smaller amounts of growth in the embryonic period but increasing relative velocities of growth thereafter.

[1] Scammon, R. E., and Calkins, L. A., PROC. SOC. EXP. BIOL. AND MED., 1924, xxii, 353.

[2] Mall, F. P., *Man. Human Embryol.*, 1910, i, 180-201.

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Effect of Phosphorus Deficient Rations on Blood Composition in Cattle.

L. S. PALMER AND C. H. ECKLES.

From the Divisions of Agricultural Biochemistry and Dairy Husbandry, University of Minnesota, St. Paul, Minn.

The authors[1] have described elsewhere a condition in which numerous cattle in Minnesota suffer from a mineral deficiency which causes stunting, osteophogia, general pica, delayed oestrous and other serious metabolic disturbance. The animals are fed largely on prairie grass pasture or hay, depending on the season, with a limited amount of grain. An outstanding characteristic of the hay is its relatively low phosphorus content, which often falls below 0.2 per cent P_2O_5. This fact points to insufficient phosphorus as the primary cause of the more or less disastrous results encountered. The further fact that bone meal or other forms of phosphate prevent and relieve the situation, when fed as a part of the ration, furnishes additional support for the phosphorus deficiency etiology of the disease.

We have recently obtained striking proof of these facts through a study of the inorganic Ca and P in the blood. The principal data secured to date are given in the accompanying table. All the animals had been reared in the P-deficient region and had been under experimental observation for at least 75 days when the first analyses were made. The hay fed during the period covered by the analyses as well as some months previous, was grown on mineral soil, low in phosphorus. The hay was of high quality for prairie hay; it had a bright green color and was palatable. The animals received all they would eat. The oats fed were of unknown origin, and were fed at the rate of 2 to 12 pounds daily, per head, depending on whether the cattle were dry or milking, and the milk production.

The P content of these prairie hay-oats diets was abnormally low.

The Ca content was not high but was apparently adequate. Typical cases were as follows, based on analyses of the products and monthly food intake: The ration of a dry cow contained 0.08 per cent P and 0.36 per cent Ca; that of a cow giving 12 pounds milk daily contained 0.13 per cent P and 0.30 per cent Ca; that of a dry cow receiving phosphorus supplement contained 0.28 per cent P and 0.35 per cent Ca.

TABLE I.

Animal No.	Mineral Supplement fed	Period of feeding mineral[1]	P and Ca in 100 cc. blood plasma during											
			August			September			October			November		
			P	Ca	Ca×P	P	Ca	Ca×P	P	Ca	Ca×P	P	Ca	Ca×P
		days	mg.	mg.		mg.	mg.		mg.	mg.		mg.	mg.	
33[2]	none		2.55	12.29	31.2	2.20	13.46	29.6	2.99	12.51	37.4	1.75	12.81	22.4
73	none		2.47	12.13	30.0	2.11	13.49	28.5	2.28	12.87	29.2	1.99	12.25	24.4
91[2]	none		2.39	11.87	28.3	1.93	12.82	24.7	1.26	11.78	14.5	1.03	11.60	11.9
94[2]	none		1.28	13.01	16.6	2.04	15.2	31.1	1.32	16.02	21.1	1.09	10.97	11.9
75	$CaCO_3$[3]	102	1.75	12.19	21.3	1.80	14.63	26.3	1.94	13.30	25.8	2.38	12.62	30.0
93[2]	$CaCO_3$	73	1.07	12.06	12.9	2.02	14.6	29.6	1.03	16.47	16.9	1.58	13.17	20.8
58	NaH_2PO_4[4]	600	6.56	11.29	74.1	5.43	13.11	71.2	—	—	—	—	—	—
74	NaH_2PO_4	102	5.51	10.65	58.7	5.17	11.78	60.9	5.40	11.63	62.8	4.75	10.53	50.0
92[2]	NaH_2PO_4	85	4.41	12.66	55.8	3.82	12.86	49.1	5.27	12.06	63.6	6.04	10.51	63.5

[1] Up to time of 1st analysis.
[2] Cow in milk.
[3] 100 grams daily for cows 75 and 93.
[4] 75 to 100 grams daily for cows 58, 74, and 92.

Blood Ca was determined* by the Kramer and Tisdall[2] method, P by the Briggs[3] modification of the Bell-Doisy method, in both cases on citrated plasma. It was found necessary to add a known quantity of phosphate to the low P samples before a satisfactory estimation could be made. The analyses reported represent the changes in succeeding months based on the average of samples of venous blood taken on three successive days.

The data show clearly the abnormally low inorganic P in the blood plasma of animals confined to the hay-oats ration, either with or without $CaCO_3$ supplement. The plasma Ca, however, was normal throughout. The product of Ca × P for these animals is seen to be rarely above 30 and frequently much below 20, values which would be indicative of a rachitic condition in growing animals according to the results of Howland and Kramer.[4] In contrast is the normal composition of the blood of animals fed the hay-oats ration plus NaH_2PO_4. The Ca × P in these cases ranges from 50 to 75.

[1] Palmer, L. S., and Eckles, C. H., *Minn. Agr. Exp. Station Bulletin* 229, 1926.

* The analyses were made by W. M. Neal, analyst.

[2] Kramer and Tisdall, *J. Biol. Chem.*, 1921, xlvii, 475.

[3] Briggs, *J. Biol. Chem.*, 1924, lix, 255.

[4] Howland and Kramer, *Am. J. Dis. Child.*, 1921, xxii, 105.

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Filtration Through Living Membrane.

SAMUEL AMBERG AND LEONARD G. ROWNTREE.

From the Section on Pediatrics and Division of Medicine, Mayo Clinic, Rochester, Minn.

The mesentery of the bullfrog *(Rana catesbiana)* was used as the filtration membrane to test the rate of filtration of various fluids. The mesentery was so placed that a funnel could be easily approximated to it. This funnel led into a flask from which a glass tube connected with the vacuum pump and manometer and regulating stop cock. The animal was anesthetized with urethane. A catheter could be introduced into the bladder or into each ureter. This technic can also be applied to similar membranes in other animals.

During the experiment the flow of blood could be observed. Pulsation in some cases was readily visible at a pressure of 40 cm. of water. Even when no pulsation was visible, in some vessels at least, the flow of blood could be seen. Some membranes readily