

COOPERS®
PERMATRACE®

Sheep

TECHNICAL MANUAL

THE PROOF IS IN THE PELLET.

The science of long lasting Selenium, Cobalt & Copper

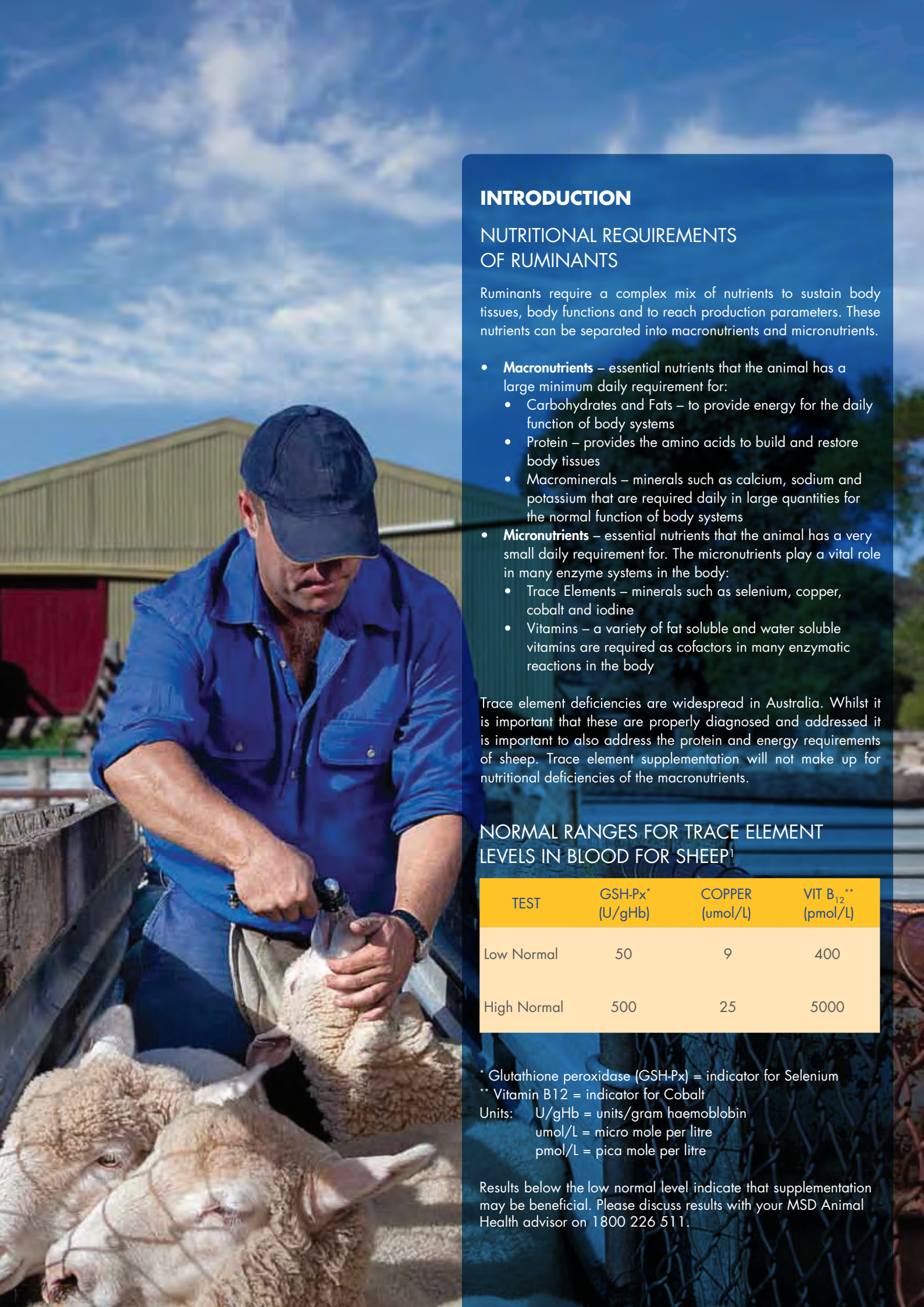




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Selenium, Cobalt & Copper

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INTRODUCTION

NUTRITIONAL REQUIREMENTS OF RUMINANTS

Ruminants require a complex mix of nutrients to sustain body tissues, body functions and to reach production parameters. These nutrients can be separated into macronutrients and micronutrients.

