CHAPTER 5
Choosing feeds

This chapter discusses the use and interpretation of feed analyses in costing and balancing rations.

Key Messages

- **A feed analysis is the only accurate way to determine the value of the feed being offered to your cattle.**
- **Feed analysis samples should be taken and sent to arrive at the laboratory as quickly as possible (e.g. avoid them being held in transit over a weekend).**
- **Key figures to know are energy, protein, fibre and dry matter of the feed.**
- **If purchasing feeds, compare the feed costs based on the component you are buying the feed for – energy, protein or fibre.**

Understanding the components of a feed

It is important to provide stock with a ration that will enable them to achieve a desired level of performance. When developing a feed budget, the main feed components to know the value of are energy, protein, fibre and dry matter. Other components that are tested and reported in a feed analysis, such as minerals and vitamins, should also be taken into consideration.

It is difficult to judge feed quality visually. To ensure cattle are properly fed, it is important to get an objective measure of the feed components.

Energy

The metabolisable energy (ME) values of different feeds are important for two main reasons:

- The ability of the animal to maintain their weight and production level (growth, reproduction and lactation) is highly dependent on meeting specific energy requirements. It is only possible to calculate the amount of feed required to meet production targets when you know the energy value of the feeds that make up a ration.
- The decision to buy a feed should be based on the cost per unit of energy rather than the cost per tonne. See later in this chapter for details on costing feeds on an energy basis.

One problem with feeding based on energy values alone is getting the stock to physically eat enough. Feeds high in fibre (such as mature pasture hay, cereal hay and straw) cannot be eaten in large enough quantities to provide the required energy because they are digested slowly and stock physically can't fit enough in. This shortfall in energy requirements results in the animal using body fat to meet its needs. To avoid this, do not use low energy feeds as a sole ration. Mix high-fibre feeds with higher-energy feeds, such as pasture, silage, good quality hay or grain, to meet overall requirements. The higher the energy requirement, the smaller the amount of low-quality feed that can be used in the diet.

A feed analysis report will report back 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 cattle for use. It involves the measurement of energy excreted in faeces, urine and exhaled as methane. This requires specialised equipment so in Australia it is calculated based on the digestibility of a feed.

As an example of the importance of knowing the variability in feed quality, the ME of pasture hay can vary from 6.5 MJ ME/kgDM for very poor, mature grass hay to 9.5 MJ ME/kgDM for top-quality clover-dominant hay. Grains can range from 9 to 13 MJ ME/kgDM.

Protein

Protein contains nitrogen, which is used to estimate the protein content of feeds. It is typically measured as crude protein and expressed as a percentage of dry matter. It is called crude protein because it measures both the true protein (amino acids) and a portion of the nitrogen in feed that is non-protein nitrogen (nitrates, ammonia and urea).

The protein requirements of cattle vary according to the weight and type of animal, as well as the level of production (growth, reproduction and lactation). Crude protein values give a good indication of whether a particular foodstuff will satisfy the protein needs of an animal.

Green pasture is typically high in protein (leafy pasture is 25-30% crude protein). 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 fall below requirements. Failing to meet protein requirements will result in the energy in the diet not being completely used and may even result in stock using the breakdown of muscle to overcome the shortfall of protein.

Growing stock have high demands for protein. Steers and heifers weighing between 180 kg and 400 kg require 13% crude protein in their diet to grow 1 kg/day. Early-weaned calves have even higher requirements of 16% protein.

Some supplements, such as processed grain and pellets, are medium to 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.

Crude protein values can range from 6% to 19% in hay. Silage can show similar variation, and in the case of cereal grains, protein can vary from 5% to 16%.

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

Fibre

Cattle need a certain amount of fibre to ensure the rumen functions properly. Generally, cattle grazing pasture will get enough fibre in their diet.

Neutral detergent fibre (NDF), as reported in a feed analysis, is a measure of the total 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 result in a lower intake. Conversely, lower NDF values lead to higher intakes. The minimum level of fibre required in the diet is 30% NDF for all classes of cattle.

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 (such as grains) cause the rumen to become acidic. These feeds include cereal grains, some by-products and certain vegetables, such as potatoes. These feeds need to be introduced into the diet slowly. See Chapter 7 for more detail on how to introduce cattle to grain.

