

Studies on 'the Utrecht Abnormality of Milk' in the Miyuki Dairy Farm II. Ca and Mg Contents in Blood

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(Fig. 1 - 4, Tables 1 - 2)

The abnormal milk, affected by the so-called 'the Utrecht abnormality of milk.' showed alcohol test positive and heating test positive properties. Yet, the growth mechanism of this phenomenon is not known. A great deal of abnormal milk secretions were observed on lactating dairy cows in the Miyuki Dairy Farm, in Japan, and this abnormality of the milk was identical to the phenomenon appearing in the Netherlands and called 'the Utrecht abnormality of milk' which occurred in the nineteen thirties.

The characteristic symptom of the abnormal milk in the Miyuki Dairy Farm were normal acidity but alcohol test positive, high content of ionized Ca, and high content in total Ca but low content in total Mg in skim milk. From this, the author diagnosed that the cows in the Miyuki Dairy Farm had been fallen into some metabolic disturbance producing in the milk an abnormal outflow of Ca and a saving of Mg from the cow's body.

The present paper describes the results of these investigations and field experiences on the blood samples from Miyuki Dairy Farm. High Ca and low Mg level in milk were yielded from cows suffering from high Ca and low Mg in blood serum.

Materials and Methods

Whole blood and its serum samples for the abnormal group of lactating dairy cows were collected from the Miyuki Dairy Farm mentioned in a former report (5), and for the normal groups, samples from healthy cows were collected from various other dairy farms located in the vicinity of the Miyuki Dairy Farm. The abnormal group of lactating dairy cows was determined by the alcohol test positive cows in the Miyuki Dairy Farm and the normal healthy cows were determined by the alcohol test negative cows.

Whole blood samples were invariably taken from the jugular vein. After the collection, 1ml of the sample was immediately pipetted into a micro-kjel-dahl flask for the wet-ashing. Needed amount of blood was stored and separated out to the serum.

Determinations of Ca & Mg were made on the samples of whole blood and its serum by the atomic absorption method. For this, 1ml of samples was ashed with 2ml of 70%

HClO₄ in a micro-kjel-dahl flask at 130–160°C in glycerin bath. The sample was then diluted to 100 ml by mean of deionized water, SrCl₂ solution containing 12.5g Sr/l, and 100% ethanol. These diluted solutions which contained Ca 0.5–1.0 ppm, Mg 0.15 – 0.25 ppm, 1000 ppm Sr and 20% ethanol, were then examined by Hitachi 207 type atomic absorption spectroscopy. Recovery experiments for Ca and Mg were made by the use of blood serum, and the results of the analysis were 99 – 100% in the case of Mg and 98 – 100% in the case of Ca.

Results and Discussions

The relationships of whole blood Mg and serum Mg are plotted in Fig. 1. It can be seen that most of the points for the abnormal samples fall beneath the plots of normal ones. This obviously is due to the fact that the serum Mg of the abnormal samples was in a lower concentration than that in the normal ones, but the whole blood Mg of the abnormal samples were unaltered. Table 1 presents the mean values of Mg contents in whole blood and its serum samples. It is clear from the Table 1 that serum Mg content in the abnormal group is at a level reduced approximately by 10%, whereas, in the case of whole blood the Mg content decreased approximately only by 2% compared to that of the normal samples. The ratio of serum Mg and whole blood Mg shows 1.00 for abnormal cows and 1.08 for normal cows. It is due to only the difference in these averages that the Fig. 1 has two different types of relationships, apparently one pertaining to the abnormal group and the other to the normal group. The characteristic sign of these abnormal cows was the shortage of Mg contents in the blood serum.

The relationship of whole blood Ca and serum Ca is visualized in Fig.2, and the relationship of whole blood Ca and Mg is shown in Fig. 3. The Ca contents in whole blood samples observed for abnormal cows show a higher level when compared with the plots of normal cows. Such tendencies are, however, not apparent either in Ca contents of serum or in Mg contents of whole blood in abnormal group compared with normal group. The mean Ca level of whole blood and its serum samples are summarized in Table 2. The serum Ca contents, as can be seen there, in abnormal cows are higher than in normal cows. The Ca contents in whole blood of abnormal cows are in excess by more than 14%. As is clear from Fig. 4, while the Mg contents in blood serum are at a fairly low levels, the Ca contents are quite high.

