CHAPTER 3

What to feed sheep

This chapter covers some background information on the nutritional requirements of sheep. It includes an explanation of feed analyses tests used to help choose a supplement that will fill the needs of all classes of sheep through drought or in any supplementary feeding situation.

Key messages

- **Ruminants have a unique digestive system that enables them to utilise energy from pastures, but consideration of this system is required when supplementing with other sources.**
- **Energy is generally the most important and limiting requirement for sheep.**
- **Protein becomes more important with the need to grow and reproduce, but protein levels higher than needed can be wasteful.**
- **Roughage, or fibre, is required for healthy rumen function but too much will limit intake.**
- **Calcium is the most limiting mineral on high-grain diets.**
- **Vitamins A and E may be required for young stock fed for long periods with no green pick.**
- **Supplements vary considerably in their nutritive value. A feed analysis is the only accurate way to determine their suitability for your stock, how much is required and value for money.**
- **Feed test analyses will supply estimates of dry matter, energy and digestibility, protein and fibre. Estimates of water-soluble carbohydrates and fat are also available for some feeds.**
- **If purchasing feeds, compare the feed costs based on what you are buying the feed for – energy, protein or fibre.**

Nutrition of sheep

Sheep, like cattle and goats, are ruminants that have a digestive system that enables them to digest fibrous pasture diets. To do this they have four stomachs, the largest being the rumen. The rumen acts as a large fermentation vat, filled with microbes that ferment feed into products (energy, protein and vitamins) that the animal needs to maintain, grow and reproduce. The rumen is maintained at constant temperature and generally at a constant acidity level or pH. This system gives the animal the unique ability to utilise dry and fibrous feed in which cellulose is the main structural carbohydrate and the most abundant energy source in plants. Rumination or 'chewing the cud' is when a bolus of food (cud) is regurgitated for further physical breakdown and production of saliva, which acts as a buffer to maintain the pH.

The microbes digest carbohydrates in the diet to produce volatile fatty acids, which are the main source of energy for the sheep. Easily digestible carbohydrates, like soluble sugars and starch, are broken down quickly compared to the more complex cellulose. The products of fermentation are available to both the animal and to the microbes. The microbes are able to use nitrogen to make new protein and also to make many vitamins required by the animal. Partially digested feed and microbes continue through the other stomachs and intestine for further breakdown and absorption. Undigested material is eventually excreted as faeces. Fermentation in the rumen also produces carbon dioxide and methane, which are both greenhouse gases. One of the other downsides of the system is that the rumen and its microbes need time to adjust to changes in feed types. When considering the nutritional needs of the sheep, both the animal and the microbial population need to be catered for.

Nutritional requirements can be broadly classified as:

- energy
- protein
- minerals
- vitamins.

Non-nutritional requirements include fibre and water.

Energy

Energy is the most important requirement for all livestock and is the most common limitation during a drought or any feed-limited situation. An animal's requirement for energy is measured in megajoules (MJ) and expressed as metabolisable energy (ME). One megajoule is equivalent to 1,000 kilojoules. Metabolisable energy is the amount of total energy that can be utilised by the animal. When referring to pasture energy values, the term digestibility is used. Digestibility refers to how much of the feed is retained and used by the animal. If the digestibility of a feed is 75 per cent, then for every kilogram of dry matter eaten, 750 g is retained by the animal and 250 g is excreted.

Energy requirements can be estimated in Dry Sheep Equivalents or DSE ratings. This measure gives all classes and sizes of animals an energy rating that can be used for estimating stocking rates. A DSE is the energy required to maintain the body weight of a 2-year-old non-lactating sheep in condition score 3. The body weight of the standard dry sheep is not always consistent but is generally 45–50 kg, requiring between 7.6 and 9.7 MJ ME/day.

More commonly, as sheep have got bigger, a 50 kg wether is considered to be 1 DSE. A 50 kg wether can still vary in its requirements for energy, depending on its genetics, how much activity it is doing, if it is cold or bare shorn, and even how much extra energy it might need to digest poor-quality feed. Estimates of energy requirements are just that – estimates – and they need to be adjusted and monitored for your animals and the conditions. But the DSE system is useful as a simple estimation of the different energy requirements across classes of sheep. For example, if a dry 50 kg wether is considered to be 1 DSE, requiring 8.3 MJ ME to maintain weight at Condition Score 3, a 50 kg ewe with one lamb at foot would be classed at 2 DSE, requiring 16.6 MJ ME.

The daily energy requirements and DSE rating for different classes of sheep are given in Table 3.1, along with minimum crude protein as a percentage of the dry matter of the diet fed.

Table 3.1: Energy and protein requirements of a range of classes of sheep.

