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Assessing stock feed additives and mineral supplements

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As a producer of beef, wool or lamb there are many stock feed supplements and additives to choose from, but how do you decide on the products that will benefit your stock and profit?

The following checklist can be used to assess the usefulness and economic benefit of stock feed additives and supplements.

This information sheet does not attempt to cover all mineral and vitamin requirements of grazing or intensively fed ruminants. Recommendations and values listed should be considered as a guide only. The analysis of all sources of feed and the use of independent nutritional advice are highly recommended.

Vitamins, minerals and requirements

As many as 14 different minerals are needed by ruminants to maintain sound health and production. Some are required in relatively large amounts and form a significant proportion of the body. Such minerals are often classed as macro minerals. Others are required in much smaller amounts and are known as micro minerals or trace elements. Micro minerals generally assist or increase the rate of chemical reactions within the animal's body.

There are significant interactions between minerals and vitamins and differences in availability can be unpredictable. It is therefore difficult to clearly define recommendations for supplementation.

In most circumstances, grazing ruminants will obtain the bulk of their requirements from pasture. The concentration and availability of minerals and vitamins depend on pasture composition, soil type, climatic conditions and stage of maturity, as well as the grazing selectivity of the animals.

The range of minerals considered necessary for maintenance through to rapidly growing, pregnant or lactating stock (higher values) is shown in the following table. Values shown are a guide only.

The Primefact *Mineral content of common ruminant stockfeeds, crops and pastures* outlines mineral composition data for a range of concentrates, mineral supplements, pasture, silage, roughages and by-products. It can be accessed at www.dpi.nsw.gov.au/primefacts

While it is beneficial to know a feed's mineral and vitamin content and availability you should also consider requirements and differences due to foraging behaviour, age, genetic variability and stage of production effects. For example, Merinos are considered to be more susceptible to iodine and selenium deficiencies but less susceptible to copper deficiency or toxicity than some British breeds.

With respect to age-related issues, adult or mature animals may have sufficient reserves of many vitamins and minerals, allowing them to tolerate periods of deficiency, whereas young stock may have inadequate reserves and may require supplementation.

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Macro and micro mineral requirements for ruminants

	Sheep	Cattle
Macro minerals (g/kg DM)		
Calcium	1.4 – 7.0	2.0 – 11.0
Phosphorus	0.9 – 3.0	1.0 – 3.8
Chlorine	0.3 – 1.0	0.7 – 2.4
Magnesium	0.9 – 1.2	1.3 – 2.2
Potassium	5.0	5.0
Sodium	0.7 – 1.0	0.8 – 1.2
Sulfur	2.0	1.5
Micro minerals (mg/kg DM or ppm)		
Cobalt	0.11 – 0.15	0.07 – 0.15
Copper	4 – 14	4 – 14
Iodine	0.5	0.5
Iron	40	40
Manganese	20 – 25	20 – 25
Selenium	0.05	0.04
Zinc	9 – 20	9 – 20

* ppm = parts per million
*Lower values – maintenance
*Higher values – growing, pregnant or lactating animals

Source: Freer, M (2007). Nutrient requirements of domesticated ruminants

Macro minerals – roles and availability

Pasture and fodder crops usually contain sufficient minerals and vitamins for normal ruminant production. Minerals and vitamins are generally not the first limiting factor that negatively impact on intake and performance. Dietary energy and protein must first be addressed and consumed in quantities appropriate for the class of stock being fed.

The following are those minerals and vitamins considered essential for normal rumen function and animal performance.

Calcium (Ca)

Found in bones (about 99% of total body Ca), teeth and intracellular fluids, calcium is important for nerve function, muscle contraction, blood clotting, activation of a number of enzymes and bone formation. It is found in stems and leaves of herbage and is seldom deficient in soils. Availability does not decline with maturity of plant but deficiency can occur on acid or sandy soils when animals are grazing forage consisting of rapidly growing grasses or cereals or when grain supplementation is high.

Calcium deficiency can occur in stock grazing oat crops in winter but this is often best treated using vitamin D due to the interaction between Ca:P balance and vitamin D (see the section on Vitamins). This phenomenon may account for the commonly held belief that animals grazing cereal crops in winter will do better if fed hay since most sun-ripened hay is sufficiently high in vitamin D.

Deficiency symptoms include milk fever, lethargy, weak bones and (in concert with low vitamin D) poor growth.

Phosphorus (P)

Phosphorus is found predominantly in the bones (about 80%) saliva and major metabolites (e.g. nucleic acids) and is important for cell membranes, energy production, muscle contraction, appetite and bone formation. While phosphorus deficiency in sheep is uncommon, it is relatively common in cattle grazing pastures growing on low-P soils, particularly when pastures are dominated by low quality dead grass with little or no legume. Deficiency signs include slow growth rates, decreased appetite, listlessness and poor fertility.

