or range sections, quoting Theiler and Green in their discussion of this problem, the soundest advice is to "manure the soil through the mouths of the cattle; i. e., take the immediate spectacular live weight increase as the first return on the outlay for phosphorus and leave the residual values to enrich the soil for the next generation."