CXL. CHANGES IN THE CALCIUM AND MAGNESIUM OF THE SERUM AND IN THE INORGANIC PHOSPHORUS OF THE BLOOD OF COWS AT CALVING AND OF THE CALF DURING EARLY LIFE.

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IN view of the recent work of Sjollemma and his co-workers on "grass tetany," a good review of which is given by Sjollemma himself [1932], and of the increasing incidence of "lactation tetany" or "Hereford disease" as referred to by Dryerre [1932], it was decided, in conjunction with Dr H. H. Green of the Ministry of Agriculture Veterinary Research Laboratory, Weybridge, to include the study of serum-Mg in normal cows throughout the reproductive cycle. We, therefore, repeated our studies [Godden and Allcroft, 1932] of the changes in the blood of the cow at calving, including determinations of serum-Mg in this series and omitting those of N.P.N., total chloride and sugar which had shown no marked alterations before.

The experimental procedure and the methods for serum-Ca and inorganic P were the same as used before except that, on this occasion, the calves were

Fig. 1.

Fig. 1. Changes in the average composition of cow's blood just before, at and after calving (data for Cow 15 omitted).

Fig. 2.

Fig. 2. Changes in the average composition of the blood of 8 calves from birth to 8 weeks.

Table I. *Composition of the blood of cows, just before, at and for 6 days after calving.*

All values in mg. per 100 ml.

Days before or after calving	Serum- Ca	Serum- Mg	Blood- inorg. P	Serum- Ca	Serum- Mg	Blood- inorg. P	Serum- Ca	Serum- Mg	Blood- inorg. P	Serum- Ca	Serum- Mg	Blood- inorg. P
	Cow 4			Cow 5			Cow 7			Cow 8		
2 before	10.05	2.00	5.87	10.75	1.95	6.13	11.35	1.92	6.89	—	—	—
1 "	9.95	2.35	5.92	9.60	2.25	5.19	9.45	2.00	3.75	10.15	1.95	5.87
Calving	10.00	1.99	4.78	7.45	2.85	4.47	8.50	2.17	3.05	7.15	2.74	3.07
1 after	9.95	1.83	4.93	8.60	2.96	4.62	10.30	2.23	6.08	7.65	2.87	5.67
2 "	9.45	2.25	4.66	8.35	2.45	4.35	10.70	2.00	5.58	8.70	2.26	4.82
3 "	9.25	2.00	5.07	8.95	2.02	4.82	10.80	1.87	6.89	8.45	1.90	4.82
4 "	10.50	2.72	4.72	9.35	1.51	5.19	12.05	1.78	7.26	10.30	1.82	5.58
5 "	10.55	2.48	5.87	9.85	1.80	5.11	11.40	1.60	6.75	10.40	2.00	5.53
6 "	10.85	2.38	5.92	10.55	1.84	5.53	10.75	1.60	6.75	9.70	2.01	5.40
	Cow 11			Cow 12			Cow 13			Cow 15		
2 before	11.05	2.17	6.08	9.65	2.61	9.00	10.25	—	4.85	—	—	—
1 "	8.85	2.48	4.44	10.75	3.22	8.04	10.35	1.60	4.50	9.60	2.26	6.13
Calving	6.10	2.81	2.66	7.95	—	4.82	8.25	1.85	2.81	7.80	2.58	6.13
1 after	6.25	2.96	3.24	9.25	3.69	5.40	9.50	2.45	5.19	6.35	3.57	4.93
2 "	7.85	2.78	4.47	9.35	2.95	5.87	9.30	2.20	5.15	—	—	6.08
3 "	11.30	1.35	6.03	9.70	2.14	5.58	10.15	2.19	5.58	5.95	2.96	3.82
4 "	11.50	1.82	7.10	10.80	1.97	5.19	10.60	1.86	6.08	6.75	2.74	3.52
5 "	11.25	1.87	8.44	10.15	1.47	5.67	9.40	1.80	6.49	6.50	2.37	2.70
6 "	11.05	2.12	6.82	10.20	2.25	6.19	9.50	1.99	5.04	9.45	0.94	3.92
	Cow 16			Cow 18			Cow 19			Cow 20		
2 before	10.55	2.25	5.67	11.10	2.78	5.58	10.65	2.74	4.27	12.15	2.12	5.11
1 "	9.80	2.45	4.51	7.20	3.81	3.75	12.40	2.48	4.25	11.55	2.17	4.32
Calving	9.30	2.00	5.82	7.35	4.05	3.84	9.65	2.85	3.09	8.75	2.74	2.78
1 after	10.25	2.00	5.23	10.05	3.63	5.62	10.90	2.15	5.15	11.05	2.61	5.77
2 "	10.05	2.26	5.02	11.40	2.02	5.67	10.75	2.23	4.21	11.10	1.82	5.82
3 "	10.05	2.17	4.59	11.80	1.81	6.85	9.80	2.19	4.40	10.95	1.67	6.03
4 "	10.95	2.00	4.56	11.35	1.81	6.79	10.50	1.82	6.03	10.00	1.97	4.38
5 "	10.65	1.94	4.82	13.50	1.89	5.84	9.70	1.99	6.10	10.45	1.77	4.38
6 "	11.15	2.01	5.11	11.85	2.00	5.40	10.05	2.23	6.03	11.20	1.72	5.11

