



SMARTSHOT® – SUPPLEMENTATION WITH LONG-ACTING VITAMIN B₁₂ AND SELENIUM



INTRODUCTION

Cobalt and selenium are well recognised as essential trace elements for successful sheep farming in New Zealand. Vitamin B₁₂ injections are commonly used to ensure optimal growth of lambs, and selenium is often incorporated in regions with soil deficiencies.

While the greatest requirement is in lambs, there are also niches for injectable B₁₂ in hoggets and adult sheep, and to a lesser extent cattle, and a need for selenium in both species. There are many options for supplementation, including short and long-acting

products as well as combinations with other treatments such as vaccines or drenches. Understanding the science behind these options is important for making informed decisions and recommendations to farming clients.

SHORT-ACTING VITAMIN B₁₂ AND SELENIUM INJECTIONS

The definitive New Zealand research on short-acting B₁₂ injections in sheep was conducted in 1998 by Neville Grace et al.¹ In this peer-reviewed study weaned Romney lambs on a cobalt deficient diet were treated with 2 ml of subcutaneous Prolaject B₁₂ 1000 (Bayer Animal Health). Liver and serum B₁₂ levels were elevated rapidly (by day 2 in serum and day 8 in liver), and both were not significantly different from controls by day 24.

Based on this research it is widely accepted that in NZ conditions vitamin B₁₂ injections will last as little as 4 weeks in deficient lambs, with label claims for registered products for 4-6 weeks of elevated B₁₂ levels.

As such the recommendation of Grace and other nutritionists (including Beef and Lamb NZ)^{2,3} is to use short-acting B₁₂ products monthly to avoid falling

into marginal deficiency between treatments, and to maintain optimal production.

Short-acting selenium (sodium selenate or selenite) injections have a similar duration of action to vitamin B₁₂ of 4-7 weeks². This similarity and the often dual requirement for these trace elements makes B₁₂ and selenium a useful and widely used injectable combination.



LONG-ACTING VITAMIN B₁₂ AND SELENIUM

In the 1990s Neville Grace and his AgResearch colleague Scott Knowles identified an opportunity for a long-acting vitamin B₁₂ injection for lambs, potentially in combination with selenium. Their aim was to develop a product that would allow a single injection to get a lamb to slaughter, or to take a replacement through its highest demand period.

A secondary possibility of a treatment that could be used pre-mating in ewes to provide trace elements throughout the pregnancy and to the new-born lamb was also identified.

At the time there were intra-ruminal cobalt and selenium boluses that could fill this niche, however they were difficult to administer and not an option in young lambs, plus absorption from oral sources can be

inconsistent. Injectable long-acting barium selenates also had dose rates that were more targeted to cattle, making them impractical for small lambs.

Since there was no other long-acting B₁₂ injection worldwide, Grace and Knowles had to design a unique Kiwi technology. Eventually they developed microspheres – as the name suggests tiny beads, which contain vitamin B₁₂ inside them (Figure 1).

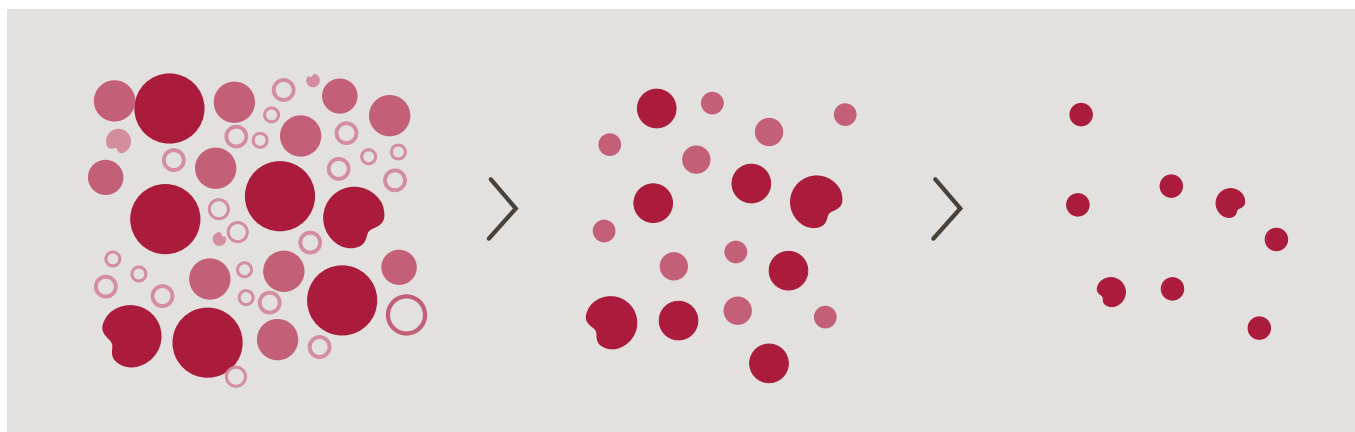


Figure 1: The body absorbs microspheres according to their size. Smaller microspheres are broken down in body fluids faster than the larger, thus sustaining the B₁₂ release over time.

