The Importance of Calcium and Phosphorus in Swine Rations

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Nutritional diseases as a result of inadequate amounts of calcium, phosphorus or vitamin D are not unusual in swine. The total amounts of calcium and phosphorus in the ration are significant and their relative amounts are equally important. In winter when pigs are kept stabled with a low intake of vtamin D the importance of the ratio of calcium to phosphorus in the ration assumes a more significant role. Data on amounts of calcium and phosphorus in swine serum, carcasses, milk and bones taken from the literature are summarized in Table I. These data indicate that in the normal pig calcium is used in a proportion of about 1.6:1 of phosphorus. The actual amount of a given mineral ingested by an animal is sometimes very difficult to determine. Average analyses as quoted by standard texts and various reports are useful guides but in some cases may be misleading.

The mineral content of feed may vary from year to year depending on seasonal differences. There is evidence indicating that very rapidly growing grains and grasses are lower in calcium than more slowly maturing vegetation. Under such conditions a calcium deficiency may exist some years while not at other times.

Experiments reported by Aubel and his associates (5) have established a minimum of about 0.3 per cent phosphorus in the ration as the lowest content which will support growth. In these experiments vitamin D was supplied. The Ca/P was approximately 2.8:1. In one of the experiments reported by Bethke et. al. (6) they used a similar ration but very low in vitamin D with a calcium content of 0.79 per cent and a phosphorus content of 0.32 per cent (Ca/P 2:46:1). Under these conditions the animals failed to grow and later were unable to walk. These experiments illustrate the necessity of vitamin D when too wide a Ca/P ratio is fed.

Under field and laboratory conditions the importance of other factors in the production of mineral disturbances has been observed. Swine fed rations very low in calcium have been kept over long periods without evidence of mineral deficiencies. In all of these cases there was failure to grow due to lack of vitamins or protein. Field cases of acute calcium deficiency have been observed in which the serum calcium has been found to be very low. This type of calcium deficiency is characterized by tetanic convulsions and is usually found in rapidly growing pigs. A similar condition is occasionally observed in lactating sows.

Phosphorus deficiency is less common under field conditions because most of the grains contain considerable phosphorus. A decrease in the serum inorganic phosphate is one of the first manifestations of phosphorus deficiency in pigs. Blood samples obtained from pigs purchased for laboratory use have been found to have a low serum inorganic phosphorus as well as low calcium. These and other data obtained from laboratory tests have indicated that many rations fed pigs contain sub-optimum amounts of both calcium and phosphorus.

Critical experiments to determine the optimum amount of calcium and phosphorus in rations for growing swine have not been possible with the present knowledge of swine nutrition. The numerous vitamin and protein complexes which cannot be completely supplied in synthetic rations act as a limiting factor in evaluat-

ing mineral deficient rations.

The present information indicates that with an otherwise complete ration a calcium content of approximately 1 per cent is desirable and that the calcium to phosphorus ratio should be between 2:1 and 1:1. The addition of a vitamin D supplement or access to sunshine makes possible the use of wider ranges of Ca/P.

A Ca/P ratio of 3:1 or greater tends to produce a condition similar to rickets in swine. This is a true phosphorus deficiency disease. In swine the symptoms are not as exaggerated as in cattle and pica may or may not be present. Failure to grow and excessive consumption of water were among the outstanding manifestations of phosphorus deficiency as reported by Aubel and his associates (5). When the Ca/P ratio is less than 1:1 the condition known as osteoporosis develops. Here failure to grow may be marked. The bones have a tendency to be very thin and break easily. Spontaneous fracture of the leg bones seems to be a very common occurrence in calcium deficiency in swine. Dunlop (7) has reported using a ration containing 0.45 per cent calcium with a Ca/P of 1:1.3 with vitamin D with very excellent results. These findings are not in entire agreement with the results of some of the other investigators.

TABLE I. The Calcium and Phosphorus Content of Swine Serum, Carcass, Milk and Bone.

	Calcium per cent	Phosphorus per cent	Ca:P
Swine serum (1)	0.01193	*0.00834	1.43:1.0
Lean pig (2)	0.77	0.46	1.67:1.0
Fat pig (2)	0.45	0.29	1.55:1.0
Swine colostrum (3)	0.076	0.0893	0.92:1.0
Swine milk (3)	0.252	0.151	1.67:1.0
Bone ash (4)	37.22	18.88	1.97:1.0
Femur and humerus (5)	23.87	11.42	2.08:1.0

* Refers to inorganic P.

Either calcium or phosphorus deficiency as well as most of the other nutritional diseases develop in young rapidly growing animals. In many herds only one group of pigs may show evidence of nutritional failure. A phosphorus deficiency can be easily diagnosed by the determination of the inorganic phosphorus content of the blood serum. A simultaneous determination of the serum calcium often indicates the presence or absence of a simultaneous calcium deficiency. Post-mortem examination of the bones will usually show the difference between the soft type of bone resulting from phosphorus deficiency and the brittle type associated with calcium deficiency.

Preventive treatment of both calcium and phosphorus deficiencies is much more satisfactory than curative treatment. Sows must be fed adequate minerals to supply the growing fetus and the production of milk. Vitamin D should be supplied sows by use of pasture or hay and free access to sunlight. Many nutritional troubles in young pigs are traceable to inadequate rations for the sows. Available evidence has shown that pigs from well fed sows are very resistant to the experimental production of many of the vitamin and mineral deficiencies.

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