The results obtained in the case of these dairy cows are very identical as those of experimental Mg-deficient rats examined by MacIntyre and Davidsson (2), and show similar tendencies of fall in serum Mg levels and rise in serum Ca levels to those noticed in the studied of hypomagnesaemic calves made by Blaxter and Sharman (1). These author, however, never made any specific remarks about the relationship between Ca and Mg contents in blood serum. It is a generally accepted hypothesis that in a Mg-deficient animals the serum Mg is at a reduced level but the serum Ca remains unaltered according to L'Kelly and Fontenot (3), decreases according to Parr (4) and increases according to MacIntyre and Davidsson (2).

It can be observed easily that serum Ca and serum Mg are closely related in their sum totals in the case of abnormal cows as well as in that of normal cows. The sum totals of the mean values of serum Mg and serum Ca levels are 6.30 meq/l for abnormal 17 cows and 6.26 meq/l for 54 normal cows.

$$1) 1.82\text{meq/l Mg} + 4.48\text{meq/l Ca} = 6.30\text{meq/l (for abnormal group)}$$

$$2) 2.00\text{meq/l Mg} + 4.23\text{meq/l Ca} = 6.26\text{meq/l (for normal group)}$$

From these inferences, the author was brought to make the reasonable conclusion that when the Mg level is decreased in blood serum, due to certain abnormalities, the Ca level increases in a inverse proportion in order to maintain the concentration of divalent cation in the blood serum. In other words, irrespective of the differences in levels of Mg and Ca, their sum totals have gotten to remain constant in the blood serum, i.e. $\text{Mg} + \text{Ca} = \text{constant}$.

From these signs, namely low Mg level in blood serum and milk, and high Ca level in blood serum and milk, the author came to the conclusion that the lactating dairy cows in the Miyuki Dairy Farm must have been suffering a chronic disturbance of Mg metabolism or Mg deficiency. It was observed that the hay and the silage of Italian ryegrass grown in the Miyuki Dairy Farm for feed of the cows had a low Mg content only reaching 0.106% or 0.086% in dry weight. Mention may be made also that radino clover which as the characteristic yellow leaf of Mg deficient plants, was also found here and there in the meadow of that dairy farm.

Table 1. Ca and Mg content in Whole blood and its serum

Cow No.	Whole Blood		Blood Serum		
	Ca	Mg	Ca	Mg	
For Abnormal group	1	3.99	1.61	4.29	1.58
	3	3.63	1.78	3.89	1.73
	4	3.63	1.88	4.59	1.89
	5	3.63	1.63	4.68	1.59
	6	3.81	1.58	4.42	1.49
	7	3.90	1.79	4.73	1.83
	8	3.83	1.88	4.77	1.93
	9	4.09	1.84	4.59	1.77
	10	3.92	2.01	4.42	2.01
	11	3.60	1.89	4.29	1.89
	12	3.87	1.79	4.63	1.79
	13	3.50	1.78	4.54	1.84
	14	3.59	1.92	4.71	2.01
	15	3.87	1.77	4.25	1.63
	17	4.00	1.97	4.76	1.97
	19	4.32	2.07	4.33	2.10
	20	3.83	1.66	4.33	1.84
For Normal group	N1	3.51	1.68	4.73	1.83
	N2	3.24	1.95	4.56	2.25
	N3	3.24	1.805	4.56	2.01

