Vitamins, Minerals and Additives

General

Minerals are necessary for bone, teeth, tissue and blood formation and efficient digestion. Five (5) are discussed below.

Of the 7 major and 8 minor minerals/trace elements only 3 (calcium, sodium and selenium) have been recognised as likely to be limiting within feedlot rations

Vitamins A,D,E and B12 may have major impacts on lamb performance within a feedlot. These are needed for bone development, cell regulation and light transmission (Vitamin A); maintaining cell membranes (Vitamin E); regulating the bodies Ca:P balance (Vitamin D) and have a role in the production of glucose (Vitamin B12)

There are numerous supplements/additives currently available for preventing mineral imbalances. The major ones are also discussed within this paper

Mineral requirements and feedstuff contents

Following are a series of tables showing mineral requirements (as a percentage of dry matter intake) and the mineral levels in common feeds and grain. Values shown are averages and may vary between samples and varieties. Those figures highlighted in yellow indicate 'below requirement' values

Figure 1. Average mineral levels in common cereal grains.

	Need	Wheat	Barley	Sorghum	Corn	Oats
Ca	0.20-0.82	.10	.10	.04	.02	.10
P	0.16-0.38	.40	.40	.30	.30	.40
S	0.14-0.80	.18	.18	.18	.12	.18
Mg	0.12-0.18	.15	.14	.13	.15	.13
K	0.50-0.80	.40	.60	.30	.30	.40
Zn	20-33 ppm	42	16	16	12	30

Figure 2. Average mineral levels in pulses, meals and lucerne

	Need	Lupins	CSM	SFM	CM	Lucerne
Ca	0.20-0.82	.22	.20	.40	0.8	1.4
P	0.16-0.38	.30	1.3	1.0	1.2	0.2
S	0.14-0.80	.22	.40	.30	.80	.30
Mg	0.12-0.18	.15	#	#	#	#
K	0.50-0.80	.82	1.7	1.2	1.3	2.0
Zn	20-33 ppm	35	66	55	68	24

** CSM = cottonseed meal; SFM = sunflower meal; CM = canola meal

Minerals:

Calcium (Ca)

- Important for nerve function, muscle contraction, blood clotting, activation of a number of enzymes and bone formation.
- 99% of the bodies' calcium is found in skeleton and blood plasma. Cereal grains are a poor source
- Deficiency symptoms include milk fever, lethargy and weak bones
- The calcium to phosphorus ratio is important… a 1.5 or 2 to 1 ratio is needed for normal body function and prevention of water belly/bladder stones
- Excessive calcium can reduce Zinc absorption and utilisation

Phosphorous (P)

- Important for cell membranes; energy production; muscle contraction and bone formation. Found in some proteins, lipids and nucleic acids
- 80% found in bones.
- Cereal grains are a good source
- Deficiency symptoms include slow growth rates, decreased appetite and listlessness, rickets, poor fertility, muscle weakness and stiff joints

Magnesium (Mg)

- Magnesium has a role as an 'enzyme cofactor' and is involved in the metabolism (breakdown) of carbohydrates, lipids & protein and also in nerve conduction and muscle contraction
- Approx 70% stored in skeleton but is it is poorly mobilized
- High intakes of K, Ca, P and Organic Acids decrease Mg availability while high intakes of Na and carbohydrates increase availability
- Excess magnesium may decrease Ca absorption and increase Ca secretion
- Cereal grains are a good source of Mg
- Deficiency symptoms include excitability, convulsions, tetany and death
- Excess Mg causes damage to rumen, scouring, reduced feed intake and lethargy

Potassium (K)

- Important for enzyme functions; muscle contraction; nerve signal transmission and the bodies electrolyte, acid/base and water balance
- One of most abundant minerals so deficiencies are rare
- Excess potassium may inhibit Mg absorption and cause a magnesium deficiency (hypomagnesaemia)
- Cereal grains a good source

Sodium (Na)

- Sodium has a role in maintaining salt levels in body fluids, maintaining the acid/base and water balance and in nerve transmission
- Cereal grains are a poor source
- Deficiencies may cause dehydration and poor growth rates
- Supplementing with salt will increase water intakes, reduce incidence of urinary calculi and acidosis induced dehydration and improve feed intakes

