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Effect of a long acting injectable Vitamin B₁₂ on the Vitamin B₁₂ status of the suckling lamb

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ABSTRACT

Treatment of lambs with a long acting microencapsulated injection of 3 mg and 6 mg Vitamin B₁₂ at 3 to 4 weeks of age, at docking, will increase and maintain their Vitamin B₁₂ status for at least 120 days. This new product has the advantage over intraruminal Co bullets which can only be administered to 10 to 12 week old lambs with a functional reticulorumen while the injectable water soluble Vitamin B₁₂ is only effective for about 4 weeks and a Co drench is effective for about 10 days.

Keywords: sheep; Co deficiency; long acting Vitamin B₁₂.

INTRODUCTION

Cobalt (Co) deficiency is an important problem in New Zealand livestock, particularly in sheep (Grace 1994). The young lamb is most sensitive to Co deficiency and the synthesis of Vitamin B₁₂ by the micro-organism in the reticulorumen is dependent on the Co intake. In sheep grazing pastures with Co concentrations of < 0.08 mg/kg DM the amount of Vitamin B₁₂ synthesised and absorbed is inadequate to meet the Vitamin B₁₂ requirements of young sheep. As Vitamin B₁₂ is essential for the energy and protein metabolism of ruminants Co deficiency therefore has a marked effect on growth (Rice *et al.*, 1989; Kennedy *et al.*, 1992).

An annual spring topdressing with Co at the rate of 60 g/ha (e.g. 350 g CoSO₄·5H₂O/ha) will increase herbage Co content 5 to 8-fold for 6 to 8 weeks before it decreases to baseline concentrations during the next 6 to 10 months (Sherrell 1990). This approach is very effective on the North Island pumice soils but it is less effective on some other soils, for example in Southland, where high soil Mn concentrations can interfere with the plant Co uptake (Metherell 1989).

Alternative supplementation strategies include the intraruminal Co bullet, which if not regurgitated, will increase and maintain Vitamin B₁₂ status of sheep and cattle (Judson *et al.*, 1995). These bullets cannot be given to lambs younger than 10 weeks because the animals are too small and they do not as yet have a functional reticulorumen capable of synthesising Vitamin B₁₂ from elemental Co. The water soluble injectable Vitamin B₁₂ is only effective for about 24 days (Grace *et al.*, 1998) while a Co drench is effective for about 10 days (Field *et al.*, 1988).

AgResearch has developed a new, much longer acting injectable Vitamin B₁₂ microencapsulated in a copolymer of organic acids. This product is administered by subcutaneous injection into the anterior neck region and has been shown to increase and maintain serum and liver Vitamin B₁₂ concentrations in weaned lambs (Grace and Lewis 1999) and ewes (Grace 1999 unpublished data) for 250 days.

In the present study, the efficacy of this new animal remedy to increase and maintain the Vitamin B₁₂ status of 3

to 4 week old lambs was investigated because lambs, even though they are born to ewes with a high Vitamin B₁₂ status (i.e. serum Vitamin B₁₂ of > 1000 pmol/L), their liver Vitamin B₁₂ stores will become depleted by 4 weeks of age.

MATERIALS AND METHODS

Animals and Design

The study was carried out on the AgResearch Aorangi Research Farm, near Palmerston North where a marginal Co deficiency in lambs occurs. Soil type on the farm is Te Arakura sandy loam. Twenty one week old Romney Suffock cross lambs aged 3 to 4 weeks were randomly distributed among 3 groups of 7 animals each. Group 1 were untreated controls. Group 2 and Group 3 were injected subcutaneously with either 3 or 6 mg respectively of the microencapsulated Vitamin B₁₂, carried in 1 ml peanut oil. Details of the injection protocol have been described (Grace and Lewis 1999). Briefly the Vitamin B₁₂ is encapsulated in a copolymer of acids which are slowly hydrolysed thereby controlling the release of Vitamin B₁₂ for up to 8 months. All lambs and their dams were grazed on pasture as a single mob until weaning at 18 weeks of age.

Collection of samples

Blood was collected for serum Vitamin B₁₂ determinations just prior to treatment and again at 35, 82 and 126 days after injection. Pasture herbage samples were collected at about 4-weekly intervals for Co determinations. The pasture was not washed to remove the adhering soil as unwashed pasture reflects what was ingested by the sheep. The lambs were weighed at about 4-weekly intervals.

Analytical methods

Serum Vitamin B₁₂ concentrations were measured by the Becton Dickinson radioassay method (Millar and Alby 1984). Pasture Co was measured by graphite furnace atomic absorption spectroscopy (Jago *et al.*, 1971).