- **Macronutrients** – essential nutrients that the animal has a large minimum daily requirement for:
 - Carbohydrates and Fats – to provide energy for the daily function of body systems
 - Protein – provides the amino acids to build and restore body tissues
 - Macrominerals – minerals such as calcium, sodium and potassium that are required daily in large quantities for the normal function of body systems
- **Micronutrients** – essential nutrients that the animal has a very small daily requirement for. The micronutrients play a vital role in many enzyme systems in the body:
 - Trace Elements – minerals such as selenium, copper, cobalt and iodine
 - Vitamins – a variety of fat soluble and water soluble vitamins are required as cofactors in many enzymatic reactions in the body

Trace element deficiencies are widespread in Australia. Whilst it is important that these are properly diagnosed and addressed it is important to also address the protein and energy requirements of sheep. Trace element supplementation will not make up for nutritional deficiencies of the macronutrients.

NORMAL RANGES FOR TRACE ELEMENT LEVELS IN BLOOD FOR SHEEP¹

TEST	GSH-Px* (U/gHb)	COPPER (umol/L)	VIT B ₁₂ ** (pmol/L)
Low Normal	50	9	400
High Normal	500	25	5000

* Glutathione peroxidase (GSH-Px) = indicator for Selenium

** Vitamin B12 = indicator for Cobalt

Units: U/gHb = units/gram haemoglobin

umol/L = micro mole per litre

pmol/L = pica mole per litre

Results below the low normal level indicate that supplementation may be beneficial. Please discuss results with your MSD Animal Health advisor on 1800 226 511.



COBALT DEFICIENCY IN SHEEP

THE ROLE OF COBALT IN SHEEP

Cobalt is an essential trace element as it is required by rumen microbes to synthesise Vitamin B₁₂, and this is the only source of Vitamin B₁₂ to the animal. Vitamin B₁₂ is required by enzymes involved in a variety of metabolic processes. Cobalt is not stored for any significant length of time in the body but Vitamin B₁₂ is able to be stored in the liver.

THE IMPORTANCE OF COBALT AND VITAMIN B₁₂ TO THE SHEEP

Cobalt is required for:

- Vitamin B₁₂ synthesis
- Healthy rumen function

Vitamin B₁₂:

- Produced in the rumen
- Required by ruminants in much greater amounts than other animals
- Deficient animals are unable to metabolise propionic acid into glucose, which is accompanied by inappetence and death from starvation

FACTORS AFFECTING THE AVAILABILITY OF COBALT

Some of the factors affecting the availability of cobalt to sheep include:

- **Soil type** – soil ingested while grazing is an important source of cobalt. Soils with reduced cobalt levels include coastal, calcareous and sandy soils. Soils high in manganese (such as red basalt) can result in a secondary cobalt deficiency as manganese binds cobalt.
- **Climate** – cobalt is more likely to be deficient in very wet seasons due to leeching from the topsoil
- **Pasture** – deficiency can occur even in sheep grazing good quality pasture
- **Fertilisers** – heavy, long term superphosphate usage can result in cobalt deficiency

SIGNS OF COBALT DEFICIENCY IN SHEEP^{2,3}

The primary effect of a cobalt deficiency is loss of appetite and then many other effects are felt as a result:

- Ill-thrift
- Decreased wool and milk production
- Malnutrition – weepy eyes, poor growth, anaemia (pale mucous membranes), depression of the immune system, death
- White liver disease – the body mobilises fat reserves in response to malnutrition and this fat is deposited in the liver. Liver damage can occur, with secondary photosensitisation resulting in scaly ears. Advanced liver disease can result in nervous convulsions and possible blindness.
- Effects on pregnancy – increased stillbirths can occur, increased rate of pregnancy toxæmia, decreased lamb viability (poor quality colostrum, slow to suckle)

DAILY REQUIREMENTS OF COBALT

- Cobalt supplementation is advised if the intake of cobalt is lower than this level
- It is recommended that sheep have a level of 0.08-0.15mg⁴ cobalt kg/dry matter in their diet

EVALUATING COBALT STATUS OF SHEEP

As Vitamin B₁₂ levels are directly linked to an animal's cobalt status, measurements of Vitamin B₁₂ are used to determine the need for cobalt supplementation.

