EFFECTS OF $MgCl_2$ AND 25-HYDROXY VITAMIN D_3 (HYD©) ON BLOOD AND URINE CALCIUM CONCENTRATIONS IN CATTLE

B. ELLIOTT[A], *B.W. NORTON*[A] *and R. ELLIOTT*[B]

[A]Schools of Veterinary Science and Animal Studies, The University of Queensland, St Lucia Qld 4072
[B]DSM Nutritional Products Australia Pty Ltd, 13 Princeton Court, Kenmore Qld 4069

High producing dairy cows frequently suffer from the metabolic disorder known as milk fever, which usually occurs between 24 hours before and 72 hours after calving. In severe cases, coma and death may follow, and represents a serious metabolic disease. The aetiology of the disease is that high producing cows cannot mobilize enough Ca from their tissues or the diet to meet the high demand for Ca in milk at the beginning of lactation. However it is not the level of demand for Ca which caused this disorder, it is the rapidity with which the rate of supply must be increased after calving that poses the threat to the animals health.

Table 1. Mean values for plasma and urinary calcium, magnesium, potassium and phosphorus in cattle given supplements of 25-OH vitamin D_3 and magnesium chloride

Treatment	Plasma (mg/L)					Urine (mg/L)			
	Ca	Mg	K	P	pH	Ca	Mg	K	P
Control	81	19	228	63	7.06a	226a	337	5702	119
HYD	79	18	230	62	7.17a	224a	264	5023	112
MG	87	19	233	74	6.20ab	397ab	411	6652	190
MG + HYD	77	17	217	55	5.82b	592bc	323	5167	244
± SE mean	4.8	0.4	5.1	8.0	0.30*	59.5*	49.4	660.9	77.1

* Significant differences ($P<0.05$) indicated where means in columns have different letter subscripts

In the Australian and New Zealand dairy industries, cows are fed mainly forage based rations before calving and it is the high K levels in these forages which result in metabolic alkalosis which is reflected by high urine pH (pH 8-9). In order to prepare the cow for calving dairy farmers often use anionic salt supplements (usually $MgCl_2$ or $MgSO_4$) which results in a slight metabolic acidosis in blood and is indicated as a decrease in urine pH. In response to this challenge, Ca is withdrawn from bones and urinary Ca excretion rates are increased (Horst *et al*. 1994). Since the discovery of 25-hydroxy (OH) vitamin D_3 as the active component of vitamin D_3 in the early 1970s it has been used to prevent milk fever (Sansom 1977). HYD© does not accumulate in animal tissues and may be safely used where animal products are consumed by humans. There is evidence that metabolic alkalosis interferes with the action of HYD©, and this interaction was studied in the following experiment.

The experiment investigated the efficacy of providing supplements of HYD© (400 mg HYD© DSM Nutritional Products Australia, contains 1.25% 25 OH vitamin D_3) with and without the use of anionic salts (MG = 150 g $MgCl_2.6H_20$) in cattle fed Lucerne hay. The experiment used 4 mature (602 ± 2.6 (se) kg) rumen fistulated Brahman cross steers held in individual pens and offered 12 kg/day of good quality Lucerne chaff (19.8% CP, 65% digestibility, 2.0% K) throughout the trial. After 2 weeks adaptation to the diet, the following treatments were applied over 2 weeks to each steer in a Latin square design, no supplement (Control), MG, HYD© and MG + HYD©. Each treatment was dosed into the rumen through a cannula each morning during each 2 week experimental period. Blood samples were collected on days 7, 13 and 14, and urine samples on days 12, 13 and 14 of each period. Urine pH was measured at collection, blood plasma was decanted after centrifugation, and together with samples of feed and water, analysed for Ca, Mg, K, Na and P in an inductively coupled plasma atomic emission spectrometer. The results were analysed as Latin square design, making comparisons between treatments after removal of any animal or period effects.

The results presented in the table show that while the treatments had no significant effects on blood concentrations of Ca, Mg, K or P, MG was effective in decreasing urine pH ($P<0.05$) and significantly ($P<0.05$) increasing the concentrations of Ca in urine. While there was no significant effect of HYD© alone on urinary elements, MG + HYD© resulted in a further significant ($P<0.05$) increase in urinary Ca concentrations. If it may be assumed that the treatments did not affect urinary volumes, then it would seem that both $MgCl_2$ and HYD© stimulated the release of Ca from the tissues, as indicated by the substantial increase in excretion in urine, and that this combination was twice as effective as MG alone. This observation suggests that HYD© therapy may a useful adjunct to anionic salts in the prevention of milk fever in dairy cows. This proposition is now being tested in commercial herds in New Zealand.

HORST, R.L., GOFF, J.P. and REINHARDT, T.A. (1994). *J. Dairy Sci.* **77:** 1936-51.
SANSOM, B.F. (1977). *Vet. Sci. Comm.* **1:** 323-35.
Email: b.norton@uq.edu.au