



A RESEARCH REVIEW™  
PRODUCT REVIEW

# SMARTShot® for Vitamin B12 Supplementation in Lambs and Ewes



Making Education Easy

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## About the expert



Andrew Roe

Andrew worked as a mixed practice vet in Central Southland for almost 30 years. With sheep, beef, and deer being the predominant farming types when he moved to the region, he developed a special interest in these areas of veterinary practice.

Following a move to Clutha Vets in 2018 he is now working with the farmers in South Otago, and is a team leader for the practice's sheep, beef and deer sector.

Andrew is involved in the wider agricultural industry through his facilitation roles with Beef + Lamb NZ and Deer Industry NZ. He is also the current editor of the *Grazing Gazette*, the newsletter of the sheep and beef cattle special interest branch of the NZVA, and represents the interests of sheep, beef, and deer vets on the NZVA's Standards Committee.

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This review is intended as an educational resource for veterinary health professionals and sheep farmers. It summarises relevant information regarding use of the long-acting vitamin B12 injection products, SMARTShot B12 and SMARTShot B12 plus Se, in the management of vitamin B12/cobalt deficiency with and without selenium deficiency in ewes and lambs. This review is funded by Virbac NZ.

## Biological role of vitamin B12/cobalt and selenium

Cobalt is essential for the synthesis of vitamin B12 (cobalamin) by ruminal microbes, with a deficiency of cobalt readily inducing vitamin B12 deficiency in ruminants.<sup>1,2</sup> Ruminal microbes can produce all of the vitamin B12 required by an animal provided that adequate cobalt is available in the diet. Vitamin B12 is a co-factor for enzymes involved in gluconeogenesis and amino acid synthesis.<sup>1,2</sup> Therefore, cobalt deficiency seriously impairs energy and protein metabolism in sheep.<sup>1</sup> Cobalt deficiency is characterised by appetite loss resulting in poor growth rates, including sub-optimal weight gain in lambs after weaning, and even death.<sup>3</sup> A high incidence of perinatal mortality has been observed in lambs born to cobalt-deficient ewes.<sup>4</sup>

Selenium is a component of many metalloenzymes and plays an important role in the cellular antioxidant system as well immune system integrity.<sup>2,3</sup> Selenium influences metabolism via its role in the synthesis of thyroid hormone and maintenance of reproductive tissues via its antioxidant role. A deficiency of selenium can result in productivity losses via slow growth rates as well as white muscle disease in lambs and infertility in ewes.<sup>2,3</sup>

## Cobalt and selenium mineral deficiency in NZ

Inadequate intake of cobalt and selenium by ruminants is prevalent in NZ.<sup>5</sup> Many NZ soils have been determined to be naturally deficient in cobalt, selenium, or both.<sup>6</sup> In an assessment of the mineral composition of NZ pastures, selenium dietary requirement for non-supplemented ruminant livestock was met by only 76% of pastures and cobalt dietary requirement by only 54% of pastures.<sup>7</sup> The main cobalt-deficient soils are in the central North Island, northwest Nelson, and certain regions of Southland.<sup>5</sup> Selenium-deficient soils exist primarily in the central North Island and east coast of the South Island.

## Timing of supplementation

The delivery of deficient trace minerals to grazing flocks at vulnerable phases of the lifecycle, particularly reproductive performance of ewes and the growth of lambs, is preferable to attempting year-round supplementation.<sup>5</sup>

Because most ovine trace mineral deficiencies occur in lambs, prevention is a valid management strategy.<sup>3</sup> To prevent the clinical manifestations of selenium deficiency, supplementing the ewe with selenium during early gestation is usually the best approach. Preventing vitamin B12/cobalt deficiency is the exception, with the best approach being to directly supplement lambs with vitamin B12 from docking onwards.

The vitamin B12 status of lambs is dependent on ewes supplying vitamin B12 to the foetal liver as well as to the milk.<sup>8</sup> As hepatic vitamin B12 stores of suckling lambs are depleted (within 40 days after birth) and their dependence on milk for nutrients decreases, lambs in flocks grazing cobalt-deficient pastures are at risk of becoming vitamin B12 deficient in early life. In cobalt-deficient flocks, direct supplementation of lambs with vitamin B12 at docking is preferred,<sup>3,8</sup> mainly because lambs should be treated as early as possible to ensure good growth rates and weaning weights.<sup>8</sup> Treating ewes during gestation only gives three to four weeks protection to their lambs.<sup>3</sup>

Taking advantage of selenium readily crossing the placenta and being secreted into milk, it is convenient to supplement ewes with selenium four weeks prior to mating to increase the selenium status of the ewe during gestation and lactation and her lamb until weaning or slaughter.<sup>3,5</sup> Otherwise, lambs at risk of selenium deficiency affecting their growth can be supplemented directly at the time of docking.

## Advantage of long-acting injectable supplements

Because the majority of sheep in NZ graze pasture year round, opportunities to administer trace mineral supplements via feeds and concentrates are limited.<sup>5</sup> In this setting, the duration of efficacy of supplement



products is an important consideration. Long-acting injections are one of the supplementation methods suited to year-round grazing livestock.