- **Liver tests** – biopsies or at slaughter. Very effective as the liver is the principal storage organ for Vitamin B₁₂.
- **Blood tests** – can be quite accurate for diagnosing cobalt deficiency but may not indicate that liver reserves of Vitamin B₁₂ are getting low
- **Supplementation trials** – in animals showing clinical signs typical of cobalt deficiency this may be one of the most effective methods of diagnosing a deficiency problem

See table on page 1 for normal Vitamin B₁₂ levels in livestock.

METHODS OF COBALT/VITAMIN B₁₂ SUPPLEMENTATION

- **Slow release pellets** – Coopers Permatrace Cobalt pellets are convenient and very effective form of cobalt supplementation and provide a sustained release of cobalt to the ruminal bacteria over a period of 3 years
- **Vitamin B₁₂ injections** – provide rapid elevation of serum B₁₂ levels and may be effective in treating clinical signs of cobalt deficiency but need to be repeated every 3 months
- **Vitamin B₁₂ drenches** – need to be given weekly to fortnightly
- **Salt blocks/mineral mixes/in water supplementation** – may assist in marginal deficiencies but ineffective if animals don't consume them (cobalt deficient animals are often inappetent)

COOPERS PERMATRACE COBALT PELLETS

- **One pellet administered orally provides effective cobalt supplementation for 3 years**
- Each 10 gram pellet contains 3 grams of cobalt oxide
- Easily administered orally with the specially designed Coopers® Permatrace® sheep pellet applicator
- Developed by the CSIRO to be of the correct weight, density and specific gravity to stay in the rumen
- Continually releases small amounts of cobalt over a 3 year period (the "pay out period"), to be converted into Vitamin B₁₂ in the rumen
- Can be used in sheep from 8 weeks of age
- Can be used with Coopers Permatrace Selenium and Copper Pellets





SELENIUM IN SHEEP

ROLE OF SELENIUM IN THE SHEEP

Selenium is required by the body for the production of a number of selenium dependant proteins, or seleno-proteins. These seleno-proteins act primarily as anti-oxidants in the body, scavenging free radicals, products of normal metabolism in the body which can cause cellular damage. The activity of selenium in the body is closely linked with the activity of vitamin E.

WHY SELENIUM IS IMPORTANT

Selenium is required for:

- Growth and production
- Foetal development
- Normal ovarian function
- Immune function

FACTORS AFFECTING SELENIUM AVAILABILITY

In Australia, selenium deficiency is widespread and often occurs in the most heavily stocked and cultivated areas. Deficiency is known to occur in coastal and southeastern Queensland, northern and southern tablelands of New South Wales, the eastern half of Tasmania, parts of Western Australia, South Australia and Victoria. Deficiencies also occur in other areas in Australia and responses to supplementation have occurred in areas or soils not known to be selenium deficient.

FACTORS AFFECTING SELENIUM AVAILABILITY TO SHEEP INCLUDE:

- Soil Type – acidic or sandy soils are more likely to be selenium deficient
- Climate – high rainfall areas (>450mm) are more likely to be low in selenium as the trace element is leached out of the soil
- Plant Types – clover & other legumes are low in selenium
- Pasture Growth – rapidly growing pastures are often deficient in selenium
- Fertilisers – superphosphate application can lower selenium uptake in plants as sulphur is taken up preferentially by the plant
- Interaction with other minerals – copper supplementation can increase the uptake of selenium by the liver.
- Animal age – young, growing animals have a higher requirement for dietary selenium than older animals

See table on page 1 for normal selenium levels in livestock.

