Anionic Mineral Supplement

Magnesium (Mg) Nutrition of the Transition Dairy Cow

Introduction

All living organisms require Mg. It is the 7th most abundant mineral found in the body. The body contains 0.05% Mg with 60-70% found in bones and the remainder in the soft tissue and extracellular fluids. The concentration of Mg within the cells of the body is higher than that of any other mineral except K. It is an element which has many critical bodily functions; integrity of bone and teeth, neuromuscular activity, enzyme activation and energy, protein and fat metabolism and has a critical relationship to other elements (Mc Donald, 1992).

Site and Extent of Absorption

For ruminants, the major absorption site for Mg is the reticulorumen, with an average Mg absorption rate of 25 to 31.2% (McDowell, 1992, Hurley et al., 1990 and Zinn et al., 1996). Biological availability of different sources of Mg for ruminants varies considerably. Peeler (1972) found that the availability of Mg ranged from 10-25% in forages and from 30-40% in grains. True availability estimates for hay and grass range from 11-37% for older ruminants (ARC, 1980). The coefficient of absorption for Mg from inorganic sources should be 50% based on Mg oxide (Goff, 2000). Mg in magnesite and dolomitic limestone should be considered unavailable when formulating dairy rations. Minerals sources of Mg such as Mg oxide are poorly soluble at normal rumen pH. Mg sulfate and Mg chloride are much more soluble and available for absorption in the rumen (Ammerman et al., 1995 and Golf, 2000).

Rumen pH

Fenner (1979) reported a low pH environment in the rumen promotes an excess of free acidity which will allow the soluble Mg to be in an absorbable form. Goff (2000) similarly indicated that the pH of the rumen fluid greatly affects Mg solubility. Mg solubility declines sharply as rumen pH rises about 6.5. Grazing animals tend to have higher rumen pH because of the higher K content of pasture and the stimulation of salivary buffer secretion associated with grazing. When high grain rations are fed rumen fluid pH is often below pH 6.5 and Mg solubility is generally adequate.

Mg Soap

Palmquist (1980) found that unsaturated fats increase Ca and Mg soap formation in the rumen and the excretion of these elements in the feces. Also, Goff (2000) reported that unsaturated fatty acids from forage sources from insoluble Mg salts.

Metabolic Relationships

Early evident (Talmage and Kraintz, 1956, Samiy et al., 1960 and Clark, 1968 and 1969) indicate that dietary Mg markedly influences and absorption and excretion of Ca and P and has a direct involvement in Ca and P homeostasis. Samiy et al. (1960) suggested that there exists a common reabsorptive site of Ca and Mg in the kidney tubules and that large amount of Mg ions inhibit the reabsorption of Ca. Further, the effects of Mg are also dependent on the dietary levels of Ca and P. Clark (1968 and 1969) reported that the net effect of supplementary Mg was to increase Ca and P balance and Ca and P absorption. This response only occurred with higher levels of Ca and P in the diet.

It was found that Cows in dairy herds with a high incidence of milk fever often have subnormal blood magnesium concentration in the periparturient period (Sansom et al., 1983). Furthermore, Mg deficiency may reduce Ca mobilization from the bone (Reddy et al., 1973 and Larvor et al., 1978). Van de Braak et al (1987) demonstrated that cows fed 71 grams of Mg per day had higher mobilization rates of Ca from the bone than did cows fed 17grams of Mg per day during the dry period. This corresponded with the findings of Cotreras et al. (1982) who found that hypomagnesemic cows were less able to mobilize Ca in response to hypocalcemia induced by intravenous infusions of EDTA solution that chelated blood Ca.

Magnesium's role in improving Ca absorption is especially important with the lack of any consistent increase in intestinal absorption of Ca with low DCAD diets, as has been discussed by Block (1994). He indicated that the research shows that the mode of action of reduced DCAD in preventing milk fever lies on the kidney and the bone. Cattle apparently have a good homeostatic control mechanism to handle excess Mg and relative poor homeostatic control against a deficiency, (Miller, 1975); thus, modest errors on high side should have less serious consequences than errors on the low side (NRC, 1989). Goff (2000) reported that despite the important of Mg there is no hormonal mechanism to control Mg homeostasis. The kidneys play a key role in maintaining Mg homeostasis, but only under conditions of hypomagnesemia. If dietary Mg is absorbed in excess of needs plasma Mg concentration rises about the renal threshold for reabsorption of Mg and the excess is excreted into the urine. Parathyroid hormone, released in response to hypocalcemia, raises the renal threshold for both Ca and Mg. The result is that during hypocalcemia plasma Mg concentration will increase if dietary Mg absorption is adequate.

Bone is not a significant source of Mg that can be utilized in times of Mg deficit, as bone reabsorption occurs in response to Ca homeostasis, not Mg status. Maintenance of normal plasma Mg concentration is nearly totally dependent on constant supply of dietary Mg (Goff, 2000).

Dietary Mg Requirements

(Beede, 1993, Hutjens, 1999 and Goff, 2000)

- Lactation: Colostrum contains about 0.4 g Mg/kg and milk contains 0.12 to 0.15 g Mg/kg
- Recommendation for close-up dry cows not receiving anionic supplementation: Minimum of 0.2% Mg in the total diet
- Recommendation for close-up dry cows receiving anionic supplementation: Minimum of 0.4% Mg in the total diet

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