Vitamins

Vitamin A

- Needed for normal bone growth & development; ,regulation of cell growth and light transmission to the brain
- Produced via conversion of carotene (the green pigment in pasture)
- Stored in liver for extended periods so deficiencies are rare except during droughts
- Deficiency symptoms include night blindness, eye discharges and ill thrift.
- Green pasture, leaves, green hay and corn are good sources.
- 10% plus loss of Vit A in pellets and premixes per month after manufacture

Vitamin E

- An antioxidant with a role in maintaining cell membranes
- Occasionally seen in weaners which have had no green feed for several months.
- Stored in liver for extended periods so deficiencies are rare
- Deficiency symptoms include may include lameness, muscle weakness and ill thrift.
- Green feed, oils and grains (unless long term stored) are good Vit E sources

Vitamin D

- Produced in rumen by sheep (sunlight)
- Helps with calcium absorption (acts as a hormone to regulate Ca:P balance)
- Green hay is a reasonable source of Vitamin D.
- Vit D metabolism can be inhibited by excessive cereal grains

Vitamin B12

- Cobalt is converted to B12 in the rumen and is stored in liver
- Needed for cell growth, energy (glucose production) and wool production (metabolisation of methionine)
- Rate of absorption is enhanced by slow gut flow but inhibited if rumen or small intestines are damaged (eg: worms)
- Cereal grains contain limited B12

Additives/Supplements

Acid Buf

- A calcium and magnesium - based additive
- A natural buffer derived from seaweed
- Has a large open structure that allows for the slow release of Ca and Mg, reducing the risk of acidosis and optimizing rumen pH
- Buffers at lower pH's and for longer than bicarb
- Add 1-1.5% on weight basis

Acid Salts

- Act by mobilising calcium from the small intestine and acidifying urine so as to prevention of bladder stones
- Common forms are ammonium chloride, calcium chloride and ammonium sulphate
- Bitter and may impact on ration palatability
- Add at 0.5 to 1% on weight basis

Bentonite

- A clay that swells to 6-7 times its size when contacting rumen fluid, slowing down the digestion process and gut flow rates.
- Acts by binding acid 'positive ions' on its surface and removing these from the rumen in the manure
- Is not a true buffer
- Has a negative affect on protozoa (these consume rumen bugs which produce protein and who also become a source of protein when digested) increasing protein availability
- Some palatability and digestibility concerns
- Add 1-2% on weight basis

Bicarb of soda (Sodium Bicarbonate)

- An alkali naturally produced by lamb when chewing (in saliva)

- Buffers against acid production
- Add 1-2% on weight basis

Calcium Carbonate (limestone)

- A calcium-based supplement
- Has some buffering action in the small intestine but may reduce intake
- Add 1-2% on weight basis

Ionophores (eg: Bovatec)

- A coccidiostat that inhibits the growth of specific rumen microorganisms improving feed conversion efficiency
- Alters rumen fermentation by increasing propionate (a glucose precursor), inhibits protozoa (increasing protein availability) and enhancing the absorption of sodium, magnesium, phosphorus and zinc
- May reduce intake
- Included at 25-70g per tonne of feed so is difficult to use unless purchased within a mineral mix/supplement

Molasses/Vegetable Oils

- Both are energy sources but are primarily used to improve palatability and reduce dust levels within rations
- Add at 0.5 to 4% depending on ration moisture

Sodium Chloride (Salt)

- A sodium supplement
- Increases water and ration intakes and helps protect against water belly
- Add 1-2% on weight basis

Urea

- Urea is known as a non-protein nitrogen (NPN) source that is converted to ammonia within the rumen and used to produce microbial protein. It may improve crude protein levels by 1-2% but it should not provide > 25% of total CP
- Adequate energy in the ration ration is needed to make full use of the NPN
- May take 4 weeks for the rumen to adjust to additional nitrogen in the system

Virginiamycin (Eskalin)

- An S4 antibiotic that prevents lactic acid producing bugs from multiplying, reducing acidosis risk and improving energy availability
- Require veterinary approval (S4)

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