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The Effect of Two Different Calcium Phosphorus Ratios upon the Growth of Calves.

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EIGHT Red Poll × Friesland cross-bred calves, eight to eleven weeks old, became available and had to be reared under laboratory conditions where observations on food intake and weight increase were part of the daily routine of the station. It was, therefore, decided to divide these calves into two groups receiving the same basal ration, and to vary the calcium phosphorus ratio by the addition of supplements of calcium carbonate and di-sodium phosphate to the basal ration. It was realized that such an experiment could not claim to be a serious attack on the problem of the effect of calcium phosphorus ratios upon growth, but still, data would be provided upon the practical aspect of the effect of a change in the calcium phosphorus ratio upon growth or weight increase, especially in this country where during periods of drought or even winter the phosphorus content of the pasture is low and the ratio of Ca : P definitely different from that which exists during the period of abundant food. Mature pasture containing approximately ·4 per cent. CaO and ·15 per cent. P_2O_5 is common in Bechuanland as well as in other parts of the Union during winter. The ratio of CaO to P_2O_5 in such pasture is about 1 to 0·4 with phosphorus definitely deficient and the effect of such deficiency soon apparent upon the grazing animals. The practical problem, so far, has been the removal of aphosphorosis by giving phosphatic supplements such as calcium phosphate, bone meal, sodium phosphate, etc., without regard to the effect upon the calcium phosphorus ratio or without a conscious attempt to alter the latter. As a matter of fact, the urgency of a solution for the problem of aphosphorosis in this country and the success which has attended attempts to overcome the deficiency by the supply of phosphatic supplements has fostered a certain amount of scepticism in regard to the practical value of calcium phosphorus ratios in cattle farming. It was, therefore, with a view to test the practical significance, i.e. the effect on growth, of a decided change in the Ca : P ratio of the ration of calves that the experiment to be described was undertaken.

It is freely admitted, of course, that the study of calcium phosphorus ratios is fundamental and essential in all work upon calcium and phosphorus metabolism. But it appears that the conflicting results obtained by investigators are due in part to the absence of differentiation between work upon this problem under conditions of a deficiency of either, phosphorus or calcium, or both, and ratio work when both the elements are present in sufficiency. However, the problem of phosphorus and calcium metabolism presents unlimited scope to the investigator and certain aspects have certainly received a very fair share of attention, but information on the interrelation of Ca and P at different levels or concentrations is still meagre according to Bethke, Kick and Wilder (1932).

Without attempting to discuss the available literature it may be said that apparently the concensus of opinion amongst workers upon the problem of calcium phosphorus metabolism under conditions of sufficiency, is that, broadly speaking, a ratio of calcium to phosphorus between the extremes of 1 to ·5 and 1 to 2 may be labelled as a good ratio, while values beyond these limits show detrimental effects upon the animal. Obviously, however, the ratio may be acceptable in the above sense but a deficiency of either calcium or phosphorus may exist with its associated ill-effects upon the animal subject to such conditions. The severity of a deficiency of either phosphorus or calcium may be minimized when working with a most favoured ratio, which usually also lies between the limits mentioned. Marek and Wellman, whose publication Die Rachitis (1932) has been mentioned elsewhere,* do not stress calcium phosphorus ratios, but claim that under all conditions, i.e. sufficiency or deficiency of Ca and P the Erdalkali-alkalizität of a good ration must lie between specific limits. This view is interesting, but requires further work to substantiate it.

DETAILS OF THE EXPERIMENT.

The object of the experiment under discussion was to keep one group of four calves on enough milk to ensure an adequacy of Ca and P intake, and to adjust the calcium phosphorus content of the diet in such a way when supplementary feeding became necessary that the ratio of Ca to P remained the same as that of whole milk, viz., $CaO : P_2O_5 : 1 : 1 \cdot 4$ approximately. This ratio is in fair agreement with that usually given, as a glance at the following table will indicate: —

Author.	CaO.	P_2O_5.	CaO : P_2O_5.
Richmond (1920)	202·7	293·3	1 : 1·4
Stocking, W. A. (1922)	200·1	243·9	1 : 1·2
Hawk & Bergeim (1927)	235	265	1 : 1·13
Rogers (1928)	202·7	293·3	1 : 1·4
Onderstepoort (several workers)	225·4	327·5	1 : 1·4
Hart, Steenbock *et al.* (1930)	155·0	240	1 : 1·4

* Studies in Mineral Metabolism. Du Toit, Malan, Groenewald, in a later number of this Journal.

If anything, our values for P_2O_5 are slightly higher than those given by other workers, although perhaps not sufficiently so to warrant serious attention.

The second group of four calves was given, in addition to the milk given to their companion group, calcium carbonate to alter the ratio of $CaO : P_2O_5$ from 1 : 1·4 to 1 : ·33. Here also in the course of the experiment $CaCo_3$ was added to keep the ratio of $CaO : P_2O_5$ constant throughout. Each group received 10 lb. of milk daily for the full period of the experiment which makes a consideration of a possible vitamin D deficiency redundant.

