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The Prevention and Treatment of Trace Element Deficiencies in Sheep and Cattle

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ABSTRACT

Factors to be considered in implementing a programme for the prevention and treatment of trace element deficiencies in livestock are outlined. These are species, age, dietary requirements, seasonal patterns in the deficiency, the pharmacology of the therapeutic agent, its mode of administration and cost. Specific treatment of cobalt, selenium and copper deficiency is discussed.

INTRODUCTION

There are many factors to be considered when recommending a programme for the treatment and prevention of trace element deficiencies. There is no universal recommendation that will cover all conditions, and yet there is a place for most therapeutic agents available.

The intention in any control programme is to ensure that the trace element status of the animal is adequate at all times. It is essential to initially determine the trace element status of the class of animals under consideration. It is then necessary to determine the trace element content of the diet and its availability. From this data and from knowledge of the requirements of the animal, a treatment programme can be introduced that will supplement the dietary shortfall. Not only must the diagnosis determine the trace element status of the animal but it should also endeavour to determine the cause of that deficiency. In some cases removal of the cause will correct the problem so that it is not necessary to introduce trace element supplementation e.g., the cobalt/parasite interaction. Although this paper is confined to the trace elements cobalt, copper and selenium, the same principles must be considered for other deficient elements.

The following factors must be considered when recommending a particular therapeutic agent: the species of animal to be treated, its age and dietary requirements; the seasonality of the deficiency in the diet; the effectiveness of the product, the pharmacology of the drug; its ease of administration and the cost. The species of animal is important as whole-farm medication can be very expensive if only a small percentage of the animals require treatment. For example, the copper requirement for cattle is 50% greater than that for sheep and on the majority of copper 'deficient' farms in New Zealand only the cattle require supplementation. The age of the class of stock to be treated

is important. For example, growing beef weaners have a much greater demand for copper than do 3-year-old steers. In sheep, cobalt deficiency is primarily a disease of lambs immediately after weaning.

Time of Treatment

The seasonality of a trace element deficiency must be recognised. Variation in pasture levels can occur, especially in winter when copper levels are at their lowest. Dietary demands may increase as in late winter, or animals may be grazing on a different class of country often with pasture of a poorer quality and lower trace element content.

Under some conditions a therapeutic agent may be ineffective. This may occur in the oral supplementation of copper salts when the problem is interference from a high dietary content of molybdenum and sulphur. These inhibiting elements will react in the rumen and cause the copper to be precipitated and not be absorbed by the animal. Similarly, the administration of cobalt to lambs that are not eating, or to lambs that have just had a change of diet, will be ineffective as there will not be a sufficient population of ruminal bacteria present to convert the cobalt into vitamin B₁₂.

Pharmacology

The pharmacological characteristics of each therapeutic agent are unique to that compound. Any alteration to it can markedly alter these characteristics. This is illustrated with the parenteral copper compound—copper calcium edetate. When administered in the correct concentration, over a range of dose rates, it has an absorption rate that is quite safe to the animal. However, if that compound is diluted in the same volume of water, the absorption rate is increased almost 3-fold. Similarly if the biochemical status of the animal is altered, the absorption rate can be changed. Again using copper calcium edetate as an

example, experiments have shown that withholding food from sheep for 48 hours prior to injection, resulted in an absorption rate 4 times greater than that in animals that had feed available at all times. Therefore it is most important that the recommendations of the manufacturer be strictly adhered to.

Cost

Cost is foremost in everybody's mind today and must be considered. It should first be determined whether trace elements are necessary. The cost of a monitoring programme is much cheaper than unnecessary treatment, but conversely, a preventive course is much cheaper than the cost of salvaging animals that have been allowed to become deficient. It is only from the use of adequate data that an effective programme can be recommended. The case can be cited of a farm on which it was suggested that copperised superphosphate be applied to the whole farm to counter copper deficiency in the cattle. The cost to the farmer would have been \$2,400. However an alternative programme based on knowledge of the copper status of the cattle, sheep and pastures recommended injecting the cattle at a cost \$175 and the copper deficiency was alleviated.

Administration

The routes of administration of therapeutic agents are varied. Whole farm administration can occur by adding the required trace elements to fertiliser. With reticulated water supplies it is possible to medicate the water using metering devices. The incorporation of trace elements in salt licks is often used on extensive farms. However about 25% of animals do not lick these blocks, and about 25% take excessive amounts. Therefore some animals may receive no additive and some animals may receive a potentially toxic dose.

Trace elements can be administered by individually dosing each animal. This is a practical method provided the animals are being drenched for other purposes and that the trace element is compatible with the drench base. Because of the ruminant system of our production animals it is possible to administer boluses of a high specific gravity containing the required trace element. These boluses dissolve during the following 3 to 6 months allowing a slow and regular release into gastrointestinal tract.

