FOLIAR SUPPLEMENTATION OF MINERALS TO PREVENT CALCIUM AND MAGNESIUM DEFICIENCIES IN DAIRY COWS

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ABSTRACT

The objectives of this study were to examine the possibility of reducing the incidence of calcium and magnesium deficiencies in cows by feeding anionic salts and by manipulating the mineral concentrations in pastures with foliar sprays during late pregnancy. Cows provided with a mineral supplement of magnesium chloride and ammonium sulphate before calving produced more milk solids and experienced less health problems. The foliar application of anionic salts, with and without sodium chloride, altered the cation balance in pastures grown on 6 different soils.

KEY WORDS

Grazing cows, mineral balance, production and health

INTRODUCTION

Recent research in USA has shown that pre-calving rations with a high DCAD (Dietary cation-anion difference, [K + Na] - [Cl + S]), are associated with an increased incidence of milk fever, and supplementation with anionic salts (Ca, Mg or NH_4 chlorides and sulphates) for 2 - 4 weeks prior to calving has reduced the problem (see Delaquis and Block, 1995 for Refs.).

Ryegrass/clover pastures in New Zealand, liberally fertilised with potash, have very high K levels (2.5 - 5.0% DM) and hence high DCAD values (300 - 1000 m equiv./kg DM). They also often contain low concentrations of Ca (0.3 - 0.4% DM) or Mg (0.15-0.20% DM), and hence have a high grass tetany index (K/Mg + Ca). The metabolic disorders of milk fever and grass tetany are common, particularly during the winter/early spring period.

Dairy cows are frequently supplemented with Mg (by dusting pasture pre-calving and drenching post-calving) in order to reduce the incidence of tetany and to stimulate milk production (Wilson, 1981). However, hypomagnesaemia remains a serious problem and improved methods of supplementation are required.

The objectives of the present experiments were to:

a) measure the effects on milk production of variation in DCAD prior to calving in pasture based diets, and
b) develop an appropriate anionic salt mix which could be applied to winter pastures as a foliar spray to help prevent milk fever and/or grass tetany.

METHODS

A dairy cow feeding experiment was undertaken at the University (July, 1995), and a series of pasture plot experiments were conducted on 6 commercial dairy farms situated on a diverse range of soil types (coarse, medium, fine, pumice and peat) during May/June 1996.

The anionic salt supplement used in the cow feeding experiment was 66% magnesium chloride and 34% ammonium sulphate [1] (Hypoaid™ 66/34). 50 mature cows, which were being fed a 50:50 maize silage and pasture ration, were divided into two similar groups and one received 60g Hypoaid 66/34 daily, mixed into (8kg DM) maize silage for a period of 2-4 weeks prior to calving. Pasture was fed once every 2-3 days when soil conditions allowed grazing. The pasture consumed by the treatment group was also sprayed at the commencement of the experiment with 15 kg Hypoaid 66/34 per ha. 20 cows from each group were bled on days 1 or 2, 3 or 4 and 10 - 12 after calving and again 5-7 weeks into lactation. Serum samples were analysed for minerals and b-hydroxybutyrate concentrations.

Because the foliar application of anionic salts in the grazing experiment did not change the DCAD markedly, the effects of including 10% NaCl in the foliar spray [1](Hypoaid™ 60/30/10) was examined during the subsequent pasture plot experiments. Common salt was included because of known antagonistic relationships between Na and K as plant nutrients. Replicated (3 or 4, 1m square) plots of pastures, yielding 2-3000 kg DM/ha, were sprayed with Hypoaid 66/34, Hypoaid 60/30/10 or distilled water at the rate of 10 kg/ha (in 200l H_20) on six commercial dairy farms. Representative samples of herbage were obtained from each plot after one week and analysed for N, P, K, S, Ca, Mg, Na and Cl. The DCAD (milk fever) and K/Mg + Ca (grass tetany) indices were calculated for individual properties and treatments.