SIGNS OF SELENIUM DEFICIENCY IN SHEEP³

WHITE MUSCLE DISEASE:

- Disease of lambs born to selenium deficient ewes
- Affects skeletal muscle, as well as cardiac muscle and smooth muscle (e.g. diaphragm)
- Muscle lesions are thought to result from free radical damage
- Clinical signs may include hind limb weakness, a stiff or stilted gait or sudden death from heart failure
- May result in still-births or appear at any age up to twelve months
- Often a whole flock problem but only a small percentage of lambs will be showing clinical signs
- Irreversible and often fatal
- Prevention by supplementing pregnant ewes with selenium

SELENIUM RESPONSIVE ILL-THRIFT

- Ill-thrift animals grazing selenium deficient pasture have been shown to respond with increased growth rates following selenium supplementation

REDUCED WOOL PRODUCTION⁵

- Numerous studies have shown that wool growth in deficient sheep can be improved following selenium supplementation
- In one study sheep had a 17% improvement in greasy wool yield at two successive shearings following supplementation with an intra-ruminal pellet

DECREASED FERTILITY

- Believed to be due to early embryonic mortality

REDUCED IMMUNE FUNCTION

- Selenium is involved in the metabolism of white blood cells
- Selenium supplemented sheep can have a lower incidence of diarrhoea than unsupplemented sheep

EXPRESSION OF JOHNE'S DISEASE⁶

- There is evidence that marginal selenium deficiency can influence the progressive expression of Johne's Disease

Increased growth and production

DISEASES ASSOCIATED WITH SELENIUM DEFICIENCY IN SHEEP³

DISEASE	AGE AFFECTED	CLINICAL SIGNS	COMMENTS
Congenital White Muscle Disease (WMD)	Newborn lambs	Sudden death, lameness, reluctant to move	On heavily supered, clover dominant pasture
Delayed WMD	1 to 3 months	Lameness, reluctance to move	On heavily supered, clover dominant pasture
Selenium responsive ill-thrift	Weaners	Poor growth rate	Ill-thrift animals grazing selenium deficient pasture have responded to selenium supplementation
Poor wool production	Weaners	Poor wool production	Wool growth and yield can be improved with supplementation in selenium deficient sheep
Decreased fertility	Ewes	Increased percentage of dry ewes due to early embryonic mortality	Impact on fertility can be significant on some properties.
Reduced immune function	Any age	Scouring, expression of Johne's Disease	Selenium is involved in the metabolism of white blood cells

DAILY REQUIREMENTS OF SELENIUM

- Recommended minimum dietary selenium content of feed for sheep is 0.05mg/kg⁴ dry matter
- Evaluating selenium status in sheep
 - Blood tests – testing a small percentage of the flock is the preferred method for measuring the selenium status of animals. Most laboratories measure the seleno-protein glutathione peroxidase (GSH-Px). This test is cheaper than measuring selenium directly and has been shown to provide an accurate reflection of the levels of selenium in the blood
 - Soil testing – can provide an indication of deficiency problem in an area but there are so many factors relating to selenium uptake by plants and animals that blood tests are a more reliable indicator of animal deficiency problems
 - Supplementation trials – often preferred by many people, especially if animals are showing typical signs of deficiency in an endemically deficient area

PERMATRACE SELENIUM PELLETS FOR SHEEP

- Orally administered intra-ruminal pellets that pay out over three years to provide a sustained release of selenium
- Registered for treatment of selenium responsive conditions as well as providing long term supplementation to ensure optimum productivity
- 10g pellets contain 0.5g of elemental selenium compressed into a matrix of iron oxide
- Developed in conjunction with the CSIRO
- The particle size of the selenium in Permatrace pellets is the most important factor in determining the life of the pellet and the rate of supply of selenium to the animal
- The CSIRO determined the optimum particle size and Coopers Permatrace Selenium pellets are manufactured to these strict specifications
- Rumen micro-organisms incorporate the selenium released from the pellet into soluble molecules and this selenium is absorbed into the bloodstream further down the digestive tract
- As opposed to injections or oral liquids you get a gradual increase in selenium blood levels and glutathione peroxidase levels when an intra-ruminal pellet is used
- Injectable selenium supplements have a greater risk of toxicity than oral selenium supplements when overdosage occurs