Class of stock	Live weight (kg) and Condition Score (CS)	DSE rating	Energy requirement MJ ME/day	Approximate protein requirement CP (%)
Adult dry sheep (wether or ewe dry or early stages of pregnancy)	40 kg CS 2	0.7	6	
	45 kg CS 2	0.8	6.5	
	50 kg CS 2	0.9	7	
	50 kg CS 3	1	8	6-8
	60 kg CS 3	1.1	9	
Ewes Pregnant last 4 weeks before lambing (single)	45 kg CS 2	1.2	10	
	50 kg CS 2	1.5	12	8-10
	60 kg CS 3	1.8	14.5	
Ewes With lamb at foot (single)	45 kg CS 2	1.8	15	
	50 kg CS 3	2.2	18.5	12–14
	60 kg CS 3	2.6	21.5	
Weaners	15 kg (growing at 100 g/day) 15 kg (growing at 200 g/day)	0.8 1.2	6.5 10	16 18–20
	25 kg (growing at 0 g/day) 25 kg (growing at 100 g/day)	0.7 1.0	6 8	9–12 12–14
	35 kg (growing at 0 g/day) 35 kg (growing at more than 200 g/day)	0.8 2.5	6.5 21	9–11 15–18

Note that weather and other conditions can change energy requirements (see Chapter 4 – Feeding sheep - how much and how often).

Sources of energy

Understanding the different sources of energy is useful because they vary in the rate of digestion and some energy sources require more care in how they are fed and how much they make up. Rumen microbes need time to adapt to different sources and some cannot be used as the sole energy source.

Carbohydrates are the main component of the dry matter of plants and consist of water-soluble carbohydrates and sugars, starch, cellulose and lignin. The water-soluble sugars are the most digestible and the lignin component is largely indigestible. Water-soluble carbohydrates include glucose, fructose, sucrose and complex sugars. Plants contain only small amounts of these sugars. As plants mature, the proportions of cellulose, lignin and water-soluble carbohydrates change and this affects their nutritive value.

Starch is the main source of energy in cereal grains. The microbes that process starch are different to those that process cellulose. Starch is rapidly converted to D-lactic acid in the rumen, producing a drop in rumen pH. The acid crosses the rumen wall and can overwhelm the sheep's buffering systems. This can lead to acidosis, the most common disease experienced with feeding high levels of cereal grains to ruminants (Chapter 7 – Sheep diseases associated with drought). The microbe population will change and adapt to a high-starch diet but this takes time and so cereals need to be introduced slowly to enable the rumen to adapt.

Fats or oils are not common sources of energy for ruminants. Although fat represents a concentrated form of energy, levels greater than about 5 per cent fat in a sheep diet will affect microbial fermentation and decrease intake. Some of the oilseeds and their by-products can have high oil levels, which is important when considering some alternative feed sources and how much can be incorporated into a ration.

Protein

In Victoria, protein is generally not the limiting factor in drought rations that supply adequate energy to meet the maintenance needs of stock. The requirement for protein increases with the level of production, such as increasing body weight or milk production, and selecting a supplement needs to ensure these extra requirements are met.

Green pasture is high in protein (leafy pasture is 25-30 per cent protein) so some short green pasture can go a long way in lifting the level of protein in the diet. When no green pasture is available, protein intake may be below requirements for some classes of stock. When the crude protein in the diet falls below 7 per cent, the microbes in the rumen are not able to reproduce themselves and utilise the carbohydrates, so feed intake and growth rate of the sheep starts to fall.

Dietary protein is measured as 'crude' protein' (CP), which is the percentage of protein (by weight) in the feed.

Ruminants can utilise both the protein in a diet as well as non-protein nitrogen to meet their protein needs. For example, urea can be used as a cheap protein source.

Growing sheep need 12–15 per cent crude protein in their diet while sheep fed for maintenance only need about 7–8 per cent. Estimates of protein requirements for different classes of sheep are provided in Table 3.1. Feeding extra protein can be wasteful. Rumen microbes digest protein faster than cellulose and fully degrade much of the protein entering the rumen into ammonia. This ammonia can be made into microbial protein for use by the sheep, but any excess ammonia is absorbed into the bloodstream and is excreted as urea in the urine. There are some forms of 'protected' protein, either natural or treated feeds, that prevent the protein being broken down in the rumen. This can sometimes have efficiency or live weight benefits on low-quality feed, but providing fully protected proteins would not feed the microbes, leading to an even less-efficient system.

Minerals

Sheep require certain minerals in their diet. These are classified as either macro-minerals or trace elements. In most cases, the minerals they require are obtained from pasture and soil, except in areas that have known trace element deficiencies.

Macro-minerals

Calcium is needed for bone growth, muscle contraction, growth of the unborn lamb and milk production. Pastures usually supply adequate calcium. Legumes are high in calcium but cereal grains are deficient. Late pregnant and lactating ewes are particularly prone to calcium deficiency if deprived of feed and young sheep can have poor growth and bone deformities if calcium is inadequate.

Magnesium is needed for muscle function and milk production and is also usually sufficient in pastures. Deficiency may cause grass tetany, which is more a problem with cattle than sheep.