The use of long-acting injectable products enables sheep to be supplemented once a year, which can be timed to target lambs at docking or ewes prior to mating or early in gestation.<sup>5</sup> From a productivity standpoint, the extended efficacy duration of long-term trace mineral supplements reduces labour costs by avoiding the need for repeated mustering of animals and administration of treatments.

## SMARTShot B12 and SMARTShot B12 plus Se

SMARTShot B12 is a long-acting trace mineral injection, containing microencapsulated vitamin B12 (hydroxocobalamin hydrochloride) for extended release, with barium selenate if SMARTShot B12 plus Se is used.<sup>9,10</sup>

### Indication

For the long-term prevention and treatment of vitamin B12/cobalt deficiencies with or without selenium deficiency in lambs, ewes, and calves, especially livestock grazing cobalt-deficient pastures.<sup>9,10</sup>

### Mechanism of action

The gradual dissolution of the encapsulating polymer after injection produces a steady, prolonged release of vitamin B12 over a long period (≈180 days after administration), which is necessary for optimal energy and protein metabolism in ruminants.<sup>11-13</sup> The insoluble barium selenate creates a depot in the tissue that provides long-term supplementation of selenium, which is necessary for growth, immunity, and reproduction.<sup>3,5</sup>

### Dosage and administration

Using the SMARTShot injector, administer via subcutaneous or intramuscular injection in the anterior half of the neck only according to the following dose recommendations:<sup>11,12</sup>

<b>Lambs for docking</b>	<ul style="list-style-type: none"> <li>• 0.5 mL for lambs for slaughter</li> <li>• 1 mL for lambs as ewe replacements</li> </ul>
<b>Lambs at weaning</b>	<ul style="list-style-type: none"> <li>• 1 mL</li> </ul>
<b>Ewes</b>	<ul style="list-style-type: none"> <li>• 5 mL</li> </ul>
<b>Calves</b>	<ul style="list-style-type: none"> <li>• 1 mL per 25 kg liveweight</li> </ul>

### Precautions

SMARTShot B12 and SMARTShot B12 plus Se should not be administered to lambs less than three weeks of age.<sup>11,12</sup> Swelling that commonly occurs at the injection site is usually transient and should disappear within one month but may take up to three months to resolve.

### Toxicity

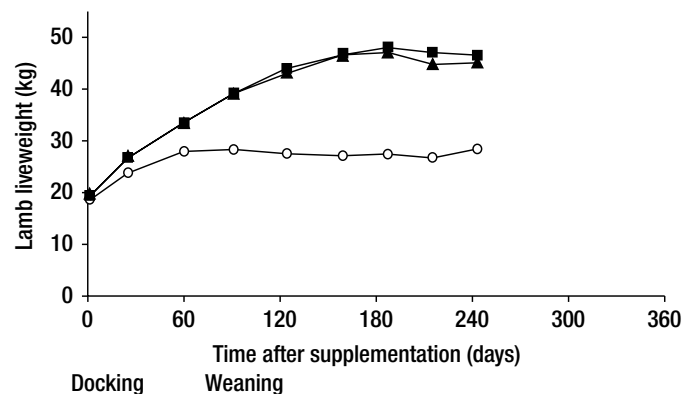
Trace mineral supplementation carries some risk of toxicity.<sup>5</sup> Excess vitamin B12 is excreted in the urine so toxicity is unlikely with vitamin B12 supplementation.<sup>13</sup> Excessive selenium supplementation can cause toxicity, the risk of which increases when multiple sources are administered. Given that SMARTShot B12 plus Se provides a sustained but low selenium peak serum level,<sup>5</sup> the additional peak following administration of an injectable short-acting or oral source may be less likely to reach toxic levels of selenium.<sup>13</sup>

### Efficacy

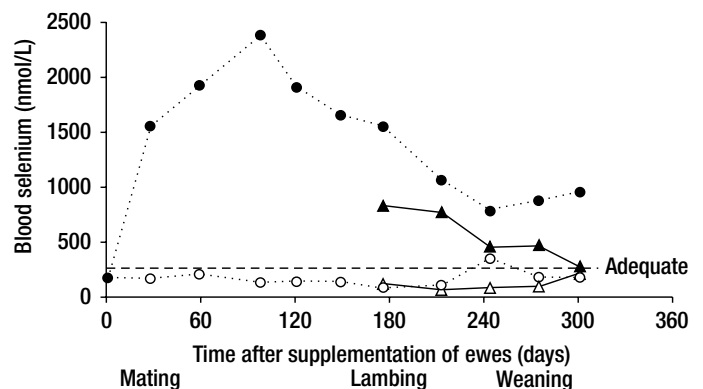
In flocks grazing cobalt-deficient pastures, treating ewes with a long-acting vitamin B12 supplement at mating prevented vitamin B12 deficiency in ewes, with levels of vitamin B12 increasing ≥70% in the liver and 270% in the foetal liver.<sup>14</sup> Liver vitamin B12 stores of the new-born lambs from vitamin B12-treated ewes depleted within 58 days, suggesting that supplementation at mating will prevent vitamin B12 deficiency until lambs can be treated at docking time. After suckling lambs were injected with long-acting vitamin B12 at docking when