Table II. *Composition of the blood of 8 calves from birth to 8 weeks.*

All values in mg. per 100 ml.

Calf No.		Birth	2 days	4 days	6 days	14 days	21 days	28 days	35 days	42 days	49 days	56 days
4	Serum-Ca	13.85	14.25	13.20	12.90	12.35	12.35	12.75	11.95	11.35	11.40	11.90
	Serum-Mg	2.10	1.58	1.70	1.82	1.83	2.20	1.99	1.88	1.93	1.58	1.60
	Blood-inorganic P	6.43	6.08	5.87	4.78	6.37	5.72	6.61	6.65	6.23	6.46	6.31
5	Serum-Ca	13.55	13.45	13.45	14.40	12.95	12.95	12.80	13.60	13.10	13.10	12.95
	Serum-Mg	1.95	1.43	1.43	1.78	1.42	1.74	1.97	1.97	2.21	1.80	1.81
	Blood-inorganic P	7.34	6.08	6.82	7.58	8.34	7.10	7.42	7.58	6.40	8.14	7.34
7	Serum-Ca	14.00	14.15	13.85	12.80	12.35	12.40	13.35	12.65	12.30	13.95	12.60
	Serum-Mg	1.74	1.12	1.69	1.55	1.83	2.00	2.12	2.05	2.20	2.25	2.12
	Blood-inorganic P	6.55	6.19	6.08	7.10	7.18	7.94	7.84	8.44	7.42	6.43	6.68
8	Serum-Ca	12.85	13.30	—	12.75	11.75	13.45	12.35	12.55	12.75	12.05	11.55
	Serum-Mg	1.63	1.58	1.78	1.74	1.80	1.80	1.81	1.89	1.79	2.05	1.92
	Blood-inorganic P	4.35	5.19	6.55	6.13	6.25	6.82	6.75	5.97	6.37	6.55	6.70
11	Serum-Ca	13.20	13.15	12.45	12.25	13.00	13.30	12.55	14.05	12.80	13.50	12.30
	Serum-Mg	1.82	1.81	1.51	1.66	2.00	2.00	1.94	2.32	2.24	2.44	2.16
	Blood-inorganic P	8.24	6.08	5.62	6.03	5.62	7.68	6.82	7.18	7.26	6.89	7.46
12	Serum-Ca	12.70	14.15	14.45	14.20	12.45	11.75	12.05	13.10	12.55	12.05	13.75
	Serum-Mg	—	1.58	1.81	2.04	1.86	2.12	2.00	2.12	2.25	2.50	2.37
	Blood-inorganic P	4.47	6.19	6.37	6.13	6.37	6.37	5.87	6.43	8.24	7.58	7.54
13	Serum-Ca	12.95	12.05	13.80	12.60	12.00	11.25	11.95	12.15	11.90	13.90	12.25
	Serum-Mg	1.21	1.50	1.37	1.86	1.39	2.25	1.86	1.47	1.70	1.86	1.64
	Blood-inorganic P	6.37	5.15	7.50	6.82	6.75	7.10	6.03	6.75	6.25	6.75	6.55
15	Serum-Ca	13.70	13.05	13.20	13.75	12.50	12.25	12.75	13.05	12.30	12.65	11.90
	Serum-Mg	1.72	1.40	1.71	1.55	1.49	1.72	1.84	1.47	1.90	2.00	1.69
	Blood-inorganic P	7.50	5.62	6.55	7.50	6.82	6.08	5.67	6.13	4.47	6.68	6.43

