Magnesium supplementation (3-1)

Why supplement cows with magnesium?

Magnesium (Mg) deficiency in dairy cows was first recognised in New Zealand in the 1970's. Since then, supplementing with Mg in late pregnancy and early lactation has become routine on most farms. Magnesium supplementation helps prevent animal health problems, such as milk fever and grass staggers (tetany), and potentially increases milk production.

There have been reports from New Zealand and Australia of *Salmonella* infections occurring in dairy cows that had received Mg supplementation, delivered as granules, prills, pellets, powder and via the drinking water. Further information is provided at the end of this Farmfact.

Before starting Mg supplementation for your dairy herd, consult your veterinarian to discuss the potential risks and to determine if there are any health or environmental factors that should be taken into consideration to reduce the risk of the development of Salmonellosis.

Magnesium and milk fever

Magnesium plays an important role in milk fever prevention (calcium deficiency). Magnesium is required for the production of hormones that aid absorption of calcium (Ca) from the gut, and mobilisation of Ca from bones. Supplementing with Mg for two to three weeks pre-calving will reduce the risk of milk fever. However, it does not build up a store of Mg in the cow.

Magnesium and grass staggers (grass tetany)

Magnesium also plays an important role in nerve and muscle function and functioning of the immune system. Although cows have significant stores of Mg in the bones, little of these stores are available to maintain levels in the blood. Therefore, the cow is dependent on the Mg supplied in the diet and from supplements to maintain blood levels. Blood and urine tests can confirm Mg deficiency. Consult your vet.

The initial symptoms of Mg deficiency, or hypomagnesaemia, are nervousness, ears pricked, nostrils flaring, eyes alert and head held high. Movement is stiff, like they are walking on stilts, and cows stagger when forced to move quickly. Cows suffer loss of appetite and reduced milk production. Death results from a "tetany", where the muscles contract uncontrollably, including the heart.

Magnesium requirements

It is recommended that dry cows receive a diet containing 0.35 percent Mg, and lactating cows 0.28 percent Mg.

Factors that increase Mg requirements of cows during the winter/spring period are:

- Diets naturally low in Mg and/or high in potassium (K) e.g. pastures (low Mg or high K), maize silage or fodder beet (low Mg), paddocks with high potash or effluent (high K).
- Cold wet weather in spring, depressing grass growth and cow intakes.
- High cow demand for Mg over calving and early lactation, e.g. due to high milk production.

Table1. Dietary magnesium requirements and quantity of supplementary elemental Mg required (grams/cow/day) for different types of dairy cattle.

Cow status	Mg requirement (% of diet)	Supplementary Mg required (g/cow/day)		
		Jersey	Crossbred	Friesian
Dry	0.35%	12	16	20
Lactating	0.28%	15	17	20

Table 2. Quantities of magnesium sources to supply the required amounts of elemental magnesium (down the cow's throat).

Magnesium source (% Mg)	Example product	Magnesium required (g/cow/day)				
		12 g	14 g	16 g	18 g	20 g
Mg Oxide (55%)	CausMag	22	25	29	33	36
Mg Sulphate (10%)	Epsom salts	122	142	162	182	202
Mg Chloride (12%)	Mag chloride	100	117	134	151	167

NB. If dusting Mg oxide on pasture, the quantities above need to be at least doubled, possibly tripled, to allow for field losses. When mixing with feed, double the rates above.

Table 3. Amount of magnesium oxide dusted on pasture (g/cow/day).

Magnesium source (% Mg)	Rate	Magnesium required (g/cow/day)				
		12 g	14 g	16 g	18 g	20 g
Mg Oxide (55%)	Double rate	44	50	60	66	72
	Triple rate	66	78	90	100	108

Magnesium supplementation

- Supplementing with Mg sulphate or Mg chloride before calving is more likely to prevent milk fever than using Mg oxide.
- However, it can be difficult to supply cows with enough Mg when using Mg sulphate or Mg chloride. Therefore, dust pastures with Mg oxide as well, to ensure the cows receive enough Mg, not just the correct type.
- One way to achieve the required dietary Mg concentration pre-calving is to add 60 grams of Mg chloride or Mg sulphate into the water trough, and dust pastures with 50 to 70 grams of Mg oxide per cow per day as well.
- Supplement with Mg from two to three weeks before calving and continue until after spring pasture growth rates have slowed (December). Use blood tests to determine if continued supplementation is required from December onwards.
- Factors that increase cow requirements for Mg, such as high milk production, or inclement weather, may extend the need for Mg supplementation into summer.

Note:

- Mg requirements are also affected by levels of potash (i.e. K) and calcium in the diet. Some farms with very high potash levels in pasture will require higher rates of Mg supplementation.
- Applying potassium fertiliser, effluent or lime within three months of calving can affect cow Mg levels at calving.

- Where Mg is added to water and the dosage is not accurate, there is a risk of the water becoming toxic and stock refusing to drink.

