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Feedlotting lambs

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Introduction

Feedlotting is a management practice which lamb producers frequently use in an effort to achieve a consistent supply of quality lamb that meets market specifications for weight and fat score.

It allows producers to maintain production when pasture availability is limited, to achieve rapid growth when feed prices are low, to generate cash flow and to value-add ration components (e.g. grain).

While feedlotting gives producers the flexibility to finish lambs irrespective of seasonal conditions, other options may be more profitable, and should be considered.

Producers should carefully compare the benefits of feedlotting with paddock supplementation or selling selected stock and grain to generate income.

Additional options include selling lambs as stores, maintaining lambs until quality fodder crops and/or pasture are available, agistment (if available), and/or contract feeding in an established feedlot.

Economic considerations

It is critical that a careful financial analysis be undertaken, to assess the viability of feedlotting lambs before committing resources to an intensive feeding system.

An example of a preliminary budget is shown in Table 1. Alternatively, producers can enter real-time values, ration details and all associated production, management and marketing costs into the Lamb Feedlot Calculator, to pre-determine the profitability of a lamb feedlotting program.

Information is also provided regarding total feed requirements, value-adding of ration components, break-even costs and returns on capital investment. The Lamb Feedlot Calculator can be downloaded free of charge from www.sheepcrc.org.au

Price margin

Producers will need to estimate the margin that exists between the present value of the lambs as stores and their expected value when finished.

To estimate their final value, contact local abattoirs for price grids or forward contract prices, assess long and short-term market trends and estimate lamb supply over the proposed selling period.

Livestock agents and meat buyers can assist with these tasks. Due to the volatility of saleyard systems, it is recommended that producers actively seek forward contracts for feedlot lambs or alternative marketing systems.

Buying light lambs to feedlot and then selling them at trade weights of below 40 kg live weight is generally not recommended. There is greater certainty in predicting the final value of lambs finished to heavy trade (20–22 kg) or export (24 kg+) weights, because of the availability of price grids and forward contracts for these lambs.

Feed cost

As most lambs require 10–14 kg of feed to produce 2 kg of liveweight (1 kg of carcase weight), ration costs are a major issue within a feedlotting program.

The amount of feed required will depend on:

- starting live weight
- ration quality (in terms of energy, protein, vitamins, minerals and digestibility)
- lamb growth rate and genotype

- the lamb's ability to convert feed to carcase weight (feed conversion efficiency)
- the target market weight.

If buying in feed, carefully consider feed quality, availability and price. Feeds need to be assessed on a dry matter, landed on-farm basis.

All the major feed components should be tested for energy and protein. Testing for chemical residues should be considered, particularly if a vendor declaration is not available.

It is strongly recommended that you contract all feed requirements at a specific price before feedlotting. This eliminates the risk of escalating prices – particularly during drought. Most lambs will need to be held within a feedlot system for 6 to 8 weeks.

Risk

Feedlotting involves financial risk. Lamb deaths, non-feeders, poor growth rates and unexpected changes in feed or market prices can affect the economic success of the venture.

Producers should therefore include a risk factor in the budget. Financial risk can be minimised by ensuring:

- that adequate feed is stored on farm
- a prearranged price for purchased feed
- sound feedlot management
- that lambs are forward-contracted to an abattoir at an agreed time and value.

Capital expenditure

A feedlot can be built without significant capital outlay. Well-designed temporary facilities can be built at low cost, or existing facilities may be modified to provide a suitable feedlot.

Holding yards near the shearing shed can often be suitable for feedlots if they allow provision of water and shade, as they are often close to working yards, as well as feed preparation and storage areas.

The greatest capital outlay when establishing a feedlot will probably be for feed troughs, feeders or hay racks. The fencing cost need only be the cost of steel posts (spaced 3–4 m apart) and lamb-proof 6-line hinge joint or ring lock fencing.

Economic viability

The following is an example budget for assessing the viability of opportunity feedlotting. This example starts with a 35 kg store lamb. The objective is to market that lamb at 45 kg liveweight.