Adequate dietary vitamin D is essential for the correct metabolism of calcium and phosphorus. The role of vitamin D is covered later.

Magnesium (Mg)

Approx 70% of a ruminant's magnesium is stored in the skeleton. Growing lambs can use this stored magnesium to offset a Mg deficient diet but it is generally poorly remobilised, particularly in older animals. Magnesium is an activator of over 300 enzyme systems and is involved in the metabolism of carbohydrates, lipids and protein. It has roles in nerve conduction and muscle contraction.

Deficiency symptoms often include muscular spasms, trembling and nervousness manifest in the condition known as hypomagnesaemia or grass tetany. Adequate fibre, sodium intake and energy within the diet will aid in reducing deficiency issues. Proportionally high intakes of potassium (K), Ca, P and organic acids may *decrease* Mg availability. High K found in lucerne stands growing in high K soils may induce a magnesium deficiency and supplementation may be required. Excess dietary Mg may cause damage to the rumen, scouring, reduced feed intake and lethargy.

CausMag is generally considered a suitable supplement when magnesium is deficient.

Potassium (K), sodium (Na) and chlorine (Cl)

These all have roles in maintaining acid:base balance and the control of body fluids. Potassium is essential for plant growth and so available herbage is usually at least adequate in K even when grown on K deficient soils. Deficiencies of sodium and chlorine are possible, however, particularly in arid areas where pastures, grains and seeds may be abnormally low in sodium. Deficiency symptoms may include ill thrift, pica (bone chewing) and anorexia. Salt licks are generally the primary means of correcting deficiencies.

Sulfur (S)

Sulfur, along with nitrogen, is essential for protein synthesis and growth of rumen microbes. In general, if dietary protein is adequate dietary sulfur is also likely to be adequate. However, if dietary protein deficiencies are overcome by the use of a non-protein nitrogen source alone (e.g. urea) sulfur can often become the factor most limiting rumen microbial growth.

Sulfur amino acids (SAA) are particularly important in sheep nutrition as wool comprises about 4% sulfur. Adding extra sulfur to the diet of sheep will not necessarily increase SAA supply for wool growth and for best response SAA should be fed directly to the animal in a form which will bypass breakdown in the rumen. Deficiency symptoms in sheep include reduced wool production, lack of crimp and poor fleece characteristics.

Micro mineral requirements

The most important micro mineral deficiencies are generally thought to be selenium, cobalt, copper, iodine and possibly zinc. Roles, dietary source and deficiency symptoms of these are discussed below.

Selenium (Se)

The only known role of Se is in the destruction of peroxides and consequently protecting tissues against oxidation (damage). Vitamin E (see below) acts by preventing peroxides forming and both have a role in preventing white muscle disease, muscular dystrophy, ill thrift and infertility in ewes. Symptoms may include poor growth rates, decreased wool production and scouring.

Selenium is not required for plant growth, so conditions that favour increased pasture growth in selenium deficient soils will predispose animals to deficiency, since the uptake of selenium by plants is incidental to their uptake of nutrients essential for plant growth. Clover-dominated pasture and highly fertilised pastures in general tend to lead to lower concentration of selenium in plant tissue and potential deficiency in grazing animal diets. The syndrome can occur on both basalt and granite derived soils, acid sandy soils, high fortified super-phosphate or gypsum use and clover dominant pastures may induce a selenium deficiency. Supplementation may include rumen bolus, injections, fortified anthelmintic drenches and subcutaneous slow release formulation.

Cobalt (Co)

While cobalt is not directly utilised by ruminants, its dietary requirement relates to its role as a precursor for synthesis of vitamin B_{12} by rumen micro-organisms. The effect of deficiency is manifested as a vitamin B_{12} deficiency.

Coastal, calcium rich or sandy soils are commonly low in cobalt **but ill thrift due to deficiency of** cobalt/vitamin B12 has also been observed on the tablelands. Excessive lime and lush pasture growth may also lead to deficiency symptoms. Symptoms include ill thrift, weepy eyes, anaemia, scaly ears, and infertility and poor mothering in ewes.

Cobalt / vitamin B_{12} deficiency is also associated with phalaris staggers and it has been found that chronic forms of staggers can be prevented through treatment with cobalt or vitamin B_{12} directly.

Supplementation may include slow release rumen bullets, vitamin B_{12} vaccination or loose licks.