Methods of supplementation

The following methods of supplementation are listed in order of effectiveness. Consult the tables above to determine what quantities are required, depending on cow type and the source of Mg that you are using.

- **Drenching**
  Magnesium sulphate, Mg chloride or Mg oxide. Magnesium oxide is the cheapest form of Mg, but is poorly soluble in water, causing difficulty with some drench systems. Additives (e.g. Comag) can reduce drenching problems.

- **Pasture dusting**
  Magnesium oxide. Wind and rain result in field losses of dusted Mg oxide. For this reason, required levels of Mg oxide are doubled or tripled when dusting. Pasture can be dusted up to three days in advance, weather permitting. In very wet weather it may pay to dust more than once per day, preferably when cows are given a new break.

- **Hay treatment**
  Magnesium oxide. Apply a slurried mixture of Mg oxide to hay - no more than 15 cows to one Mg-treated bale. This can be used in conjunction with pasture dusting. Molasses can make this slurry more palatable.

- **Water trough**
  Magnesium chloride or Mg sulphate. These can be used if no supplement is being fed or pasture is too short for dusting. They can also be used along with drenching or pasture dusting during periods of greatest risk. Use a dispenser; watch the concentration; introduce Mg gradually over two to three weeks.

- **Magnesium boluses**
  There are Mg bullets or boluses available for dairy cows. However, these only provide 2-3 g Mg/cow/day e.g. a 170 g Mg bolus that releases over nine to12 weeks will supply approximately 2-2.7 g Mg/cow/day. This is well short of the requirements for cow pre-calving and in early lactation.

Caution - Magnesium supplementation and Salmonellosis

There have been reports from New Zealand[1] and Australia[2] of *Salmonella* infections occurring in dairy cows that had received Mg supplementation, delivered as granules, prills, pellets, powder and via the drinking water.

The New Zealand case-control study[1] found that herds affected by Salmonellosis (gastroenteritis) tended to be larger and with a higher stocking rate than unaffected herds, although the difference was not significant. It was found that, compared to control animals that didn't receive any supplement, the likelihood of developing Salmonellosis was times greater for

[1] Stevenson, M et al (2012) Risk factors for acute salmonellosis in dairy herds: A case-control study in New Zealand 2011–12. VetScript November 2012, pp 56-58

[2] Morton, J (1993) Identification of factors contributing to severe epidemics of salmonellosis in dairy herds. Final Report for Project DAV 280. Melbourne, Australia: Dairy Research and Development Corporation.

cows receiving pelletised Mg and 6.2 times greater for cows receiving continuous trough treatment. The Australian study[2], which only considered Mg oxide powder, also found a relationship between the Mg supplementation dose and the incidence of Salmonellosis. Herds with a high incidence of Salmonellosis were more likely to have Mg supplementation rates of 20 grams per cow per day or greater, when compared with herds with a low incidence of Salmonellosis.

Although information exists to suggest that the use of Mg supplementation may be a risk factor in the development of clinical Salmonellosis, particularly for Mg oxide in the prill or granulated forms, the exact mechanism remains unclear. The current theory is that the extended presence of supplemented Mg in the rumen raises the rumen pH, which allows *Salmonella* to proliferate. It must be noted however that Mg oxide prills and granules are in widespread use in New Zealand, with only relatively few cases of Salmonellosis occurring, indicating the disease mechanism is likely to be multi-factorial and not necessarily predictable.

Before starting Mg supplementation of your dairy herd, consult your veterinarian to discuss the potential risks and to determine if there are any health or environmental factors that should be taken into consideration to reduce the risk of the development of Salmonellosis.

If Salmonellosis does occur in a herd being supplemented with Mg, farmers should notify their veterinarian and their milk processor. As Salmonellosis can also affect people, care needs to be taken to prevent spread to farm workers and their families. Sick animals should be separated and attended to after healthy animals, hands and protective clothing should be washed well after handling the animals, and people not required to directly care for the animals should keep away from the animals.

Further Reading

Information relevant to this Farmfact can also be found in the following resources:

DairyNZ FeedRight TechNote 13 – Monitor and mitigate milk fever. Accessed at: https://www.dairynz.co.nz/media/5789045/technote-13_web.pdf

Holmes, CW, Brookes, IM, Garrick, DJ, Mackenzie, DDS, Parkinson, TJ, & Wilson, GF. (2002) Milk Production from Pasture. Principles and Practices. Published by: Massey University, Palmerston North, NZ.

Kay, JK, Loor, JJ, Heiser, A, McGowan, J, and Roche, JR. (2015). Managing the grazing dairy cow through the transition period: a review. Animal Production Science. 55: 936 – 942.

Roche, JR, and Berry, DP. (2006). Periparturient climatic, animal and management factors influencing the incidence of milk fever in grazing systems. Journal of Dairy Science. 89: 2775 – 2783.

Roche, JR, Morton, J and Kolver, ES (2002). Sulfur and chlorine play a non-acid base role in periparturient calcium homeostasis. Journal of Dairy Science. 85: 3444 – 3453.

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