Parenteral treatment of animals has many benefits. The element is immediately available to the animal—often at high doses, it can by-pass the gastrointestinal tract and it can be readily administered to all classes of stock. However it must be given in a slow-release base or be able to be held in a depot in animal tissue. Also, injectables can be toxic and are normally more expensive.

Cobalt

Cobalt is required almost daily in the animal diet as

the body can only store vitamin B₁₂ for a short period. Therefore most treatment regimes aim to supply cobalt daily. This may be provided in the diet by adding cobalt to the topdressing. In New Zealand the application rate is 0.35 to 1.5 kg/ha depending on soil type and on the requirement for cobalt. Liming and drainage of soil will reduce the plant uptake of cobalt. Application of cobalt with topdressing is convenient but expensive as only 2 to 4% of the applied cobalt is utilised by the plant. On those farms where cobalt deficiency does not occur every season, some farmers apply cobalt to a small area of land and then give the lambs preference on this block of land in years of low cobalt availability.

Cobalt sulphate given as a drench is convenient and effective if it coincides with management. Monthly dosing of 200 mg is effective, but expensive when compared to a weekly dose of 7 mg. The use of slow release boluses is again coming into prominence as the animals only require 1 treatment. Cobalt bullets have fallen from favour as they have a 20% rejection rate.

Vitamin B₁₂ injection is expensive, although the development of high potency slow-release formulations may make these acceptable alternatives. Certainly if animals are affected with clinical cobalt deficiency they should receive vitamin B₁₂ to get them back to full appetite as soon as possible. Oral cobalt should then be used to ensure daily requirements are met.

In many cases cobalt deficiency and gastrointestinal parasitism will affect an animal concurrently. Therefore a parasite control programme should be initiated at the same time. In some cases the removal of parasites will allow the animal to utilise available cobalt without any further supplementation.

Selenium

Selenium is an essential element required in many areas of New Zealand, but it is also a very toxic substance if used in excessive amounts. Animals should never receive selenium from 2 different sources at the same time.

Recently selenium prills applied at the rate of 10gm of Se/ha have been approved and have been shown to increase selenium levels in the animal for 12 months. Some people are now advocating the use of prills as strips covering 20% of the paddock. This method of application can be costly on extensive properties but it may be the most convenient on others.

The use of oral and injectable selenium is convenient as it is normally added to drenches or vaccines. Care must be taken in dilution of selenium concentrates and the mixing of selenium with the base product. When selenium was first added to anthelmintics, animals were drenched only 4 or 5 times a year. Now some farmers are using anthelmintics up to 15 times a year, incorporating selenium in every dose. The wisdom of

such a practice must be questioned as it may lead to potential toxicity.

Copper

Copper is the most complex of all the trace elements and also probably the most widely used. Because of its complexity, effective supplementation must be determined for each individual farm. As the absorption and utilisation of copper is inhibited by many other elements and factors, the treatment regime prescribed should aim to circumvent the site of inhibition. Copper topdressing will raise the copper content of plants growing in some soils. Unfortunately these areas are often not associated with copper deficiency. Soils containing a high content of organic matter or soils that are of a high clay content will bind up any applied copper making it unavailable to the plant.

Oral copper treatment, either as a drench or in the water supply may be subjected to inhibition in the rumen by the high dietary content of molybdenum, sulphur or iron. There are some special circumstances under which daily supplementation of copper in the diet is the only effective form of treatment. The slow release copper becoming available is in the form of copper oxide needles which are given to the animal as a bolus. This dissolves and the needles go through the rumen and stay in the abomasum. They are then slowly dissolved in the acid environment of the stomach over 2 to 3 months.

Parenteral treatment of animals with copper is effective in increasing the storage levels of copper in the liver. It is more expensive than oral treatment but under some situations is the only satisfactory method. Several products are available and they vary in their dose rate and the amount of reaction at the injection site. As mentioned earlier, animals that have been without food and water for more than 24 hours must not be injected with copper compounds.

Conclusion

Trace elements are essential for animal health. The first priority in considering supplementation is to establish a diagnosis. If animals are of a low status then the cause must be established. Then it should be possible to recommend a preventive programme. Once a treatment regime has been given it is necessary to continue to monitor that farm and its animals to ensure the treatment is effective and whether continued supplementation is necessary.

Although trace elements are commonly used, care must still be taken in their use. It is important to follow the recommended programme and not to exceed the manufacturer's recommendations. Trace elements are expensive and in excessive amounts are invariably fatal. The current practice of treatment of large numbers of animals on a single occasion, may induce toxicity that could cause many deaths.