The intake of food of the calves in both groups remained exactly the same as will be evident from a study of Table I :—

TABLE I.

Group A.—Daily Ration per Calf.

Date.	Milk.	Hay.	Maize.	Oats.	$CaCO_3$.	CaO.	P_2O_5.	$CaO : P_2O_5$.
	lb.	gm.	gm.	gm.	gm.			
28.7.31	10	—	—	—	—	10·10	14·7	1 : 1·45
7.8.31	10	100	—	—	—	10·50	15·0	1 : 1·40
17.8.31	10	200	—	—	—	10·9	15·3	1 : 1·4
5.9.31	10	450	—	—	—	12·1	16·0	1 : 1·3
10.9.31	10	450	220	220	2·5	13·6	18·5	1 : 1·4
12.10.31	10	450	450	450	2·0	14·0	20·7	1 : 1·4
5.11.31	10	900	450	450	—	15·6	21·8	1 : 1·4
18.11.31	10	900	900	450	2·0	16·9	23·6	1 : 1·4

TABLE II.

Group B.—Daily Ration per Calf.

Date.	Milk.	Hay.	Maize.	Oats.	$CaCO_3$.	CaO.	P_2O_5.	$CaO : P_2O_5$.
	lb.	gm.	gm.	gm.	gm.			
28.7.31	10	—	—	—	68	46·5	14·7	1 : 0·3
7.8.31	10	100	—	—	68	47·0	15·0	1 : 0·3
17.8.31	10	200	—	—	68	47·4	15·3	1 : 0·3
5.9.31	10	450	—	—	68	49·0	16·0	1 : 0·3
10.9.31	10	450	220	220	80	58·4	18·5	1 : 0·3
12.10.31	10	450	450	450	100	70·0	20·7	1 : 0·3
5.11.31	10	900	450	450	100	71·6	21·8	1 : 0·3
18.11.31	10	900	900	450	100	72·9	23·6	1 : 0·3

The mineral supplement was added in the milk, which was given twice daily to each calf. The rest of the ration was given in a common trough and the calves of both groups given access simultaneously. The calves were kept in a small bare paddock and allowed into a common shed at night. The supplements of hay, maize and oats were given twice daily and the calves weighed at fortnightly intervals. The average fortnightly weights of both groups of calves for the full experimental period of 9 months are represented graphically in Figure I.

A glance at Figure I shows the perfectly normal and regular trend of the curves of the weights of both groups of calves. The calves in both groups gained steadily in weight and remained in good health and condition throughout the trial. At 12 months of age the average weight of the calves in either group was approximately 370 lb., which agrees very well with the weights of the 1932 calf crop of the same cows by the same bull and hand-reared with milk according to the routine method of this Institute.

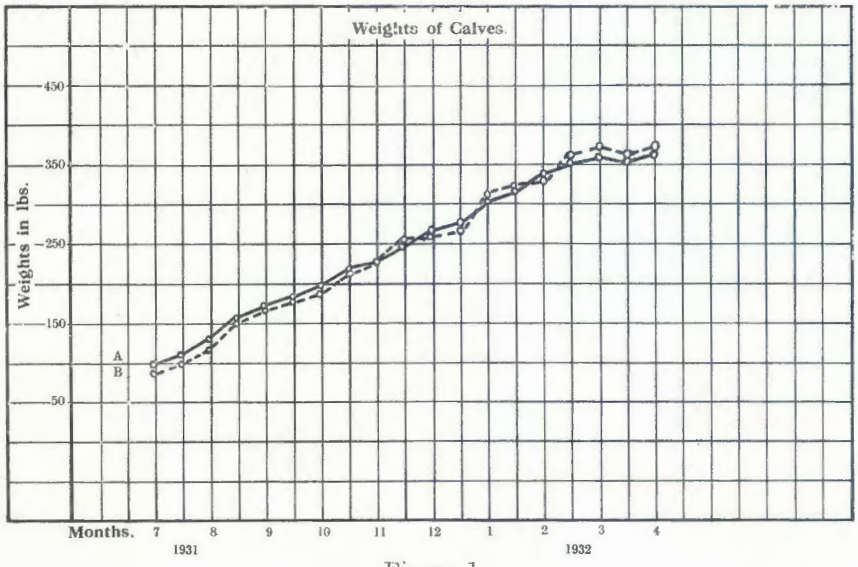

Figure 1.

There is no reason for believing that a ratio of $CaO : P_2O_5$ of 1 : 1·4 produced better growth in the calves under the conditions of the experiment, i.e. probably of calcium and phosphorus sufficiency than a ratio of 1 : 0·3. At all events such a difference, if it existed, was not apparent in the growth curves of the calves during their first year of life, i.e. of high calcium and phosphorus requirements. In conclusion it should be mentioned that as this experiment throws considerable doubt on the practical significance of varying calcium phosphorus ratios in the nutrition of calves, it is being followed up with further work along the same lines.

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