One pellet offers three years supplementation to ensure optimum productivity

METHODS OF SELENIUM SUPPLEMENTATION

- **Intra-ruminal pellets** – Coopers® Permatrace® selenium pellets for sheep. Slow release pellets, easily administered orally by pellet gun and provide sustained release of constant supply of selenium for three years. Coopers® Permatrace® selenium pellets can safely and easily be given with copper and cobalt pellets.
- **Top dressing pasture** – Can be effective at raising soil selenium levels in deficient paddocks
- **Mineralised drenches** – provide only short term increase in selenium levels as selenium is readily metabolised and excreted from the body
- **Clostridial vaccines containing selenium** – increases selenium levels for 6-8 weeks
- **Selenium injections** – Can be either short acting (sodium selenate) or long acting (barium selenate). Increased risk of toxicity when compared to sustained release capsules.
- **Premixes** – applicable in many feedlot situations but animals can have variable intake due to variable feed intake



COPPER IN SHEEP

THE ROLE OF COPPER IN SHEEP

Copper is involved in the uptake of iron from the diet and is vital for the manufacture of haemoglobin, which is responsible for carrying oxygen in the red blood cells. It is involved in many other enzyme systems in the body and has a role in the production of many pigments in the body and in wool.

Copper is required for body and bone growth as well as nervous system and immune system function





SIGNS OF COPPER DEFICIENCY IN SHEEP³

- **Effects on wool** – due to inadequate keratinisation or pigmentation
 - Steely wool
 - Loss of tensile strength
 - Loss of wool crimp
- **Anaemia** – linked to the role copper plays in the production of haemoglobin
- **High lamb mortality** – in some copper deficient areas may be due to increased susceptibility to a variety of infections. Often these deaths are associated with diarrhoea.
- **Swayback** – due to demyelination of nerve fibres. Can develop in utero and result in a dead or very weak lamb that dies, or may develop a few weeks after birth with signs appearing at 3-6 weeks of age.
- **Enzootic ataxia** – in unweaned lambs. May be apparent at birth or take 1-2 months to appear. Lambs initially appear weak and unco-ordinated and then the limbs are progressively affected until the lamb is unable to stand.
- **Fragile bones** – in severe copper deficiency lambs can develop osteoporosis and be more prone to fracture, particularly of the long bones

FACTORS AFFECTING THE AVAILABILITY OF COPPER

Copper deficiency can be primary (where there is an absolute lack of copper in the soil) or secondary (where soil or plant factors inhibit the availability of copper to the animal). In Australia many of the sandy coastal soils are copper deficient but responses due to copper supplementation have also been noted in areas not known to be deficient, due to secondary deficiency.

Factors affecting availability of copper to sheep include:

- **Climate** – in wet periods (or areas) the copper concentration in plants can be lower and is in a less available form
- **Soil type** – known deficient regions include sandy coastal soils and some granite soils or peat swamps
- **Plant type** – clovers have a higher content than grasses. Grasses and clovers can however both be low in copper during the wetter months.
- **Fertilisers** – fertilisers containing molybdenum can decrease the availability of copper in feed and also interfere with metabolism of copper in the body. Copper metabolism can also be inhibited by excessive calcium, so heavy treatment of pasture with lime can lead to secondary copper deficiency.
- **Other minerals** – excess consumption of sulphur, cadmium, iron and zinc in the diet can decrease the availability of dietary copper
- **Genetic differences** – there are marked differences between breeds of sheep regarding copper metabolism

DAILY REQUIREMENTS OF COPPER

- The recommended minimum adequate dietary concentration of copper for sheep is 4-14mg/kg⁴ dry matter

COPPER POISONING IN SHEEP

- **Acute copper poisoning** – can occur from the ingestion of a large amount of copper salts at one time (from accidental administration of large quantities of soluble copper salts, contamination of pasture by fungicidal sprays, overdosage with copper containing drenches)
- **Chronic copper poisoning** – occurs when sheep continually ingest small amounts over an extended period of time (from fungicide treated grain, pasture contaminated by smelter fumes and by soils that are rich in copper)
- **Secondary copper poisoning** – occurs in sheep grazing pasture containing normal levels of copper. Often as a result of grazing plants containing pyrrolizidine alkaloids (e.g. Heliotrope, Paterson's Curse).