A 14-day grain introductory period accustoms lambs to the change from pasture to grain-based diets. This time can be reduced if lambs have been trained prior to weaning to recognise grain as a feed source, and/or are introduced to the ration before entering the feedlot.

Lambs will consume around 15–20 kg of feed during this period, but are unlikely to gain much live weight. Shy feeders and sick lambs should be identified during this period and removed from the feedlot.

During the finishing phase of a feedlot program, an average feed conversion of 6 to 1 is assumed. Therefore, an estimated 60 kg of feed will be required to obtain a 10 kg gain in live weight.

While improved feed conversion rates may be possible, it is critical that producers investigate the costs and benefits of including high-priced feed additives promoted within industry. Improved feed conversion rates under some intensive feeding protocols and systems do not necessarily equate to greater profit margins.

Include cartage and selling charges if store lambs are to be purchased. These costs were not included in the example budget. It was assumed that the lambs were bred on the property and the owner would pay these charges whether the lambs were sold as stores or following feedlotting. Labour costs are not included.

Table 1. Example of a preliminary budget.

Value of lambs as stores	$75.00
Feed costs	
Introductory phase (17 kg at $250/tonne)	$ 4.25
Finishing phase (60 kg at $300/tonne)	$ 18.00
Running costs	
Drench	$ 1.00
Vaccination	$ 0.25
Deaths and shy feeders (5% at $85/head)	$ 4.25
Interest (2 months)	$ 1.40
Total or break-even price	$ 104.15

Setting up the feedlot

Before starting feedlot development, check with the local consent authority (usually the local council) about any legal requirements or restrictions on lamb feedlots within the proposed development area. For example, within NSW it is a legislated requirement that a development application be submitted to the local council and the Environmental Protection Agency (EPA) if

more than 4000 head are on feed or if the feedlot is located on an environmentally sensitive site.

Site

Select a well-drained site that is close to feed storage, water, yard and shed facilities. The site should have adequate shade and protection from prevailing winds.

Medium clay loam soil types are preferred. Heavy clay soils may 'pug' in wet weather and dry slowly, increasing odour and welfare problems. Sandy/light soils have high infiltration rates and are prone to erosion.

In a poorly drained feedlot, lambs can become covered in mud during wet weather and feeding vehicles can bog. Lambs may also be predisposed to foot abscess or scald and diseases such as coccidiosis and salmonellosis.

Protect trees from damage caused by erosion and lambs chewing bark or rubbing. Loosely wrap individual tree trunks with wire netting, or build temporary exclusion fences. Artificial shade may also be provided.

Size

Feedlot size will be determined by the number of lambs to be accommodated, past experience, site suitability and personal preference.

As a guide, provide each lamb with a minimum of 5 m² of yard space. Additional area (from 10 to 20 m² per lamb) may reduce social stress and the number of shy feeders.

The area should not be large enough to allow the growth of a green pick, which lambs will chase, leading to a decline in their growth rate.

Reducing area to 2 to 3 m² per lamb may reduce dust levels through urine/manure moisture effects and compaction of topsoil, but may also increase social stress, shy feeder numbers and health issues.

The preferred lot size is one that will accommodate 300 to 400 lambs, with a maximum of 500 lambs. Poor results have been experienced with large mobs of lambs.

As a guide, an area of 50 m x 50 m is a suitable yard size for between 250 (10 m² per lamb) and 500 (5 m² per lamb) lambs.

Water

A plentiful supply of cool, clean, good-quality water is essential. This point cannot be overemphasised.

Provide water in troughs rather than by access to dams as water quality is likely to suffer and there are few options to solve the problem.

Poor quality water (including contamination by feed dust and faeces) leads to a reduction in water consumption by lambs. Reduced water intake leads to a reduced feed intake, resulting in poor lamb growth rates and an inefficient feedlot.

Water troughs are best placed at the opposite end of the yard to hay racks and feeders. Raise them a minimum of 40 cm. A gravel or concrete base is recommended, to minimise erosion and assist drainage around trough bases.