If you are using low-fibre supplements, ensure there is adequate fibre elsewhere in the diet. Hay, straw, silage and pasture all have a lot of fibre and can be used to keep fibre at the desired level. Oats are the safest and highest fibre grain with 29% NDF, compared with barley at 14% NDF and wheat at around 11% NDF.

Too much fibre limits the amount an animal can eat. For example, if cows with young calves are grazing poor pasture and fed a supplement of low-quality hay, their energy intake would be too low. This would result in cow weight loss and poor calf growth. In these instances, a low-fibre, high-energy supplement (such as grain or pellets) should be provided.

Dry matter

It is important to know the dry matter (DM) content of the feed. All measurements of energy and protein are made on a DM basis so feeds of different moisture contents can be compared.

DM 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% DM. This means 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% DM. This means 1 tonne of grain has 900 kg of dry matter and only 100 kg of water.

Knowing the DM 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 50 MJ ME of energy?
>
> Silage required:
>
> 50 MJ ME ÷ 11 MJ ME/kgDM = 4.5 kgDM
>
> 4.5 kgDM ÷ 0.45 (silage 45% dry matter)
>
> = 10 kg as fed

Other components of a feed analysis

- Moisture is the amount of water in the feed and is measured as a percentage of the original sample.
- Digestibility can be seen on a feed analysis report as DDM or DMD (depending on the company completing 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%. Feeds below 55% are of poor quality and even if cattle are given unlimited access, they will be unlikely to be able to maintain their liveweight.

- 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; 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 in the sample.
- Fat is expressed as a percentage of dry matter and is a measure of the lipid content of the feed. If the diet of cattle is too high in fat correct rumen function can be impaired.
- 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 source of energy for the rumen bacteria and therefore the cattle.

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

How to sample for a feed analysis

The first step is to select the feed analysis company you wish to use. The company websites have details about how to sample, costs involved, how to access sampling kits and payment methods.

The following companies offer feed analysis:

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

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 pasture

Walk through the paddock and cut a sample to residual grazing height (height cattle normally graze down to) from near the toe of your right boot, every 10 steps. Ensure that the same sized area is cut every time (about 30 square centimetres) and that you sample from at least 15 locations in the paddock. Combine these samples into one and thoroughly mix to obtain an amount not exceeding 500 g. Be careful not to contaminate the sample with soil or faeces. 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 areas. Thoroughly mix them and send 300-400 g of this mix for testing.

Use one bag for each sample. Fill out the analysis company's sample information sheet with details of the feed and its intended use.

Samples should be posted as soon as possible after collection.

Table 5.1: Energy and protein compositions of common livestock feeds (pasture, hay, silage, straw).

Feed	Approx dry matter (DM) %	Energy MJ ME/kg DM		Crude protein % dry matter	
		Average	Range	Average	Range
GRAZED PASTURES					
Grass-dominant pasture			3-14		1-37
Young, immature	23	11		25	
Mature	40	7		5	
Clover-dominant pasture			4-12		1-35
Immature	15	11		30	
Mature	30	4		7	
Lucerne			4-13		3-41
Young, immature	17	11		30	
Full bloom	24	8		15	
GRAZED CEREAL CROPS					
Barley/oats			7-13		3-33
Early vegetative	19	9		20	
Post-bloom	21	10		8	
HAY					
Pasture hay, grass dominant			5-11		1-30
Flowering	80	10		9	
Two weeks after flowering	85	9		8	
Pasture hay, sub clover dominant Flowering	80	9	7-11	13	8-26
Lucerne hay			5-11		6-28
Pre-flowering	85	9	5-12	15	
Flowering	90	8		14	
Oaten/wheaten hay			5-11		1-16
Flowering	85	9		7	
Milk stage	87	8		5	
Ripe seed	90	8		3	
Canola hay	70	11	8-13	17	4-27
SILAGES					
Grass dominant	45	10	7-11	14	4-23
Legume dominant	44	10	8-12	15	8-28
Lucerne	51	10	7-11	19	11-27
Cereal	46	9	6-11	11	4-21
Canola	60	9	6-10	17	9-26
CEREAL STRAWS					
Barley, oaten, wheaten	90	5	4-7	2	1-4

Table 5.2: Energy and protein compositions of common grains (whole and processed).