3 to 4 weeks of age, serum vitamin B12 levels were increased and maintained compared with untreated animals for ≥120 days.<sup>8</sup> Long-acting injectable vitamin B12 has also been shown to significantly increase and maintain the vitamin B12 status (serum and liver levels) of weaned lambs for ≥210 days.<sup>15</sup>

Growth benefits have been demonstrated in 3- to 5-week-old lambs from a flock grazing cobalt-deficient pastures that received long-acting vitamin B12 at the time of docking (**Figure 1a**).<sup>1</sup> Mean growth rates were increased by ≥116 g/day above that of untreated controls for 6 months, and liveweights were maintained for 8 months. Serum vitamin B12 levels increased as much as 18-fold, peaking at day 25. The growth response was similar to that achieved with long-acting vitamin B12 in 4-week-old lambs in an earlier similar study conducted on the same cobalt-deficient pastures.<sup>16</sup>



**Figure 1a.** Effect of no treatment (○) or subcutaneous injection of long-acting vitamin B12 (0.15 [▲] and 0.30 [■] mg/kg LW) on liveweight when administered directly to cobalt-deficient lambs at docking time.<sup>1,5</sup>



**Figure 1b.** Effect of no treatment (○) or subcutaneous injection of selenium as barium selenate (●) administered to ewes 4 weeks prior to mating on serum selenium levels of ewes (○, ●) and their lambs (△, ▲) from birth to weaning.<sup>5,17</sup> Adequate selenium status: blood level >250 nmol/L.

In a dose-response study, injecting selenium-deficient ewes with long-acting vitamin B12 plus selenium at 4 weeks prior to mating increased and maintained the ewes' selenium status for ≥300 days (serum and liver levels) as well as that of their lambs from birth to weaning (milk, serum, and liver levels) [**Figure 1b**].<sup>17</sup> Vitamin B12 status was maintained for ≥176 days in ewes (serum levels) and in lambs (serum and liver levels) for up to 37 days after birth. The increases in selenium and vitamin B12 levels were predictable and proportional to the dose administered, suggesting that supplementation can be tailored to the severity of the selenium or cobalt deficiency in a flock.



## EXPERT'S CONCLUDING COMMENTS

When it comes to helping our sheep farmer clients prevent vitamin B12/cobalt deficiency in their stock, one of the biggest challenges, compared to dealing with deficiencies of other trace elements, is the variability and unpredictability of cobalt levels in their pastures. Due to a range of factors, the timing and severity of deficiency can vary from year to year, farm to farm, and even across different parts of the same farm.

SMARTShot takes away all the guesswork around vitamin B12 supplementation. Given at tailing, and lasting for six months (or for the life of most of your finishing lambs, if a 0.5 mL dose is used) farmers in my area (southern South Island) can be confident that the vitamin B12 with/without selenium requirements of their lambs will be met for the whole of the period where cobalt levels may be low in their pastures. And, for those farmers in areas that experience more severe cobalt deficiency, there is the option

to treat the ewes as well, to ensure that their lambs start life with adequate vitamin B12 reserves.

Convenience is the other important benefit of SMARTShot. While it may be possible to achieve similar results using repeated injections of short-acting vitamin B12 and selenium products, the need to yard the lambs monthly as well as the extra work around administering multiple injections, not to mention the increased risk of injection-site lesions, all add to the appeal of SMARTShot.

From a veterinary perspective, SMARTShot is a great product and I do not believe that anyone would dispute its effectiveness. Our challenge is to point out to our farmer clients the value, in terms of productivity, reliability, and convenience, of investing in a long-acting vitamin B12 and selenium treatment for their lambs.

## TAKE HOME MESSAGES

- Vitamin B12/cobalt and selenium are important for the development and productivity of flocks grazed on NZ pastures.
- About 45% and 25% of NZ pastures, respectively, will not provide adequate cobalt and selenium for grazing livestock.
- Because lambs should be treated as early as possible to prevent deficiencies of vitamin B12/cobalt or selenium, preference should be given to injecting at docking time.
- SMARTShot is a novel form of long-acting vitamin B12 injection with or without selenium for vitamin B12/cobalt and selenium supplementation in sheep.
- In studies of cobalt- and selenium-deficient flocks:
  - Following a single long-acting vitamin B12 injection of lambs at docking, vitamin B12 levels were increased and maintained at adequate levels for 3-4 months until time of slaughter. Mean growth rates were increased above that of untreated controls for 6 months and liveweights maintained for 8 months.
  - Following a single long-acting vitamin B12 plus selenium injection of ewes pre-mating, adequate levels of vitamin B12 were maintained for 180 days and levels of selenium for 300 days. Adequate levels were maintained in their lambs until 1 month of age for vitamin B12 and until weaning for selenium.

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