It is recommended that troughs be cleaned regularly (on a daily basis if practical or necessary). Many commercial operations will clean troughs more than once daily, depending on the level of contamination, time of year and weather conditions.

Capped industrial-grade PVC troughs can be used to provide adequate trough length and minimise water waste when cleaning. The high risk of feed contamination in such low-volume water systems requires these systems to be regularly cleaned. Be wary of the use of copper-based algaecides in such systems, as they may increase the risk of copper poisoning.

The average water requirement of lot-fed lambs is usually around 2.5 times feed intake or 3 to 4 L a day. Around 2000 L of water is needed daily for 500 lambs, although actual consumption may range from 1000–3000 L daily. This depends on prevailing temperatures, lamb body weight, the water content of the ration and salt levels within both feed and water.

There are no set requirements for length of trough, however, 30 cm plus 1 cm per head is generally accepted within industry. Supply (good pressure and flow rates) and quality are critical, regardless of trough length or type.

Feeding equipment

Feed should be available at all times. This facilitates higher lamb growth rates, which is important to overall feedlot efficiency. It also helps to reduce the risk of digestive problems and shy feeders. Where feed troughs are used, they may require twice-daily filling.

The grain and roughage portions of the diet can be offered together as a total mixed ration in a trough or, following processing, in a self-feeder.

Total mixed rations lower the risk of lambs preferentially selecting the grain component of the ration, and thereby reduce grain poisoning (acidosis) risk. Not all self-feeder systems are suitable for total mixed rations. Many may lead to feed 'bridging', unless there is adequate clearance between the hopper and feed trough to allow free flow of feed.

The grain and roughage components of the ration may be fed separately in self-feeders or in hayracks.

Poorer quality fibre can be used during the finishing period to meet fibre requirements. High-quality hay fed during this period may be preferentially eaten, reducing grain intakes and growth rates, unless fed periodically (i.e. every second day) or within effective hay racks.

Troughs

Troughs can be simple and inexpensive. They can be accessed from one or both sides, and should be constructed to prevent lambs from standing in them and fouling the feed.

Allow a minimum of 15–30 cm per lamb, depending on the trough system used. For example, 300 lambs need 45 m if able to access feed from both sides of the trough.

However, if lambs have access to a single side only, 90 m is recommended. A trough width of 30 cm and depth of 20–25 cm is ideal. This allows filling without wastage, and gives enough space for a day's feed per lamb.

Providing additional trough space per lamb and spreading the troughs out within the feedlot may also minimise the incidence of shy feeders.

The top of the troughs should be 30 cm above ground level and can be raised using permanent legs, or by sitting troughs on tyres or hardwood sleepers.

Troughs should be cleaned daily, and sited on a slight slope well away from watering points. This will assist drainage from the troughs during wet weather and prevent feed from contaminating watering points.

Self-feeders

Self-feeders allow lambs to eat to appetite, without the need to regularly fill troughs. They require less labour than open troughs, as they eliminate the need for daily (in many instances) or twice-daily feeding. The flow of feed can be a problem in some designs and with some rations. Self-feeders do not eliminate the need for daily supervision.

Allow 3 to 5 cm of access to the self-feeder per lamb. For example, 300 lambs will need 9 to15 m of trough space when self-feeders are used.

A horizontal bar along the face of the trough or ensuring the feeder is 40 cm above ground height will reduce the likelihood of lambs fouling or raking feed from the trough.

'Lick' style self-feeders will minimise the risk of engorgement and acidosis. Lambs are required to actively lick grain, reducing gorging and allowing small intakes of grain throughout the day, reducing acidosis risk. Lick feeders do not necessarily limit grain intake; lambs can still maintain intake needed for growth.

If lambs go off the grain, even for a short time (e.g. during wet weather), provide additional high-quality hay, to minimise acidosis risk when lambs begin eating grain again.