Cow No.	Whole Blood		Blood Serum		
	Ca	Mg	Ca	Mg	
For Normal group	N4	2.92	1.86	4.49	2.07
	N6	3.24	1.84	4.32	1.99
	N7	3.20	1.79	4.46	2.04
	N9	3.32	2.01	4.09	2.28
	N10	3.75	1.64	4.53	1.74
	N11	3.41	1.90	4.49	2.02
	N12	3.10	1.79	4.29	1.93
	N13	3.37	1.69	4.29	1.90
	N14	3.33	2.05	4.36	2.10
	N15	3.75	1.83	4.39	1.78
	N16	3.37	2.18	4.46	2.36
	N18	3.52	2.10	4.18	2.20
	N19	3.41	1.97	4.28	2.11
	N21	3.52	2.06	4.61	2.28
	N22	3.07	1.69	4.02	1.78
	N23	3.18	1.76	4.28	1.90
	N24	3.22	1.84	3.98	1.96
	N25	3.79	1.97	4.54	1.90
	N31	3.16	2.09	4.18	2.17
	N32	3.61	2.01	4.28	2.16
	K2	3.46	1.80	4.21	1.98
	K4	3.24	1.83	3.79	2.15
	K5	3.53	1.83	4.07	1.92
	K9	3.24	1.75	4.07	1.90
	K10	3.24	1.69	4.07	1.87
	K12	3.28	1.71	4.19	1.84
	K13	3.20	1.72	4.00	1.91
	K14	3.68	1.60	4.35	1.79
	K16	3.21	1.78	3.86	1.87
	K17	3.10	1.73	3.79	1.82
	K18	3.28	1.72	4.35	1.84
	K19	3.17	1.99	4.21	2.11
	K20	3.13	1.92	3.93	2.25
	K23	3.17	1.69	4.35	2.03
	K26	3.13	1.76	3.79	1.84
K27	3.31	1.80	4.14	1.88	
K28	3.17	1.69	4.19	1.90	
K29	3.31	1.74	4.12	1.92	
K35	3.20	1.94	3.98	2.14	
K36	3.70	2.13	4.43	2.24	
K39	3.66	1.89	4.33	2.01	
K42	3.13	1.80	4.05	1.95	
K43	3.20	1.76	4.22	1.78	
K44	3.73	1.99	4.33	2.00	
K45	3.91	2.16	4.43	2.22	

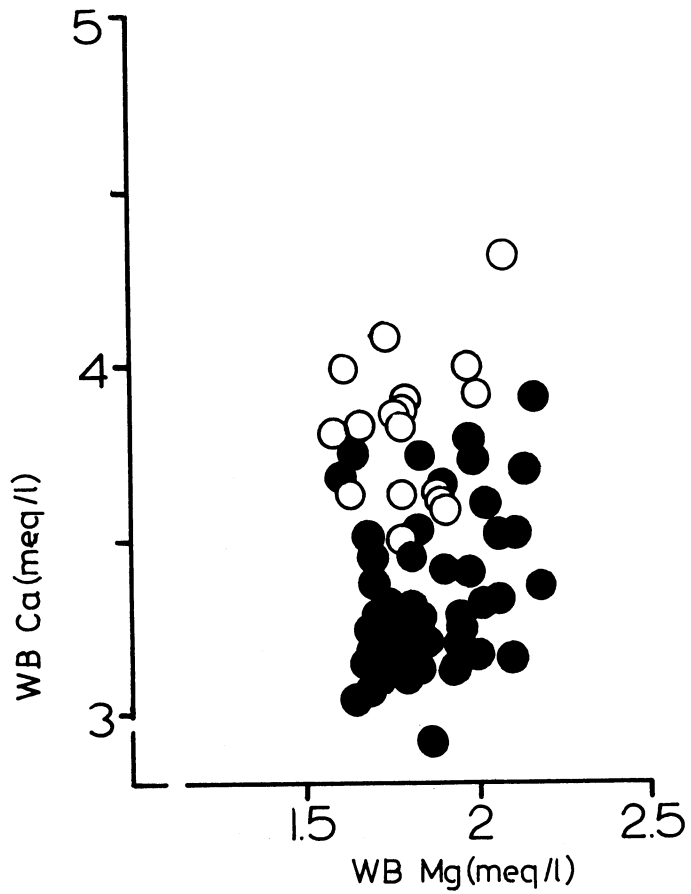


Fig. 1 Relationship of Mg contents between whole blood and it's serum for abnormal cows (○) and normal cows (●).