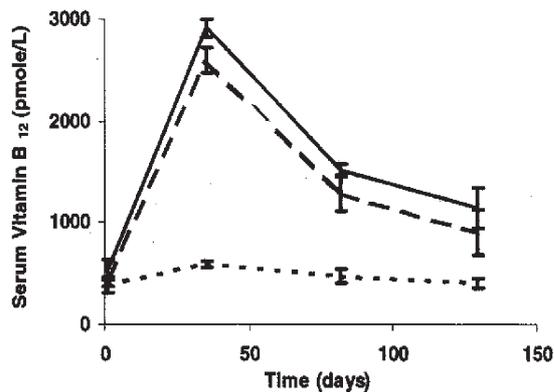
Statistics

Differences between treatments were determined by analysis of variance of repeated measures over time using the procedures of the Statistical Analysis System (SAS), 1987.

RESULTS

Pasture Co concentrations ranged from 0.07 to 0.15 mg Co/kg DM with lowest values in November. There were no treatment effects on lamb growth rate, and the mean (\pm SE) weight at weaning was 29.7 ± 1.08 kg. Serum Vitamin B₁₂ concentrations from day 1 through day 126 are shown in Figure 1.

FIGURE 1: Effect of a long acting injectable Vitamin B₁₂ on the Vitamin B₁₂ status of the suckling lamb. Control (----), 3 mg Vitamin B₁₂ (- - - -) and 6 mg Vitamin B₁₂ (____). Vertical bars represent standard error of the mean.



Serum Vitamin B₁₂ concentrations of the untreated lambs were lowest (383 pmole/l) at the start of the study, slightly higher (590 pmole/l) at day 35, and then gradually decreased to day 126 (407 pmole/l). The treated lambs show a marked increase in serum Vitamin B₁₂ concentrations (> 2500 pmole/L) to day 35 which then gradually declined to day 126. At day 126 serum concentrations of the 3 mg and 6 mg Vitamin B₁₂ treated lambs were still significantly greater from the controls ($P < 0.05$ and $P < 0.01$ respectively).

No tissue reaction was observed at the site of the injection.

DISCUSSION

Changes in serum and liver Vitamin B₁₂ concentrations were used to assess the Vitamin B₁₂ status of young sheep. Growth response to Co or Vitamin B₁₂ supplementation occur in lambs when serum and liver Vitamin B₁₂ concentrations are < 500 pmole/l and < 375 nmole/kg fresh tissue, respectively (Clark *et al.*, 1989). The lower the Vitamin B₁₂ status of the lamb then the greater will be the growth response to the Co or Vitamin B₁₂ supplementation. Increased Co intakes result in elevated serum and liver Vitamin B₁₂ concentrations (Somers and Gawthorne 1969). The observed increase and then the decrease in serum Vitamin B₁₂ concentrations of the untreated lambs reflects the changes in their Co intakes over the study period. While the Co content of pastures changes with season, botanical composition for example the clovers are higher in Co when compared to grasses, and the amounts of soil ingested, the influences of these factors on the intake of Co and the Vitamin B₁₂ status of the lamb are difficult to measure accurately (Grace 1994).

The efficacy of the new long acting injectable Vitamin B₁₂ was assessed in terms of changes in serum Vitamin B₁₂ concentration (Clark *et al.*, 1989). The 3 and 6 mg Vitamin B₁₂ doses increased and maintained serum Vitamin B₁₂ concentrations when compared to untreated animals for at least 126 days, after the suckling lambs were injected 3 to 4 weeks of age at docking.

The Vitamin B₁₂ status of the ewe influences that of the lamb by supplying Vitamin B₁₂ to the foetal liver as well as to the milk (Quirk and Norton 1987; Fisher and MacPherson 1991). As the liver Vitamin B₁₂ stores of suckling lambs are depleted in less than 40 days after birth and their dependence on milk for nutrients decreases, lambs in flocks grazing Co deficient pastures can become Co deficient in early life (Quirk and Norton 1987; Grace 1999 unpublished). Clearly the onset of Co deficiency is hastened in young lambs if Vitamin B₁₂ status of the ewe is low that is their serum Vitamin B₁₂ concentrations are < 500 pmol/L (Quirk and Norton 1987).

To ensure that lambs reach suitable liveweights for slaughter within 16 to 20 weeks, growth rates of at least 220 g/day must be maintained. In Co deficient flocks it is essential that the decreasing or low Vitamin B₁₂ status of lambs is increased early in life to ensure good growth rates and weaning weights. The new long acting Vitamin B₁₂ formulation developed by AgResearch can be easily injected at docking time and will remain effective until weaning and longer because the same formulations were shown to increase and maintain serum and liver Vitamin B₁₂ concentrations in weaned lambs for 250 days (Grace and Lewis 1999).

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