Phosphorus is needed in balance with calcium, and phosphorus deficiencies are rarely seen in south-eastern Australia. A phosphorus-calcium imbalance, where there is too much phosphorus for the calcium, can lead to milk fever and other diseases.

Sodium is seldom limiting except in grain diets.

Sulphur is required for wool production, but responses to supplements are seldom seen.

Trace elements

The trace elements – iron, zinc, manganese, copper, cobalt, iodine, molybdenum and selenium – are required in very small quantities. Iron and zinc are unlikely to be deficient in sheep diets. In some areas copper, cobalt, selenium and iodine can be deficient and require supplementation, particularly to young sheep or to late pregnant ewes in the case of iodine.

Mineral nutrition will vary depending on soil types and can also vary throughout the year, depending on mineral uptake and seasonal growth patterns, how much soil the sheep ingest and the mineral content of the water supply.

Vitamins

Most vitamins required by sheep are made by rumen microbes. Vitamin A and E are sourced from green plants, so deficiencies in young sheep have been reported during prolonged droughts. Supplementation is generally recommended for lambs in feedlots. Particular risks exist when sheep have gone from long dry periods to an intensive finishing system with no access to green feed. In these conditions injectable supplementation may be a necessity. Vitamin D is produced by the action of sunlight on the skin so Vitamin D is needed when sheep are shedded for long periods.

Fibre

Fibre, or roughage, is not a nutrient as such but has physiological benefits and is required for a stable digestive system. Fibre promotes saliva production, which helps to maintain the rumen pH, activity and stable digestion. Fibre in plants includes cellulose, hemicellulose and lignin. Generally, as plants mature, fibre increases but energy and protein levels decrease. The best measure of fibre for ruminants is neutral detergent fibre (NDF), which includes all the components of fibre, however fibre must also be sufficient length and size to be effective. Finely, milled feed products can be high in NDF but may not supply sufficient effective fibre in the diet.

Sheep grazing pastures or crop stubbles are unlikely to benefit from a fibre supplement. Cereal grains are low in fibre so sheep on full grain diets may benefit from a fibre source and this is recommended particularly for young growing animals, and ewes and lambs. If the fibre in a diet is too high, e.g. some hays, sheep may not be able to eat enough to meet their nutritional requirements. Where sheep are confined or shedded (e.g. Sharlea sheep) and so are unable to graze, additional roughage as hay has reduced the incidence of wool biting and may also contribute to other behavioural and welfare requirements.

Water

Water requirements of sheep are covered in Chapter 5 – Water during a drought.

Choosing a supplement

The aim of feeding sheep in a drought is generally to maintain weight in dry sheep and to meet the requirements of late pregnancy and lactating ewes. Lambs and weaners need to grow sufficiently to avoid permanent checks (Chapter 2 – Setting targets for sheep). Other classes of stock may require a finishing ration if it is a profitable option. Targets for sheep will be based on required production, welfare and cash flow considerations; these will set which sheep will be fed and how much.

Selecting what supplements to feed involves:

- estimating the energy and protein requirements of each class of sheep
- assessing what and how much can be met from pasture and/or crop residues (and for how long)
- calculating which available fodders are suitable, lowest cost and practical to feed
- assessing other needs (e.g. calcium and fibre).

Feed testing

Feed resources held on the farm are often the most obvious choice for a drought ration, but may not necessarily match your sheep's needs. If the farm feed resources are in demand commercially, it may even pay to sell them and buy in something else at a lower price, provided that the feeding targets can still be met with the purchased supplement. Feed prices usually rise as drought progresses, so do not be too anxious to sell off surplus feed only to discover that it is needed later on.

Storage and feed-out facilities will also influence the choice of practical feed sources. Some pellet suppliers require attachments to silos to allow feed to be 'blown' in. Silage may require specific equipment and sometimes cheap alternative products have come onto the market (e.g. copra meal) that do not store or flow well in silos. Generally, grain and hay or straw will supply most drought rations.

To supply your needs for the best value for money, you need to know the nutritive value of the feedstuffs. It is difficult to judge the quality of a feed visually, so it is important to have feeds analysed to get an objective measure of the quality so that you can estimate its value to you and how much will need to be fed.

The main feed components that can be tested are energy, protein, fibre and dry matter.

Energy

As energy is the main requirement of livestock, knowing the metabolisable energy (ME) values of different feeds is important for two reasons:

- Calculation of the amount of feed required to meet production targets is only possible when the energy value of the various feeds that make up a ration is known.
- Deciding to buy feed should be based on the cost per unit of energy rather than the cost per tonne.

A feed analysis report will report on metabolisable energy (ME), expressed as megajoules per kilogram dry matter (MJ/kgDM), sometimes also written as MJ ME/kgDM.

ME is the amount of energy in the feed that is available to sheep for use. It involves measurement of energy excreted in faeces, urine and exhaled as methane. This requires specialised equipment and, in Australia, is not available as a direct measure. Instead, it is calculated based on the digestibility of a feed.