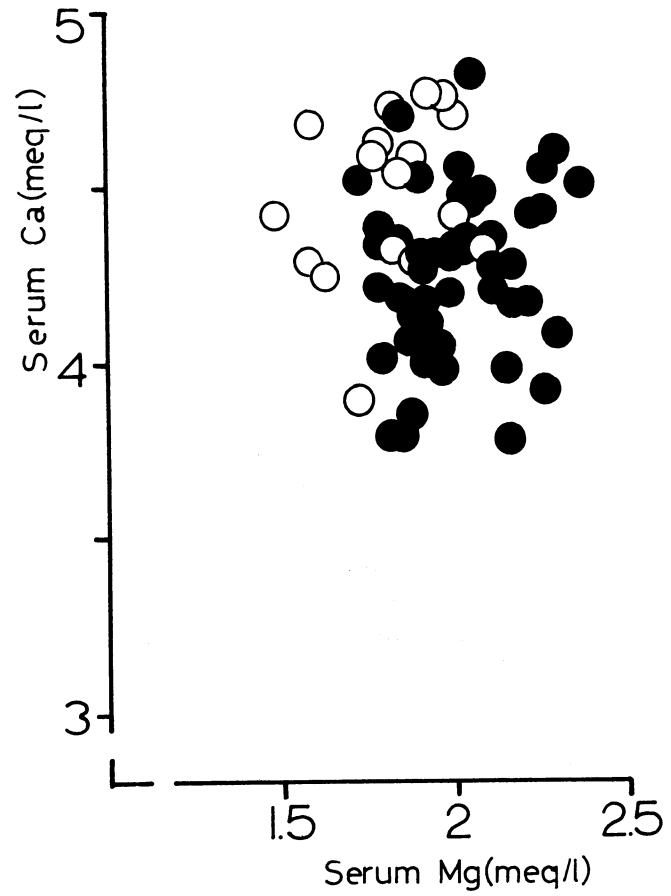


fig. 2 Relationship of Ca contents between whole blood and it's serum for abnormal cows (○) and normal cows (●).

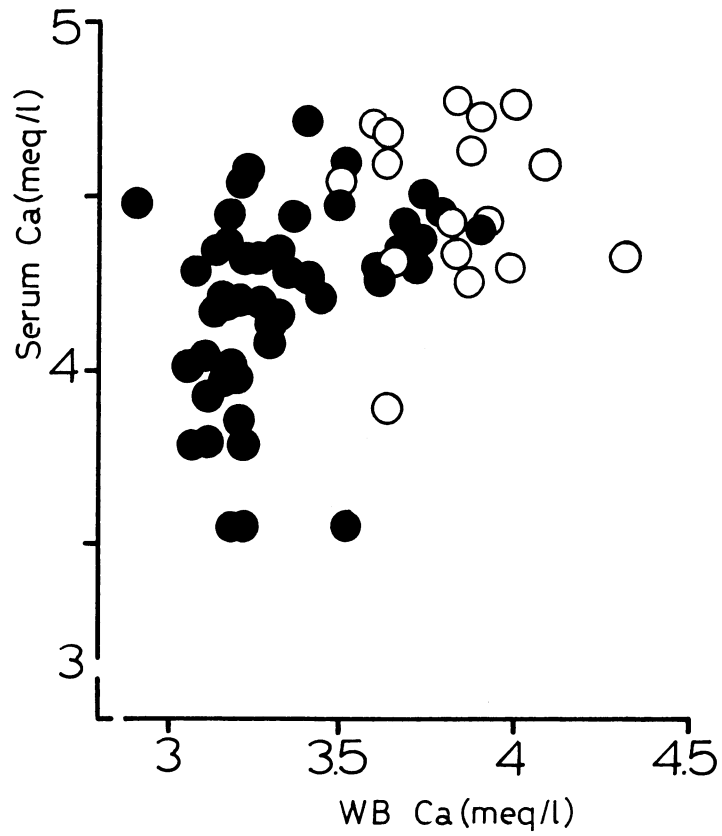


Fig. 3 Relationship between Mg and Ca contents in blood serum for abnormal cows (○) and for normal cows (●).

