THE EFFECT OF AGE ON ERYTHROCYTE MAGNESIUM CONCENTRATIONS OF DAIRY COWS DURING LATE PREGNANCY AND EARLY LACTATION

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ABSTRACT

Blood samples were taken at weekly intervals from fifty four dairy cows (mainly Friesians and Jerseys) during the periods 8 weeks before and 8 weeks after calving. The cows were divided into two age groups: Group 1 consisting of 26 cows 2½ to 4 years old and Group 2 consisting of 28 cows over 4 years old.

The changes in erythrocyte magnesium (EMg) and plasma magnesium (PMg) concentrations before and after calving were expressed as the slope of each blood parameter regressed on weeks. The post-partum EMg concentration slope (increase) was greater (P<0.05) in the older cows than in the young ones. The older cows also had higher (P<0.05) mean EMg concentrations than the young cows. Between cow EMg concentration variations were significant (P<0.05) in both age groups while the weekly EMg concentration variations were only significant (P<0.05) in the older cows after calving. Age did not influence the changes in PMg concentrations before or after calving. Nor did the PMg concentrations vary significantly either between cows or between weeks.

INTRODUCTION
Erythrocyte magnesium (EMg) concentrations do not fall as quickly or as much as plasma magnesium (PMg) concentrations in acute magnesium deficiency (Tuft & Greenburg, 1937; Elin et al., 1971). However, a prolonged lesser degree of magnesium deficiency can lead to a marked decrease in EMg concentrations (Tuft & Greenburg, 1937; Salt, 1950; Elin et al., 1971).

During pregnancy, and especially in the last trimester, there is increased magnesium demand by the developing foetus (Lim et al., 1969; Murtuza et al., 1979). Women with low PMg concentrations in the last trimester of pregnancy were also found to have low EMg concentrations (Lim et al., 1969). This is in accordance with the observation that erythrocytes formed during periods of low PMg concentrations have low magnesium content (Salt, 1950; Elin et al., 1971). Young women at fertile age were found to have lower EMg concentrations than postmenopausal women (Goldsmith, 1971; Henrotte et al., 1980).

This study was undertaken to study the effect of age on the EMg concentrations of dairy cows during the periods 8 weeks before and 8 weeks after calving.

MATERIALS AND METHODS
Experimental Animals
Fifty four Friesian and Jersey cows aged between 2½ and 9 years from one herd and on
the same feeding regime were used. The cows were grazed on irrigated rye grass and clover pastures during the dry winter months and in the wet summer months were grazed on tropical pastures consisting of Rhodes, Kikuyu and Green panic grasses. The milking cows were given a concentrate supplement mixture containing sorghum grain and meat meal *ad libitum* during the morning and afternoon milking.

The cows were divided into two age groups; Group 1, of 26 cows aged 2½ to 4 years old, and Group 2, of 28 cows over 4 years old.

**Blood collection and analysis**

Weekly blood samples were collected between 9.00 and 11.00 am from the coccygeal blood vessels of each cow during the period 8 weeks before to 8 weeks after calving. The blood samples were analysed for packed cell volume by a microhaematocrit method, plasma magnesium (PMg) and erythrocyte magnesium (EMg) concentration by atomic absorption spectroscopy (Willis, 1960). The EMg concentration was estimated indirectly using haemolysed blood. The haemolysed blood was prepared by diluting 0.35 ml blood with 1.0 ml of double deionized water. This was centrifuged at 3000 rpm for 10 minutes to remove the cell debris and the magnesium concentration in the supernatant was determined. The concentration of Mg in the erythrocytes was then calculated using the following formula:

\[
\text{EMg (mmol/l)} = \frac{3.9 \times \text{HBMg value} - (1 - \text{PCV}) \times \text{PMg value}}{\text{PCV}}
\]

where 3.9 = dilution factor

HBMg value = Haemolysed blood Mg value (mmol/l)

PMg value = Plasma Mg value (mmol/l)

PCV = Packed Cell Volume (l/l)

The changes in PMg and EMg concentrations for the periods 8 weeks before and 8 weeks after calving were expressed as the slopes (linear regression coefficients) obtained by individually regressing each parameter on weeks in each of the two time periods.

The data was further analysed by an analysis of variance.

**RESULTS**

The changes in PMg and EMg concentrations from 8 weeks before calving to 8 weeks after calving according to age groups are shown in Figure 1. The PMg concentrations did not show any significant changes in either age group in either the pre-partum or the post-partum periods (Figure 1). The mean EMg concentrations increased after calving but the increase was significant (P<0.05) only in the older cows (>4 years old). The mean PMg concentrations did not show any significant differences between the age groups in either the pre-partum or post-partum periods (Table I). However, the mean EMg concentrations were significantly (P<0.05) higher in the older cows than the young cows (<4 years old) in both the pre-partum and post-partum periods (Table I). The rate of increase in the EMg concentrations after calving was greater (P<0.05) in the older cows than in the young cows. The older cows also had significantly (P<0.05) different mean PCV slopes, than the young cows (Table I).

The mean PMg concentrations did not show any significant weekly or between cow variation in the two age groups in either the pre-partum or the post-partum periods (Table II). Unlike the PMg concentrations, the pre-partum and post-partum mean EMg con-
centrations varied significantly (P<0.05) between cows in both age groups (Table II). The variation in weekly EMg concentration was significant (P<0.05) in the post-partum period in the older cows only.

**DISCUSSION**

Although EMg concentrations may be genetically determined (Dariu et al., 1981; Henrotte & Colombani, 1981), they are also related to the erythropoietic activity of the bone marrow (Bernstein, 1959; Ginsburg et al., 1962; Henrotte et al., 1980). Any acceleration in erythropoesis leads to increased liberation by the bone marrow of young erythrocytes which have a higher Mg content than the mature erythrocytes (Bernstein, 1959; Ginsburg et al., 1962; Timms & Murphy, 1980; Brown et al., 1986). Accordingly the increase in EMg concentrations after calving may have been due to increased production of young erythrocytes as a result of the decreased haematocrit levels (Table I). The higher EMg concentrations in the older cows after calving may have been due to the greater decrease in haematocrit levels in these animals. This might have led to a higher erythropoietic activity and hence release into the circulation of a greater number of young erythrocytes in the older cows than in the young cows. Young women in their fertile age were found to have a lower erythropoietic activity and lower EMg concentrations than post-menopausal women (Goldsmith, 1971; Henrotte et al., 1980). It is possible that young cows also have a lower erythropoietic activity and hence lower EMg concentrations than older cows.
1959; Ginsburg et al., 1962) and can also vary from time to time (Schalm et al., 1975). However, the EMg concentrations fluctuated little in individual cows, except in the older animals in which they varied significantly (P<0.05) between weeks after calving. This may also reflect increased erythropoietic activity in these older cows after calving.

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REFERENCES


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