An example of the range in feed values as tested at one of the Victorian feed-testing laboratories is given in Table 3.2. Hay and silage values range considerably and some grains vary less than others. For example, if you purchased a load of oats, assuming a feed value of 10 MJ ME/kg DM, and the actual value was 8 MJ ME/kg DM, you could be underfeeding your stock by 20 per cent or, conversely, have paid 20 per cent more than if you had bought grain with the higher value.

Protein

Protein is measured as crude protein as a percentage of dry matter. Protein contains nitrogen, and this is used to estimate the protein content of feeds. A portion of the nitrogen in feed is non-protein nitrogen (nitrates, ammonia and urea); crude protein is a measure of both this and the true protein (amino acids).

Crude protein values give a good indication of whether or not a particular feed will satisfy the protein needs of an animal.

Some supplements, such as grain legumes, are high in protein and will be useful if they are cost effective and practical. Supplements that are likely to be low in protein include cereal hays, straws, low-quality pasture hays and some cereal grains. Protein can range from 6 to 19 per cent in hay. Silage can show similar variation, and in the case of cereal grains, protein can vary from 5 to 16 per cent. Lupins are very high in protein and are often added to a cereal grain to increase the protein level of the diet.

Forms of non-protein nitrogen such as urea can be used to increase the rate of digestion of high-fibre feeds such as hay and straw, but caution is needed as products such as urea can be toxic if

Table 3.2: Nutritive values and ranges of common feeds. Source: FeedTest Laboratory

Feed type	Energy (megajoules/ kg DM)		Protein (% Crude Protein)	
	Average	Common range	Average	Common range
Wheat, Triticale	13	12–15	12	8–23
Barley	13	11–13	11	6–17
Maize	13	12–14	9	8–13
Lupins	13	12–14	30	26–40
Peas	13	10–13	23	18–29
Faba Beans	12	10–13	25	18–28
Oats	11	9–13	9	6–12
Sheep pellets (brands vary)	10	6–13	12	4–21
Lucerne hay	8.5	7–9	20	16–25
Clover hay (early)	8.5	7–9.5	18	15–20
Pasture hay (mid-season)	7	6–7	11	8–16
Oaten hay	7	6–8	8	5–10
Grass hay	6	5–7	8	5–10
Cereal straw	5	4–8	4	2–5

WARNING: As seen from the large ranges for each feed type, feeds vary considerably in their nutritional value depending on growing conditions, stage of harvesting and storage conditions. The only way to be sure of the nutritional value of a particular batch of feed is to have it tested for energy, protein and dry matter.

consumed in large quantities. In general terms, at least two-thirds of an animal's crude protein intake should be provided as true (natural) protein. That is, not more than one-third of the crude protein should be represented by non-protein nitrogen (NPN). These additives should not be included in levels above 2 per cent of the diet.

Fibre

Neutral detergent fibre (NDF), as reported via a feed analysis, is a measure of all the fibre (the digestible and indigestible parts) and indicates how bulky the feed is. It is reported as a percentage of dry matter.

A high NDF will mean lower intake. Conversely, lower NDF values lead to higher intakes and tend to have higher energy values.

Too little fibre can result in acidosis, as the feed is digested too quickly and the rumen isn't able to function properly. Low-fibre, high-starch diets (grains) cause the rumen to become acidic. The fibre levels of most high-starch grains are generally low. Oats and lupins are both generally higher in fibre and lower in starch. This is why these grains are generally much safer to feed than the cereal grains. Oats are the safest and highest-fibre cereal grain with 29 per cent NDF, compared with barley at 14 per cent NDF and wheat at around 11 per cent NDF.

Cereal grains can be feed in large amounts for long periods very safely, but slow introduction is the key. See Table 4.2 for a guide on introducing sheep to grain.

Dry matter

All measurements of energy and protein are made on a dry matter basis so feeds of different moisture contents can be compared. Dry matter is the amount of feed left after all the water in the sample has been removed by oven drying. It is expressed as a percentage of the original sample.

Silage has a high moisture content and is around 45 per cent dry matter. This means that 1 tonne of silage has only 450 kg of dry matter and 550 kg of water. Grain has a much lower moisture content, and is about 90 per cent dry matter. This means that 1 tonne of grain has 900 kg of dry matter and only 100 kg of water.

Knowing the dry matter percentage enables you to work out how much to feed to provide to meet the energy requirements of the stock.

Example: If silage has an energy level of 11 MJ ME/kg DM, how much silage do you need to feed 10 MJ ME of energy?

Silage required:

10 MJ ME ÷ 11 MJ ME/kgDM = 0.9 kgDM

0.9 kgDM ÷ 0.45 (silage 45% dry matter)

= 2 kg as fed

Other components of a feed analysis

Moisture – measured as a percentage of the original sample, it is the amount of water in the feed. It is what is taken out to give the dry matter reading.