These are made of a polymer of amino acids (similar to dissolvable sutures), which slowly breaks down until the microsphere ruptures, releasing the B₁₂ inside.

Smaller spheres break down more quickly, so if different sizes are incorporated at known ratios the release profile can be controlled over a long period (Figure 2).

Barium selenate is then added to the oil surrounding the microspheres to provide the long-acting selenium.

This new technology was registered in 2003 as SMARTSHOT[®], which is now manufactured by Virbac in Hamilton. It remains a unique product globally and is still owned and supported by AgResearch.

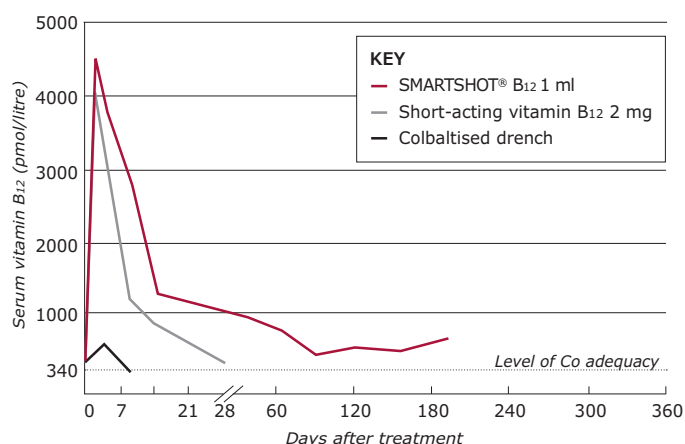


Figure 2: Duration of Elevated Serum Vitamin B₁₂ After Administration of Oral, Short-Acting and Long-Acting Treatments.



RESEARCH

LAMBS

SMARTSHOT® is one of the most researched trace element products in New Zealand. There are numerous papers supporting its use, across various stock classes. Given the highest requirement for vitamin B₁₂ is in lambs, research in this area is the most important commercially.

The initial trial work in lambs supports the efficacy of the emerging microsphere technology^{4,5}, and shows the effect of different doses on liver and serum vitamin B₁₂ and selenium. From these studies it was established that a 1 ml dose of SMARTSHOT® provides 6 – 8 months of vitamin B₁₂ and selenium. Halving the dose to 0.5 ml also halved the duration of action to 3 – 4 months, creating an option for use in lambs destined for early slaughter.

Later research looked at the growth responses where SMARTSHOT® was used in cobalt deficient Romney lambs in Southland⁶. After 243 days there was a 17 kg difference in liveweight ($p < 0.001$) between untreated animals and lambs given a 1 ml dose of SMARTSHOT® at docking/ tailing (Figure 3).

While the untreated animals in this trial were clearly clinically deficient, this and other research on animals with more

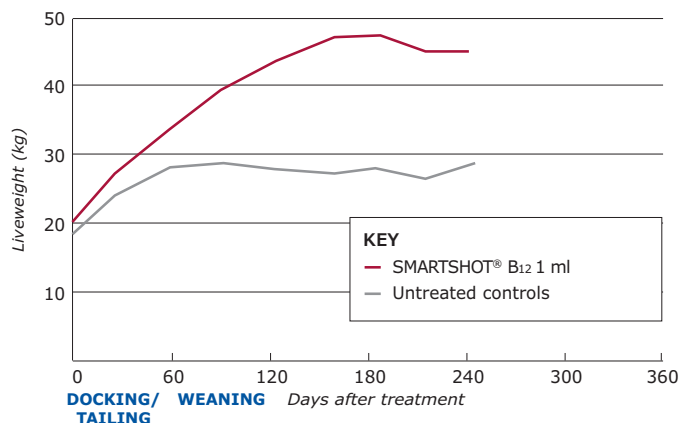


Figure 3: Growth Responses in Cobalt Deficient Lambs Treated With 1 ml of SMARTSHOT® at Docking/Tailing

marginal deficiencies demonstrates the substantial financial benefit of effective and sustained B₁₂ supplementation.

The 4 kg liveweight difference seen by weaning (two months after treatment) also supports the recommendation by Grace and Beef and Lamb NZ^{2,3} to treat at docking/tailing rather than weaning for optimal growth.