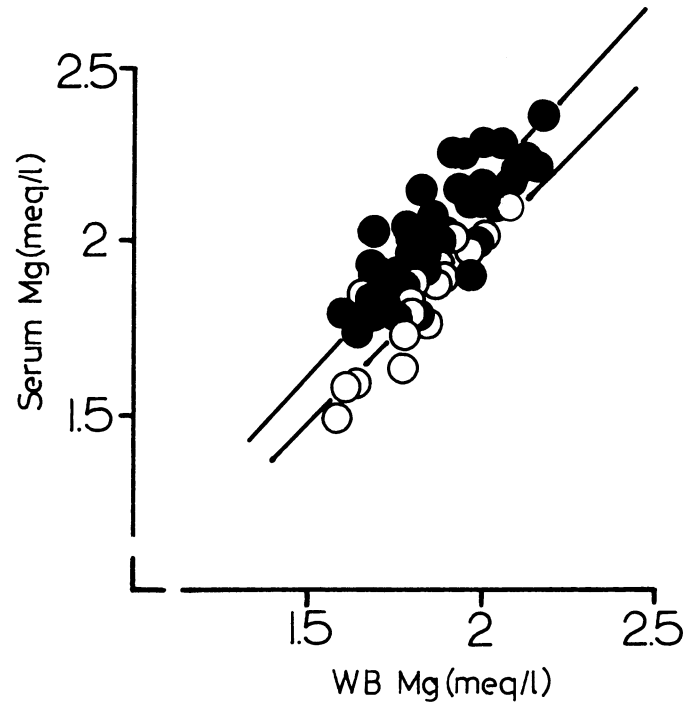


Fig. 4 Relationship between Mg and Ca contents in whole blood for abnormal cows (○) and for normal cows (●).

Table 2-1. Mg contents in whole blood and it's serum

	Number of cows	A Means values of serum Mg	B Means values of whole blood Mg	A B
For abnormal group	17	1.82meq/l	1.82meq/l	1.00
For normal group	54	2.00meq/l	1.85meq/l	1.08

Table 2-2. Ca contents in whole blood and it's serum

	Number of cows	Mean values of serum Ca	Mean values of whole blood Ca
For abnormal group	17	4.49meq/l	3.82meq/l
For normal group	54	4.24meq/l	3.34meq/l

SUMMARY

A great deal of abnormal milk secretion has been observed in the Miyuki Dairy Farm, and the abnormal milk showed alcohol test positive and heating test positive properties that are called 'the Utrecht abnormality of milk.' The abnormal milk showed high Ca and low Mg content in it's skim milk and had a high ionized Ca level.

The cows in the Miyuki Dairy Farm showed a low Mg content and a high Ca content in the blood serum, and a high Ca level in the whole blood compared with that of normal groups.

1) The mean value in the blood serum of Mg is 1.82meq/l for abnormal groups and 2.00meq/l for normal ones.

2) The mean value in the blood serum of Ca is 4.49meq/l for abnormal and 4.24meq/l for normal ones.

3) The mean value in the whole blood of Mg is 1.82meq/l for abnormal and 1.85meq/l for normal groups.

4) The mean value in the whole blood of Ca is 3.82meq/l for abnormal and 3.34meq/l for normal groups.

From these results, the abnormal milk in the Miyuki Dairy Farm which showed a low Mg and a high Ca content must have been yielded from cows suffering from a low Mg and a high Ca content in their blood serum. From low serum Mg and high serum Ca, the author has arrived at the conclusion that the lactating dairy cows in the Miyuki Dairy Farm must have been suffering from chronic lactation disorder accompanied by a disturbance of the Mg metabolism or by a Mg deficiency.

References

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御幸牧場において「集団発生した低酸度二等乳」に関する研究

(2) 低酸度二等乳泌乳牛の血中Ca及びMgについて

吉田 繁

1970年に御幸牧場で集団発生した低酸度二等乳はアルコール試験陽性でまた熱凝固性を示し、これは 'the Utrecht abnormality of milk' と同じ特徴を示した。そしてまたその異常乳はCaが高くMgが低いこととイオン状Caが高い値を示した。

御幸牧場の乳牛の血清Caが高く血清Mgが低いことと全血Caが高いと云う特徴がみられた。尚、全血Mgには差がみられなかった。

表 御幸牧場の乳牛群と対称牛群の血中のMg及びCaについて

	頭数	(単位 meq / l)			
		全血中のCa	全血中のMg	血清中のCa	血清中のMg
御幸牧場の乳牛群の平均値	17	3.82	1.82	4.49	1.82
対象群の平均値	54	3.34	1.85	4.24	2.00

以上の結果から、御幸牧場の乳牛群の血清Caが高い。血清Mgが低いと云う特徴とが密接に関係していると考えられる。乳牛の血清Mgが低く血清Caが高いと云う特徴はその乳牛群がMgの代謝異常かMg欠乏をともなった慢性的な泌乳障害におち入っているにちがいないと推定される。