Digestibility – is provided on a feed analysis report as DDM (Digestible Dry Matter) or DMD (Dry Matter Digestibility), depending on the company doing the analysis, and is reported as a percentage of dry matter. It is the percentage of the dry matter actually digested by the animal. High-quality feeds will have a figure over 65 per cent. Feeds below 55 per cent are of poor quality and even if sheep are given free access, they will be unlikely to be able to maintain their live weight if it is supplying all of the diet.

Digestibility of organic matter – DOMD is a calculated figure and is expressed as a percentage of dry matter. It is a measure of the digestibility of the organic component of the feed and takes into account the inorganic component (referred to as ash) such as sand, dirt and clay that may be present in the sample.

Acid Detergent Fibre – ADF is reported as a percentage of dry matter. It estimates the proportion of feed that is indigestible to stock (mainly cellulose and lignin). Feeds with a low ADF are high in energy, and those with a high ADF are low in energy.

Ash – is reported as a percentage of dry matter and is the inorganic portion that is not utilised by the stock. It is any sand, dirt and clay present in the sample.

Fat – expressed as a percentage of dry matter, is a measure of the lipid content of the feed. If the diet of sheep is too high in fat (i.e. greater than 5 per cent), intake will be reduced.

Water soluble carbohydrate – WSC is reported as a percentage of dry matter and is a measure of the total naturally occurring sugars in the feed. The sugars are a highly digestible source of energy for the rumen bacteria and therefore the sheep.

Note: Not all companies test and report on the same components. Metabolisable energy, protein, neutral detergent fibre and dry matter are key components to have tested.

When sourcing feeds, ask for the feed analysis before you buy. If a test is not available, it may be possible to get a sample and send the test off yourself before deciding whether to buy. If you buy feed without a test, it is still worth taking a sample and getting a test done so that you can fine tune your rations and assess whether all requirements are being met.

How to sample for a feed analysis

There are a number of companies in Victoria that do feed tests and can provide follow-up advice if needed. Three are listed below and their websites will provide details about how to sample, costs involved how to access sampling kits and payment methods.

- FEEDTEST®, www.feedtest.com.au/, PO Box 728, Werribee Vic 3030 Ph: 1300 655 474 Email: feed.test@agrifood.com.au
- Livestock Logic, livestocklogic.com.au/feed-logic/, 60 Portland Rd, Hamilton Vic 3300, Ph: 03 5572 1419, Email: feed@livestocklogic.com.au
- Feed Central, www.feedcentral.com.au/test-fodder/, 38 New Dookie Road Shepparton VIC 3630, Ph. 03 5823 0000, Email: info@feedcentral.com.au

Sampling and sample submission

The analysis is only as good as the sample taken, which must adequately represent the feed being tested. Hay and silage in particular, are quite variable, so great care is needed when sampling them.

Sampling hay and bale silage

Use a coring device, made from 32 mm steel tubing about 450 mm long, and attached to an electric drill or hand brace. The cutting edge should be slightly scalloped and must be kept sharp. Each sample should consist of cores taken at random from 15–20 bales, with each core taken from the 'butt' end of a bale.

Take separate samples to represent different paddocks, cutting times, clover content, weather damage, etc.

Hay and silage can be sampled by hand as described in the silage section. This method, however, is much less accurate.

Sampling pit silage

Sample by hand from 10–20 spots across a freshly cut face of the stack, mix thoroughly and sub-sample, to yield a total amount not exceeding 500 g. Alternatively, use a hay corer if feasible.

Seal the sample in a strong airtight plastic bag. Send the sample immediately. If a delay is unavoidable, refrigerate the sample until it is sent, especially in hot weather.

Sampling grains and pellets

Select several sub-samples from different locations or bags within the complete lot. Thoroughly mix the sub-samples and send 300-400 g of this mix for testing.

One bag should be used for each sample. The sample analysis company's sample information sheet must also be filled out, giving details of the feed and its intended use.

Samples should be posted as soon as possible after collection.

Costing fodders on energy value

Fodders such as grain and hay are always bought and sold on a price per tonne (or some other unit of weight or size) of feed. Feeds contain moisture and need to be converted to a dry matter basis before they can be compared. This section aims to help you calculate which feed is the best value for money. To make comparisons you must first look at the energy and dry matter content of the feed.

Example: Two feeds are available for purchase. Which feed is better value?

	Cost/ tonne	Dry Matter (%)	Energy (MJ ME/ kgDM)
Feed A	$195	85%	10
Feed B	$230	90%	13

Calculate the cost per unit of energy, i.e. cost/MJ of ME.

Feed A

Step 1 – Calculate the price of the feed on a dry matter basis at 85% dry matter
In a tonne of this feed, there is 850 kg dry matter and the rest is water. To calculate the cost of a kilogram of dry matter, divide the cost/tonne of feed by the number of kilograms of dry matter.