EWES

Research in ewes has focussed on pre-mating and pre-lambing use. In one study a 5 ml pre-mating dose in Romney ewes was sufficient to sustain B₁₂ levels for the duration of pregnancy, and to elevate the B₁₂ levels in their lambs for four weeks⁷. In deficient flocks this can improve lamb birthweights and survival, as well as improving the early growth of the lamb through increased milk production in the ewe and higher B₁₂ levels in milk⁸.

A subsequent study titrated doses of 3 ml, 4 ml and 5 ml in 60 – 70kg Poll Dorset ewes⁹. This demonstrated that the principle of using a lower dose to reduce duration of activity applies in ewes as well as lambs, which may create an opportunity to use a less expensive and shorter acting dose pre-lambing (Figure 4).

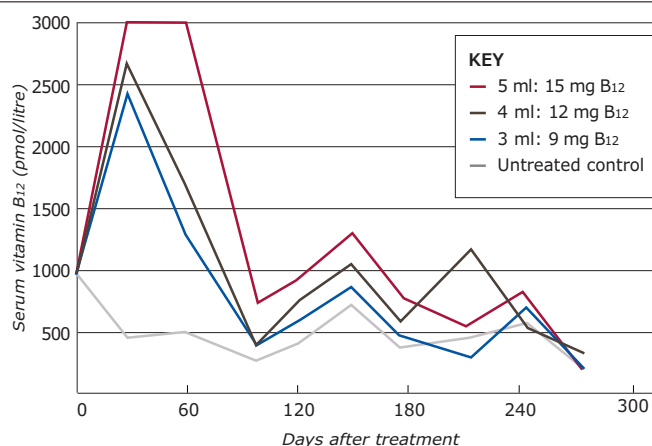


Figure 4: Serum Vitamin B₁₂ Concentrations in Ewes After Varying SMARTSHOT® doses.

CATTLE

SMARTSHOT® is on label for calves at a dose rate of 1 ml/25 kg, and studies in calves and adult dairy cattle^{10,11,12} have shown consistently elevated B₁₂ levels, although they failed to demonstrate any production benefits.

Since the animals in these studies were not considered to be clinically deficient there may still be benefits where deficiency is diagnosed – although this is less common in cattle than in sheep. Use of the selenised version may also be an advantage, particularly in growing calves.



TOXICITY

Toxicity is extremely unlikely with vitamin B₁₂ (hydroxocobalamin), as any excess is excreted in urine. In humans hydroxocobalamin is defined as non-toxic, and IV doses of up to 5 g (i.e. 5000 x 1 mg doses) are used to treat smoke inhalation without major side effects¹³.

Most veterinarians will be wary of selenium toxicity, particularly where multiple sources are administered. The barium selenate dose in SMARTSHOT® B₁₂ Plus SE provides a sustained but low peak serum level¹⁴, so the additional peak of an injectable short-acting or oral source is less likely to reach toxic levels (Figure 5).

Best practice is always to avoid multiple sources of selenium, however the risk of toxicity is low if other selenised products are used subsequent to SMARTSHOT® B₁₂ Plus SE.

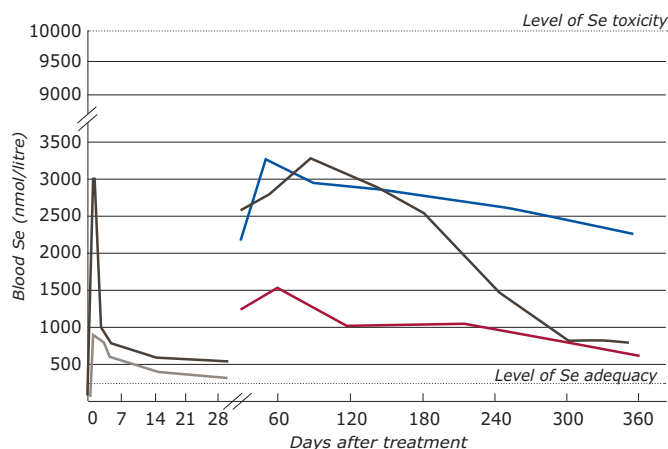


Figure 5: Toxicity levels of Se Supplements

KEY

- Long-acting Se injection (1 mg Se/kg LWT, as barium selenate)
- Se fertiliser (10 g Se/ha)
- Se bolus (10 g bolus, as 10% Se: 90% Fe)
- Selenised drench (0.1 mg Se/kg LWT, as sodium selenate)
- Selenised vaccine (0.1 mg Se/kg LWT, as sodium selenate)

SUMMARY

The SMARTSHOT® technology is a world-leading and unique form of long-acting vitamin B₁₂ and selenium. The consistent maintenance of trace element levels provides a reliable and versatile method of trace element supplementation in multiple stock classes, which is supported by peer reviewed research.

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