Copper (Cu) and molybdenum (Mo)

Copper is an essential part of several enzymes and is required for body, bone and wool growth. Grasses tend to contain more copper than clover-based pastures and availability is higher from dry feed than green herbage. High intakes of sulfur, zinc, iron, cadmium and calcium can decrease the availability of copper, although it has been shown that excess molybdenum is the main factor linked to copper deficiency.

Care must be taken to ensure that copper toxicity does not occur from supplementation since toxic levels are only slightly above the upper end of the target dietary intake range.

Toxicity effects may be exacerbated where liver function has been compromised by intake of alkaloids from plants such as Paterson's curse, sencio spp (fireweed / groundsel / ragwort) and blue heliotrope. This condition also interacts with supply of cobalt since high rumen concentrations of vitamin B_{12} can serve to detoxify these alkaloids before they can cause any damage.

Zinc (Zn)

Zinc has a role in enzymes and their involvement in carbohydrate metabolism and protein synthesis. It is

constantly required in the diet as the body does not have significant mobilisable reserves.

Deficiency symptoms may include excessive salivation, loss of wool crimp, loss of hair or wool around mouth and eyes, stiff joints, scaly and dry skin, slow wound healing and inappetence leading to reduced growth rates. Poor testicular growth and infertility are also symptoms commonly found with zinc deficiencies.

Vitamins – roles and availability

Vitamin A

Vitamin A is needed for normal bone development, maintenance of epithelial cells (cells which line the body cavities) and night vision. It is produced via conversion from beta-carotene which is found in green feed and is stored in the liver. Deficiencies, although rare, may occur during a prolonged period of drought or grazing dry, matured pasture.

Young stock are more susceptible to a vitamin A deficiency as their meagre liver reserves are more quickly depleted. Deficiency signs include night blindness, eye discharges and ill thrift, and are more common during periods of high grain feeding or in shedded animals.

Green pasture, leaves, green hay and yellow maize are good sources of beta-carotene and ultimately vitamin A. Supplementation is rarely required. Be wary of vitamin A availability in pelleted feeds and premixes as availability declines by up to 10% per month after the date of manufacture.

Vitamin B12

Vitamin B12 is produced for ruminant animals by the action of rumen microbes using cobalt as a precursor. It is needed for cell growth, energy metabolism (glucose production) and wool production (metabolisation of methionine). Production of vitamin B12 in the rumen is enhanced by increased concentration of cobalt although the efficiency with which cobalt is converted to vitamin B12 declines. The rate of absorption is inhibited if the rumen or small intestines are damaged (e.g. by worms).

Colostrum contains some vitamin B12 but milk and cereal grains contain limited amounts. Supplementation with vitamin B12 may be useful if you have a known cobalt deficiency (e.g. light sandy or traprock style soils as found in Tablelands) or for young stock that may not have fully functional rumens (e.g. lambs <30 kg) and are not synthesising adequate B12. In adult animals a slow release cobalt bullet is likely to be more effective and economic than direct injection with B12.

Vitamin D

Vitamin D is contained in sun-cured hay and is produced in the skin of animals through irradiation. It is stored in the liver and helps with calcium absorption by acting to regulate the Ca:P balance. Deficiencies are rare in extensively grazed animals, although in more southern latitudes a vitamin D response has been recorded in animals grazing oats during winter (see the section on Calcium).

Supplements may be used when feeding stock high grain rations for long periods (over 2 months). Supplementation may be necessary if the Ca:P ratio is less than 1:1 (recommended is 2:1). Deficiency signs include ill thrift, anorexia, hunched back and rickets (swollen joints, bow legs, knock knees). Hypocalcaemia may also result from vitamin D deficiency.

Vitamin E

Vitamin E is an antioxidant needed for unsaturated fatty acid metabolism and maintaining cell membranes. Deficiencies may occur occasionally in weaners which have had no green feed for several months but it is seldom seen in mature sheep. Symptoms may include lameness, muscle weakness and ill thrift and white muscle disease (diagnostically different from that caused by selenium deficiency).

Green feed, oils and grains (unless stored long-term) are good vitamin E sources. Deficiency may also be addressed using an injectable multi-vitamin (A, D and E).

Be prepared to question ‘trial’ findings and recommendations

Glossy, ‘too good to be true’ producer testimonials are often just that. Be wary of testimonials, anecdotal evidence or small-scale trial results. When presented with such information you should consider if the following issues have been fully addressed and explained.

- Was the trial independently conducted and its design and findings clearly stated or statistically analysed?
- Were comparisons made between additive or supplement tested (used vs not used)?
- Was the trial replicated? Are results clearly quantified and do the findings ‘hold up’ over a range of different classes of stock, environments and feed conditions?
- What of pasture availability and quality issues such as energy (MJ/ME) and crude protein?
- Is feeding/nutritional and/or specific management advice provided or required?