$/ tonne as fed	x 10	÷	% DM	=	Cents/ kgDM
195	x 10	÷	85	=	23

Step 2 – Calculate the cost per MJ of energy
In each kilogram of dry matter there are 10 MJ of energy.

Cents/ kgDM	÷	MJ ME/ kgDM	=	Cents/ MJ ME
23	÷	10	=	2.3

Feed B

Step 1 – Calculate the price of the feed on a dry matter basis at 90% dry matter
In a tonne of this feed there is 900 kg dry matter and the rest is water. To calculate the cost of a kilogram of dry matter, divide the cost/tonne of feed by the number of kilograms of dry matter.

$/ tonne as fed	x 10	÷	% DM	=	Cents/ kgDM
230	x 10	÷	90	=	25.6

Step 2 – Calculate the cost per MJ of energy
In each kilogram of dry matter there are 13 MJ of energy.

Cents/ kgDM	÷	MJ ME/ kgDM	=	Cents/ MJ ME
25.6	÷	13	=	1.97

Therefore, Feed B (2¢/MJ) is better value per unit of energy than Feed A (2.3¢/MJ).

Table 3.3 calculates some of the relative prices of feed energy, over a range of prices. It can be used to compare the purchase of feeds with different energy levels.

Example: If you can buy wheat, with 12 MJ/kg DM, for $225 per tonne, you are paying a unit energy cost of 2.1¢/MJ. This would be the same value as another grain with an energy value of 10 MJ ME/ kg DM at $190/t or good hay (10 MJ ME/kg DM) at $175/t. If these alternatives were cheaper, they would be better value than the wheat option.

Table 3.3: Cents per megajoule of energy calculated from $/tonne and MJ/kg DM.

		$/tonne															
Fodder	**MJ/ kg DM**	**125**	**150**	**175**	**200**	**225**	**250**	**275**	**300**	**325**	**350**	**375**	**400**	**425**	**450**	**475**	**500**
Grain/ pellets (assuming 90% DM)	14.0	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.6	3.8	4.0
	12.0	1.2	1.4	1.6	1.9	2.1	2.3	2.5	2.8	3.0	3.2	3.5	3.7	3.9	4.2	4.4	4.6
	10.0	1.4	1.7	1.9	2.2	2.5	2.8	3.1	3.3	3.6	3.9	4.2	4.4	4.7	5.0	5.3	5.6
	8.0	1.7	2.1	2.4	2.8	3.1	3.5	3.8	4.2	4.5	4.9	5.2	5.6	5.9	6.3	6.6	6.9
Hay (assuming 85% DM)	10.0	1.5	1.8	2.1	2.4	2.6	2.9	3.2	3.5	3.8	4.1	4.4	4.7	5.0	5.3	5.6	5.9
	8.0	1.8	2.2	2.6	2.9	3.3	3.7	4.0	4.4	4.8	5.1	5.5	5.9	6.3	6.6	7.0	7.4
	6.0	2.5	2.9	3.4	3.9	4.4	4.9	5.4	5.9	6.4	6.9	7.4	7.8	8.3	8.8	9.3	9.8
Silage (assuming 40% DM)	14.0	2.2	2.7	3.1	3.6	4.0	4.5	4.9	5.4	5.8	6.3	6.7	7.1	7.6	8.0	8.5	8.9
	12.0	2.6	3.1	3.7	4.2	4.7	5.2	5.7	6.3	6.8	7.3	7.8	8.3	8.9	9.4	9.9	10.4
	10.0	3.1	3.8	4.4	5.0	5.6	6.3	6.9	7.5	8.1	8.8	9.4	10.0	10.6	11.3	11.9	12.5
	8.0	3.9	4.7	5.5	6.3	7.0	7.8	8.6	9.4	10.2	10.9	11.7	12.5	13.3	14.1	14.8	15.6
Straw (assuming 90% DM)	6.0	2.3	2.8	3.2	3.7	4.2	4.6	5.1	5.6	6.0	6.5	6.9	7.4	7.9	8.3	8.8	9.3
	4.0	3.5	4.2	4.9	5.6	6.3	6.9	7.6	8.3	9.0	9.7	10.4	11.1	11.8	12.5	13.2	13.9
	2.0	6.9	8.3	9.7	11.1	12.5	13.9	15.3	16.7	18.1	19.4	20.8	22.2	23.6	25.0	26.4	27.8

Feed intake – how much can they eat

In choosing the best value feed that will meet the needs of the various classes of stock, you may also need to consider whether the animals can eat enough of the supplement to meet their energy needs. This is particularly relevant when considering cheap but low energy feeds, including those with high fibre content. How much an animal can and will eat will depend on its body weight, requirements to grow, reproduce and lactate and also the quality of the feed. Other factors that may reduce how much they can eat include high water content; some mineral deficiencies, extreme temperatures (very hot or very cold and wet); palatability; trough space; access to feed, feeding time and disease. Generally dry adult sheep will eat 2-3% of their body weight. This proportion increases for growing lambs (approximately 4%) and for lactating ewes (4 to 5.5%) on good quality feed.