RESULTS AND DISCUSSION

The cows supplemented with anionic salts (DCAD 165, v 250 for controls) reached their peak milk production significantly ($P<0.01$) earlier than those in the control group (Day 26,v 36). Milk production from the treated cows (Table 1) was higher at the first herd test (day 10-21 of lactation), with the greatest effect being on protein yield (+14%). The positive effects were still present at the second test (day 30 - 50 of lactation), but were not so marked.

Serum Ca concentrations in the treatment group were higher over the first week of lactation (9.01 v 8.84mM) and Mg concentrations from day 12 onwards (0.93 v 0.87mM), but neither of these differences reached statistical significance. On the other hand a much smaller proportion of the cows which received anionic salts, compared with the controls, showed hypocalcaemia (3/20 v 8/20, less than 8.0mM) and hypomagnesaemia (8/20 v 12/20, less than 0.6mM) on one or more days in early lactation. Peripartum clinical disorders were also lower in the treated group (0 v 1/20 milk fever; 0 v 5/20 ketosis; 0 v 2/20 assisted calvings and 1 v 0/20 with retained foetal membranes, for treated and control cows respectively).

These results which showed that considerable benefits in health and production may result from a reduction in DCAD before calving were probably mediated through enhanced intake. Huber *et. al.* (1981) showed that hypocalcaemia will cause a reduction in rumen contractions which would potentially delay the establishment of normal intakes following calving.

Apart from direct supplementation with chlorides and sulphates, the DCAD of prepartum rations could be lowered in practice by reducing the use of potash fertilisers, by the use of low K feeds (e.g. maize silage), incorporating anionic salts in the water supply or by applying anionic salts to pasture as a foliar spray.

The influence of two foliar applied mineral supplements upon the mineral composition of winter pastures and indices of milk fever

[1]Hypoaid ™ is the registered trade mark of Coast Biologicals Ltd. N.Z. Pat. Appln. No. 280911.

(DCAD) and grass tetany (K/Mg + Ca), measured one week after application on 6 commercial farms, are summarised in Table 2.

The Mg contents of pastures were increased substantially (22%), especially by Hypoaid 60/30/10. In fact on the basis of estimated pasture yields for this treatment recoveries of applied Mg averaged more than 100%, which implies that the foliar treatment induced Mg uptake from the soils. Both the milk fever and grass tetany indices were reduced by the Hypoaid 60/30/10 treatment, mainly due to lower herbage K concentrations.

In conclusion it is clear that anionic salts and foliar applied Hypoaid 60/30/10 have potential to make significant impacts on production and a range of health problems associated with hypocalcaemia and hypomagnesaemia in grazing dairy cows.

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Table 1
Influence of anionic salt supplementation for 14-28 days prior to calving upon milk production in early lactation.

	Control	Treatment	SEM	P Value*
First test date (Day 10-21)				
Milk yield, kg	24.2	25.2	0.96	0.40
Milk fat yield, kg	1.11	1.21	0.04	0.10
Protein yield, kg	0.86	0.98	0.03	0.02
Second test date (Day 30-41)				
Milk yield, kg	24.9	24.9	0.64	-
Milk fat yield, kg	1.09	1.17	0.04	0.18
Protein yield, kg	0.90	0.92	0.03	-

* Probability values with 22-25 observations per mean.

Table 2
Changes in mineral composition of pastures (% DM) and health indices following treatment with alternative foliar sprays.

	Control (SD)	Hypoaid 66/34	Hypoaid 60/30/10	P Value*
Cations				
Potassium	3.91(0.50)	+0.20	-0.32	0.05
Calcium	0.46(0.12)	-0.05	+0.01	0.10
Magnesium	0.23(0.04)	+0.03	+0.05	0.16
Sodium	0.20(0.0.07)	-0.01	+0.02	-
Anions				
Nitrogen	3.95(0.45)	-0.07	0	-
Phosphorous	0.39(0.04)	0	+0.03	-
Sulphur	0.40(0.05)	0	0	-
Chlorine	1.51(0.51)	+0.11	0	-
Indices				
Grass tetany, K/Mg + Ca	2.47(0.56)	+0.12	-0.40	0.01
Milk fever, DCAD	416(70)	+13	-69.5	0.19

* Probability values for differences between changes induced by Hypoaid treatments (n=6).