Even if the trial results seem positive consider the following issues before committing resources to the use of any additive or supplement.

- Are the specific deficiencies that led to a positive trial response present in my specific situation?
- Are there specific issues and management practices needed to train stock to eat the product? What of feeding frequency? Are specialised feeding systems or equipment needed?
- Is on-farm advice offered or does the product only have point-of-sale service?
- Are veterinary prescriptions required?
- Are there specific withholding or export slaughter interval issues?
- Is it possible to meet the target intake/head/day specified?
- Is the cost:benefit ratio when using the product favourable – i.e. does production gain in value outweigh product cost?

Measuring the response at home

If you decide to undertake your own on-farm analysis of any additive or supplement you should consider whether you can provide the following:

- objective assessment of pasture/crop quality (MJ ME) and quantity (kg DM/ha) throughout the trial;
- a 'paired' paddock on-farm trial (same conditions within paddock/plots);
- stocking rate records, stock descriptions, liveweight, fat scores, etc. prior to and at the completion of trial work;
- minimum recommended stock numbers of 15 cattle/treatment and 60 sheep depending on scale or the trial, treatment number and replication of each;
- standardised measurements such as weighing stock (weigh at same time on each day of data collection so as to minimise gut fill differences.

Feed supplements/additives to fit the need

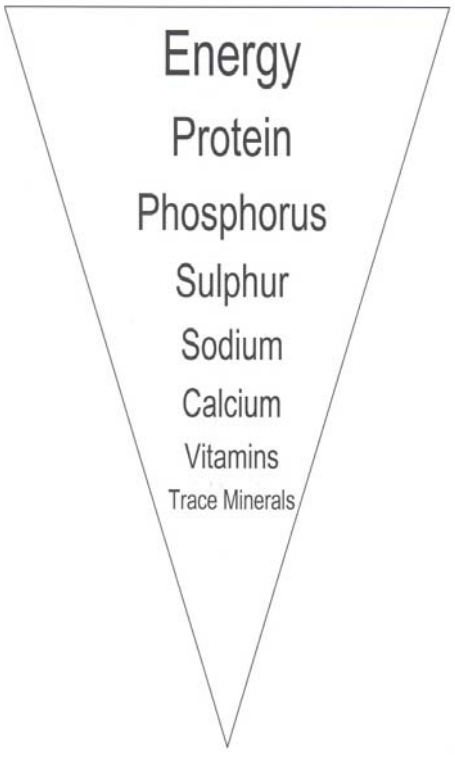
Can you identify:

- whether there is a definite deficiency that you are aiming to overcome;
- whether the deficiency is the primary limiting factor, i.e. is it necessary to provide the animal with extra energy, protein or fibre before a medicinal product, mineral or vitamin supplement is warranted;
- if a known (diagnosed) mineral imbalance is causing herd/flock production losses on your farm.

Some definite research based supplements and additives

- Sodium and sulfur (10–12% sulfur) blocks are required by all cattle and sheep grazing forage sorghums.
- Sodium supplementation is required to maximise performance on kikuyu pasture.
- Cereal grain always needs 1% to 1.5% ground limestone (by weight of grain) to restore the Ca:P balance.
- Livestock grazing winter wheats require a 1:1 salt:magnesium oxide (CausMag) 'free choice' supplement.
- Magnesium oxide (MgO) supplementation to high demand lactating cows susceptible to grass tetany (Mg deficiency) will assist in preventing deaths from grass tetany. This is typically given as 60 g of MgO/hd/day on hay as a carrier (see Primefact 421, Grass tetany in cattle – treatment and prevention).
- To determine phosphorus deficiency and implement a supplementation program requires a detailed study of soil P levels, animal blood P levels and faecal P levels across both the growing and non-growing period of the pasture/forage. Your District Livestock Officer and your RLPB Veterinarian will work as a team to assist in P deficiency diagnosis.
- When pastures are protein deficient, mature animals can be adequately supplemented with a source of non-protein nitrogen. Seek advice to do this cost effectively.
- Monensin-based products increase weight gain and aid in bloat control but may not prevent it.

Look after livestock feed nutrients in this order:



Satisfying yourself

- Make up your own list of questions to satisfy yourself that a product is worth adopting into your livestock production system.

- Beware of perceptions vs fact.
- Quantifying a result via an on-farm trial is often difficult, so seek advice if you wish to run such a trial.

Caution

- There is much ‘old’ technology that still works very well and economically.
- There is much ‘new’ technology that repackages and rebadges old technology.
- There are plenty of supplement/additive providers who will now feed your animals as part of the supply charge, but who is managing the animals?

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