Intakes will vary depending on the type of feed as low quality, fibrous feeds will decrease intake. This means that high-fibre diets that have low energy values (like some hays and straws) will not supply enough energy for the animal because they cannot digest enough feed in a day to meet their needs. A measure of fibre that is available with a Feed Test of hay and straw is Neutral Detergent Fibre (NDF). If this measure is known, a simple sum can provide an estimate of how much the animal can eat. The maximum percentage of a sheep's live weight that can be eaten is 120/NDF%.

Example

A lucerne hay sample has a FeedTest of

10 MJME/kg DM

15% Crude Protein

50% NDF

NDF of 50% will mean that an estimate of maximum daily intake is 120/50 = 2.4% of bodyweight.

Therefore, the maximum a sheep can eat of this feed per day is 2.4 per cent of its weight.

- A 25 kg lamb could eat about 0.6 kg of this feed per day supplying 6 MJME/kg DM. These animals need to grow and require about 8 MJ ME/day and so could not eat enough to do this, even though the protein level is adequate (Table 3.1).
- A 60 kg ewe could eat 1.44 kg/day (at 2.4% of 60 kg bodyweight) which would supply 14.4 MJ ME/kg DM. Using the requirements from Table 3.1, this would be enough if she was dry or pregnant (requiring 9 or 14.4 MJME/day respectively) but not once she is lambing (requiring at least 21.5 MJ ME/day). Similarly with the lambs, protein is adequate for all stages.

Other nutritional considerations

Cost feeds on energy first, but take into account the protein requirements of the sheep you intend to feed and other mineral requirements are supplied.

Protein

Either consider only costing feeds that meet the protein requirements of the sheep you will feed (e.g. if oats is the cheapest on energy but too low in protein, don't purchase) or consider adding a small proportion of a high-protein supplement (e.g. lupins) if this is practical and cost effective. It is important to know the protein content of some feeds before they are used as a diet. This is particularly the case for grass hays and oats. The only way to obtain this information is to have samples tested in a laboratory.

Minerals and vitamins

Only two major minerals, calcium and sodium, are likely to be needed as additional supplements during a drought.

Calcium is deficient when diets consist mainly of cereal grain. To prevent calcium deficiency, add 2 per cent of finely ground agricultural limestone (calcium carbonate) to cereal grain (i.e. for every tonne of grain add 20 kg of limestone). Do not use builders lime, burnt lime or slaked lime. Spread lime onto grain when filling the feed out bin. Lime is largely not lost when feeding out as the fine particles stick to the grain. Do not add lime to stored grain when filling the silo as lime may corrode the silo lining.

Sodium is deficient in most grains. Common salt can be provided at 0.5 per cent if needed, but water supplies often have sufficient salt to alleviate the need to supplement.

The addition of salt can have other benefits than nutritional. Salt is palatable and so can be used to encourage sheep to eat the limestone. It will also increase water intake which can be useful to prevent bladder stones in wethers and rams (see Chapter 7 - Sheep diseases associated with drought). Increasing water consumption may not be useful for other sheep, so if sodium is not limiting, the amount of salt supplied can be reduced once all animals are consuming the limestone.

Alternatively, both salt and calcium can be provided in a salt lick. The percentage of each mineral can vary, but calcium levels above 30 per cent start to limit uptake. You can mix your own licks cheaply or buy commercial blocks. One difficulty with licks is that the intake can be highly variable. Some sheep in the mob do not touch them whilst others consume more than is needed.

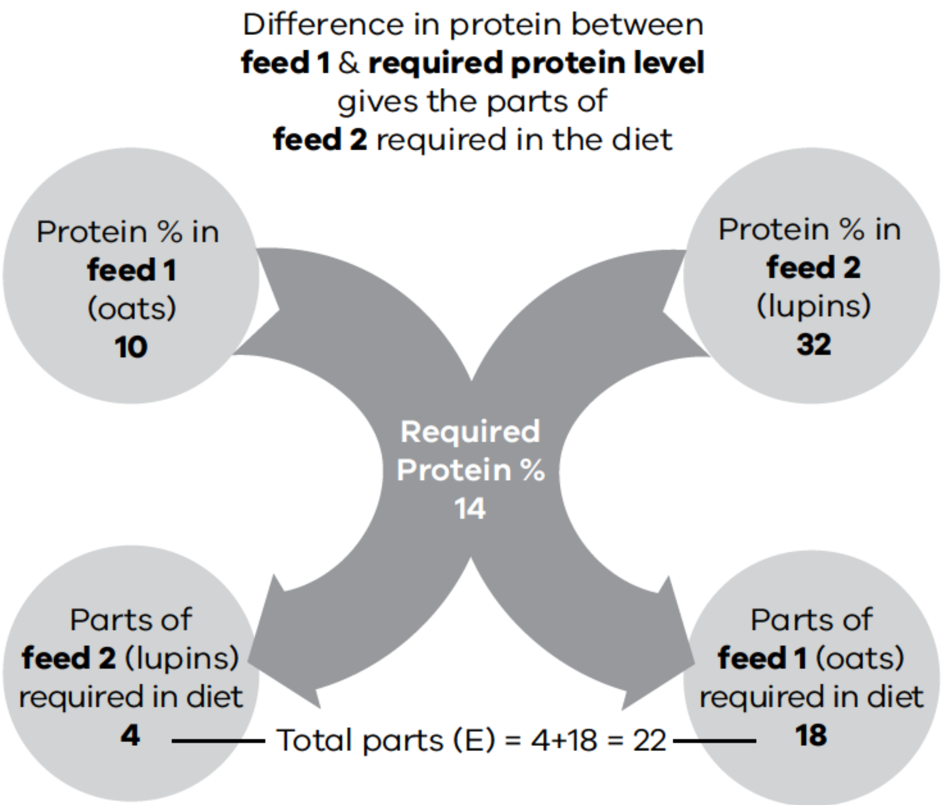
Mixing supplements to meet energy and protein needs