EVALUATING COPPER LEVELS

Definitive diagnosis of a copper deficiency can be quite difficult

- **Blood tests** – can be of limited value in marginal deficiencies as copper is removed from the blood when the blood clot forms
- **Liver biopsies/examination at slaughter** – copper is stored in the liver and drawn on when the animal is in a deficient state so copper liver measurements can give an accurate picture of the animals overall copper status. Liver biopsies are more invasive than blood tests but if abattoir samples are available liver measurement can be a good indicator of deficiency.
- **Soil testing** – may provide an indication that an area is copper deficient
- **Supplementation trial** – in deficient areas in animals showing clinical signs attributable to copper deficiency great value can often be gained from supplementing part or all of the flock

See table on page 1 for normal copper levels in livestock.

METHODS OF COPPER SUPPLEMENTATION

Copper sulphate can be supplied through copper licks or through drinking water but intake is variable. Copper drenches are available but sheep are very prone to copper toxicity, especially if they have liver damage.

The safest and most effective form of copper supplementation for sheep is with **Coopers Permatrace Copper capsule**.

COOPERS PERMATRACE COPPER CAPSULE FOR SHEEP

Formulated in conjunction with the CSIRO:

- 2.5g capsules containing fine copper oxide needles in a Polyethylene glycol capsule
- Administered with a Coopers® Permatrace® sheep pellet applicator
- Pellet lodges in the rumen where the capsule dissolves, the needles are released and they travel to the abomasum where they gradually break down
- Released copper is stored in the liver and made available as required
- Permatrace Copper Capsules provide a convenient and long lasting form of copper supplementation for your sheep
 - Blood levels start to increase immediately and are often back to normal in deficient animals within 4 weeks
 - **Provides 12 months supplementation**

***A convenient, long lasting form
of copper supplementation for
your sheep***

PERMATRACE DOSAGE AND ADMINISTRATION

PRODUCT	DOSE RATE	MINIMUM AGE	PACK SIZE AVAILABLE
Permatrace 3 Year Selenium Pellets for Sheep	1 pellet every 3 years	>2 months	500 Pellets/tub
Permatrace 3 Year Cobalt Pellets for Sheep	1 pellet every 3 years	>2 months	500 Pellets/tub
Permatrace Copper Capsules for Adult Sheep and Goats	1 capsule annually	>2 months	500 Capsules/tub

In some situations it may be required to also administer a steel grinder (grooved metal pellet) to keep the surface of the selenium or cobalt pellet clean and active. This will prevent a coating building up on the surface of the pellet. The following table highlights the situations in which a grinder would be recommended.

Caution: Selenium and copper deficiencies in sheep should be confirmed prior to administering Selenium and/or Copper pellets. Veterinary consultation is recommended.

SITUATION	STEEL GRINDER RECOMMENDED
Permatrace Selenium Only	Y
Permatrace Cobalt Only	Y
Permatrace Copper Only	N
Permatrace Selenium and Copper Only	Y
Permatrace Cobalt and Copper Only	Y
Permatrace Selenium and Cobalt Only	N
Permatrace Selenium, Cobalt and Copper	N



PERMATRACE SHEEP APPLICATION INSTRUCTIONS



1. When administering Permatrace sheep pellets, it is recommended that the COOPERS® SHEEP PELLET APPLICATOR be used.
2. To assist with administration, it is recommended to rotate the nozzle approximately 90 degrees before use. For right handers the nozzle should be rotated to the right and for left handers rotate to the left. To do this, loosen the handle clamp screw before attempting to move the nozzle and re-tighten correctly after positioning.
3. To load the applicator it is important to insert either the selenium or cobalt pellet first. The copper capsule should always be inserted into the gun last.
4. If practical, it is recommended to work from inside the race. If the operator is right handed, insert your left knee into the flank of the sheep to steady it.
5. Stretch the animal's head forward and insert the nozzle of the applicator into the side of the sheep's mouth (between the incisor and molar teeth) and place the nozzle over the base of the tongue.
6. The pellet should be deposited in the gullet, at the back of the tongue and the sheep observed for a short time to ensure the pellet has been swallowed. Tilting the animal's head slightly upwards will assist this operation (see picture of correct administration).
7. Under no circumstances should undue force be applied if any obstruction to ejection of the pellets or capsules is encountered. Withdrawing the applicator slightly and re-positioning it correctly will ensure easy and safe pellet administration.





THE PROOF IS IN THE PELLET.

Selenium, Cobalt & Copper

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