IMPORTANT – Note the difference in approximate dry matter (DM) % (ME) Metabolisable energy (MJ/kg DM)	**Approximate dry matter (DM) %**	**Energy MJ ME/kg DM**			**Crude protein % dry matter**	
		When fed whole to cattle	When fed rolled or coarsely milled to cattle			
		Average	Average	Range	Average	Range
Wheat	90	9	13	12-15	12	8-23
Barley	90	8.4	13	11-13	11	6-17
Triticale	90	10.4	13	12-15	12	9-15
Oats	90	10	11	9-13	9	6-12
Lupins	90	11	13	12-14	30	26-40
Peas	90	11	13	10-13	23	18-29
Maize	90	13	13.5	12-14	9	8-13
Safflower seeds	90		13	7-12	25	20-37
Rice (dehulled)	90		12	11-14	7	7-9
Rye	90		14		11	
Sorghum	90	10	13		11	
Pellets	90	N/A	12	10-14	12	11-16

WARNING: As can be seen from the table, feeds vary considerably in 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, fibre and dry matter.

Costing fodders on energy value

Fodders such as grain and hay are usually bought and sold on a price per tonne (or some other unit of weight or size). Feeds contain moisture and need to be converted to dry matter figures before they can be compared.

The most important basis for comparison of feedstuffs is their energy content. Tables 5.1, 5.2, 11.1 and 11.2 list the energy and protein values of a range of foodstuffs. It is important to note that those values are all expressed on a dry matter (DM) basis.

The following section aims to help 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 feedstuff.

How to calculate the cost of feed on an energy basis

Example: Which feed is the best value on an energy basis?

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

Feed A

Step 1 – Calculate the price of the feed on a dry matter basis at 85% dry matter					
$/ tonne as fed	x 10	÷	% DM	=	Cents/ kgDM
195	x 10	÷	85	=	23

Step 2 – Calculate the cost per 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 85% 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				
Cents/ kgDM	÷	MJ ME/ kgDM	=	Cents/ MJ ME
25.6	÷	13	=	1.97

Therefore, Feed B is better value per unit of energy, costing 1.97¢/MJ ME, compared to 2.3¢/MJ ME for Feed A.

Table 5.3: Quick lookup table for costing fodder based on energy value – costs are calculated on a cents/megajoule basis.

		$/tonne															
Fodder	**MJ ME/ 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

Other factors to consider when buying fodder

The cost of feeding cattle is not just the cost to buy feed. There are also costs associated with labour, freight, extra storage and handling, and the likely amount of wastage.

Grain processing

Cattle only derive the full value from grains such as wheat, triticale and barley if the grain is rolled or coarsely milled (Table 5.2). Processing equipment can be expensive, but may be worth the investment if used on a large enough scale.

Feed companies sell rolled or crushed grain, but at a higher price than whole grain. Remember to calculate the cost (in ¢/MJ ME) for both the whole and the crushed grain.

Storage, handling, feeding out

Ask the feed company about storage requirements for the feed you are looking at buying. Consider what equipment and infrastructure you will need to be able to store and feed out purchased feed. If you are using self-feeders, ask how well the feed will flow through them.

Availability

The microbes in the rumen, which provide the cattle's main digestive capacity, take up to two weeks to adjust to a new feed source and fully utilise that feed. As a result, feeding cattle for less than two weeks is uneconomic. There is little use starting cattle on a feed that you are not able to source for longer than a two-week period.

Switching cattle too quickly from one feed source to another every couple of weeks carries with it a high risk of digestive upsets and the bugs in the rumen try to constantly adapt to differing feed sources.

Cost of freight

The bulkiness and handling difficulties of some feedstuffs (for example, feeds high in moisture such as carrot pulp) mean higher freight costs compared to concentrated feeds such as grains.