If you have the infrastructure to store and mix more than one grain or other supplement, an option may be to buy two sources and make up a ration that meets stock needs for energy and protein. Typically this can occur when a cheap energy source does not supply enough protein for young animals that need to grow or for ewes with lambs at foot. There are some useful tools to make your own estimates for this but a common method is Pearson's Square. A tool or spreadsheet for this can be found online but an example is given below which can be used to make your own estimates.

Pearson's Square – Example for balancing the diet for energy and protein.

Example is for 25 kg lambs that need to grow (see Table 3.1). They require 8 MJME/day in energy and 14% crude protein. An option may be to mix a high protein grain (as lupins) with a cheaper energy source grain that is not high enough in protein (in this example – oats).

Feed 1	Oats	10 MJ ME/kgDM	10% Crude Protein	90% dry matter
Feed 2	Lupins	13 MJ ME/kgDM	32% Crude Protein	90% dry matter



Proportion (%) of **feed 1** (oats) in diet = (18÷22) x 100 = 82% or 0.82
Proportion (%) of **feed 2** (lupins) in diet = (4÷22) x 100 = 18% or 0.18

The lambs will require 82% of the ration in oats with 18% lupins to supply their protein needs. The amount to feed will need to supply their energy needs.

Amount of energy needed from feed 1 (oats)				
Proportion of oats in diet	X	Animal requirements MJ ME/day	=	Amount of energy needed from oats MJ ME/day
0.82		8		6.5 MJ ME/day
kgDM required of feed 1 (oats)				
Amount of energy needed from oats MJ ME/day	÷	Energy value of feed 1 (oats) MJ ME/kgDM	=	Amount required of feed 1 (oats) kgDM
6.5		10		0.7
Amount of feed required on an as fed basis (oats)				
Amount required of feed 1 (oats) kgDM	÷	Dry matter of feed 1 (oats) (expressed as a decimal, i.e. 90% = 0.9)	=	Kg as fed per head per day of feed 1 (oats)
0.7		0.9		0.7

Amount of energy needed from feed 2 (lupins)				
Proportion of lupins in diet	X	Animal requirements MJ ME/day	=	Amount of energy needed from lupins MJ ME/day
18		8		1.5 MJ ME/day
kgDM required of feed 2 (lupins)				
Amount of energy needed from lupins MJ ME/day	÷	Energy value of feed 2 (lupins) MJ ME/kgDM	=	Amount required of feed 2 (lupins) kgDM
1.5		13		0.1
Amount of feed required on an as fed basis (lupins)				
Amount required of feed 2 (lupins) kgDM	÷	Dry matter of feed 2 (lupins) (expressed as a decimal, i.e. 90% = 0.9)	=	Kg as fed per head per day of feed 2 (lupins)
0.1		0.9		0.6

Each lamb will therefore require 0.8 kg of the ration per day as 0.7 kg of oats and 0.1 kg of lupins. This will meet their energy requirements of 8 MJ ME/head/day with the required protein of 14%. You may also need to check that the animals will be able to eat the daily quantity required, as outlined in the section on feed intake. As these lambs can eat about 3-4% of their bodyweight, they will be able to eat 0.8 to 1 kg of good quality feed and so will be able to eat the ration as required.

Further information

- Making More From Sheep: Module 8 Turn Pasture into Product: www.makingmorefromsheep.com.au/turn-pasture-into-product/index.htm
- Sheep Farming for Meat and Wool. Edited by J. Court, J. Webb Ware and S. Hides. Published by CSIRO.

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Trace Elements in Pastures and Animals in Victoria. Prepared by W.J. Hosking., I.W. Caple., C.G. Halpin., A.J. Brown., D.I. Paynter., D.N. Conley., P.L. North Coombes.

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