studied for a longer period of time, namely 8 weeks. The method used for serum-Mg was a modification of that of Denis [1922] in which the phosphorus in the magnesium ammonium phosphate precipitate obtained from the Ca-free serum was estimated by the colorimetric method of Fiske and Subbarow [1925].

The data for each cow are given in Table I and curves of average values (excluding Cow No. 15) are given in Fig. 1. The data for 8 calves are given in Table II and the curves of average values in Fig. 2.

DISCUSSION OF RESULTS.

It should be noted that the basal ration of the whole of the cows was considered to be low in Ca. Of the cows, Nos. 5, 8, 12, 13, 15 and 18 received only this ration, whilst Nos. 4, 7, 11, 16, 19 and 20 received, in addition, a supplement of Ca salts to balance the ration. Whilst there are fairly wide variations between individual cows, these are not due to the dietary difference between the two groups, as may be seen by a study of the data in Table I.

As before, the tendency is for a fall in serum-Ca and blood-inorganic P just prior to parturition, with the lowest points at the time of calving: the only exception to this was Cow No. 16 in which the inorganic P was higher at calving. The labour of this cow was difficult and delayed and it is possible that true labour commenced 24 hours earlier, at the time of the lowest value for inorganic P. Thus we have confirmed our previous findings for the changes in serum-Ca and blood-inorganic P.

As mentioned above the data from Cow No. 15 were excluded from the averages. This was due to the fact that she suffered from a mild attack of milk fever which is reflected in the time taken for the serum-Ca to rise to its normal level and a corresponding high level of serum-Mg during that period.

Considering the results as a whole the behaviour of serum-Mg is more erratic than is that of serum-Ca or blood-inorganic P and the results are consequently less easy to assess. The curve in Fig. 1 reveals a tendency for the level of serum-Mg to be raised just at or for 24 to 48 hours after calving, but in some individual cows this rise occurred the day before calving. The post parturient fluctuations are similarly relatively wide. On the whole there appears to be a tendency for serum-Ca and serum-Mg to vary inversely.

In the case of the calves the data again showed a higher initial level of serum-Ca and blood-inorganic P than those normal for the dam. The serum-Ca dropped after 14 days from a level of 13.5–13.8 down to a level of about 12.4 and thereafter remained steady between 12.3 and 12.8, this being true for every calf except No. 11. Serum-Mg at birth was definitely of a lower order than that of the dam's normal and remained so for the first 14 days. After 21 days it had attained and remained fairly constant around the normal level for the cow.

SUMMARY.

Earlier data on the decrease in serum-Ca and blood-inorganic P of cows just before and at calving are confirmed and data presented to show that, while the serum-Mg fluctuates rather widely about this period, it tends to rise to a higher level just before, at, or within 24 hours of calving. In general serum-Mg varies inversely with serum-Ca. Calves at birth and for the first 8 weeks of life show rather higher levels of serum-Ca and blood-inorganic P than the normals for

the dam, while the serum-Mg level at birth is lower than the dam's normal, but has attained this normal after 3 weeks.

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