Noxious weeds

Take care to buy fodder that is free from noxious weeds. Weeds such as Paterson's curse, Bathurst burr, variegated thistle, etc, can be a problem for years after a drought has ended if they are accidentally introduced onto a property. It is important to inspect all samples for weed seeds, however it is not always possible to detect a potential problem or even to refuse delivered feed on these grounds.

One way to minimise potential weed problems is to restrict feeding out suspect fodder to a limited number of paddocks. Stock can be boxed together in large mobs on stable soils. This can have the added advantage of preserving some vegetation on de-stocked areas of the farm, reducing the likelihood of severe erosion.

Tips for buying hay

Hay can be a good management option in some situations, but it can be expensive and often hard to find a quality supply.

An average dry cow requires 8.5 kg DM/day of hay (depending on the quality of the hay) to maintain herself (which is almost half a small bale). If high rates of grain are fed, the diet will need to contain good-quality hay to maintain adequate fibre levels.

If you are buying hay from other districts, transport costs will be higher. Aim to buy only high quality hay to avoid paying transport on low-value feed.

Buying locally has the advantage of low transport costs and knowing the quality of the hay.

When buying, find out the feed value, how long it has been stored, the amount of legume or clover, and whether there are any weeds present. Ask the vendor if any has been sold into your district so that you can inspect hay from the same batch before buying.

It is also a good idea to ask about the pasture species, the type of shed where the hay is stored and the stage of maturity the hay was baled. If the vendor has good knowledge of their hay they are more likely to be a genuine seller rather than a dealer in hay.

If buying lucerne, be aware that first cut lucerne will have a lower nutritive value and more annual weed seeds. If you do buy lucerne, make sure it has a fine stalk. It is also important to have a method of feeding that will avoid the loss of leaf. The best method is to feed lucerne in a feeder, or to mill the hay and feed in a feed trough. Dampening the lucerne hay the day before feeding will help to hold the leaf on the stem and reduce losses.

When buying hay try to purchase by weight so you can calculate a price per tonne delivered to your property. It is a good practice to request a feed analysis for the hay, which will give an accurate measure of the metabolisable energy (MJ ME/kgDM), crude protein and fibre content. This will enable you to price your hay on a ¢/MJ ME basis and compare the value of the various feeds on offer.

Drought feeding of stock – the risk of chemical residues

Many producers are tempted to try a variety of alternate feedstuffs. Chapter 11 presents information on the feed value of a range of unusual feedstuffs. Alternative feedstuffs can range from waste plant products and vegetable matter from manufacturing processes – such as potatoes, citrus pulp, cabbage leaves and carrots – to manufacturing by-products – such as cotton waste and sawdust.

Apart from their generally poor nutritional value, these 'unusual' feedstuffs could also be contaminated with high levels of chemical residue. Potentially all supplementary feeds may contain chemical contaminants, but 'unusual' feedstuffs, not normally used for feeding livestock, pose a much greater risk.

Agricultural chemicals used on fruit and vegetable crops are typically designed to be eliminated from the edible parts of the plant at harvesting. Some residues, however, may still be present in the waste plant material after processing and problems can occur when this is fed to stock.

These agricultural chemicals are not designed to be ingested by livestock, and little is known about either their effect on livestock or the persistence of chemical residues in animal tissues.

There is a very real possibility that the meat from animals that are fed products containing chemical contaminants will itself become contaminated with these chemicals. Producers should be aware of the Export Slaughter Interval (ESI) and the Withholding Period (WHP).

The ESI is the time that should elapse between administration of an agricultural or veterinary chemical to animals and their slaughter for export.

The WHP is the minimum period that must lapse between last administration or application of an agricultural or veterinary chemical, including treated feed and the slaughter of the animal for human consumption. WHPs are mandatory for domestic slaughter and on the label of every registered product.

Chemical-withholding periods must be observed for any chemical used in a crop. In some instances chemical use earlier on in the season may preclude the option of cutting the crop for hay. It is essential that withholding periods be observed.

The best policy is not to feed unusual feedstuffs to stock without first establishing that the material is suitable.

Producers should ask the supplier of unusual feedstuffs to certify that the material they are supplying is suitable for the purpose for which it will be used.

Where possible, producers should obtain a commodities vendor declaration on any feedstuffs they buy.