Pelleted rations, available from commercial feed mills, are ideal for use in self-feeders. They generally provide a balanced ration in terms of energy, protein, vitamins and minerals. Acidosis risk is generally high, due to the high grain content of such feeds.

When introducing lambs to pellets, or when using recently sourced pellets (even if purchased from the same manufacturer), be wary of acidosis risk. Providing additional fibre will ensure there is adequate effective fibre within the diet for normal rumen function, and will reduce acidosis risk.

Self-feeders can be purchased, home built or constructed as a temporary structure in the feedlot. Cattle self-feeders can be successfully converted for use by lambs, but care needs to be taken to reduce engorgement and acidosis risk.

Hayracks

If you have access to a hammermill or mix-all, hay is best chopped and mixed with the grain. However, this approach requires additional time in preparing feed, and may increase feed costs.

Unprocessed hay or silage can be successfully fed in hay racks within feedlot pens. Waste and minimising hay substitution for grain are issues that may need to be addressed.

Simple racks can be made from 10 to 15 cm square mesh held up by steel posts. A tray near ground level will reduce trampling and wastage.

Fodder rolls and large bales are generally not suited to lamb feeding, unless they are fed from a hayrack.

Hayracks with sliding side gates that move towards the centre of bales as the lambs consume the hay may block up as waste hay collects at the base. Leave a 15 cm gap at the base of the sliding gates to minimise waste and bridging problems.

Ensure hay is free of dust and barley grass, to minimise eye problems, particularly if lambs are eating hay from below. Pinkeye problems are likely if lower quality hay is used within such systems.

Selecting lambs

Breed or breed crosses

Economic success in feedlotting is more likely with crossbred lambs because of the higher price paid per kilogram for their carcases, their faster growth rate and earlier maturity. There is a market premium for crossbred lambs over Merino lambs

Live weight and condition

Live weight is important when choosing lambs. A fundamental requirement for efficient management is access to scales. Use these when first selecting lambs, and to monitor performance over time.

Drafting lambs according to live weight and size, providing a low-stress feedlot environment and ensuring that adequate trough length is available will minimise shy feeder numbers.

Success, in terms of physical performance in the feedlot, is increased if lambs have reached a minimum liveweight of 25 kg and at least fat score 2 before entry.

However, fiscal success is more likely if the heavy trade and export market segments are targeted. In these circumstances, the minimum entry weight should be 35 kg or higher.

To finish lightweight lambs (25–35 kg) to export-grade weights requires additional time in the feedlot, increasing production costs and financial risk. If such lambs are to be finished in a feedlot, it is recommended that the target is a trade weight carcase of 18–22 kg.

Preparing lambs

Profitable feedlotting requires lambs to be prepared correctly for feedlot entry, and then for sale. When they enter the lot, lambs should be free of disease – particularly pinkeye, scabby mouth and lameness.

Internal parasites

To remove worm burdens, drench all lambs with an effective broad-spectrum drench before they enter the feedlot.

Vaccination

High-grain diets can predispose lambs to pulpy kidney (enterotoxaemia). It is essential that lambs are vaccinated before entering the feedlot with a 5 or 6-in-1 vaccine.

If lambs have not been previously vaccinated, a second vaccination may be needed if they are in the feedlot for more than four to six weeks.

Vaccination for scabby mouth may be needed if problems are experienced in successive batches of lambs.

Vaccines for vitamins A, D, E and B_{12} are commercially available. These are reasonably cheap, and are generally recommended if lambs have not had access to green feed within three months of entering a feedlot, or are from cobalt-deficient areas.

When vaccinating, take care not to damage the carcases or pelts. Preferred vaccination sites include the outer points of the pelt, such as the neck or ear area.

Shearing

Research suggests no specific advantages associated with shearing other than ensuring clean, even pelts. Shearing stimulates appetite, but may not necessarily improve feed conversion efficiencies. Shearing will, however, reduce the possibility of blowfly strike.

If the decision to shear has been made, do so two or more weeks before feedlotting. This will ensure that pelts have a minimum of six weeks of wool growth and that shearing cuts have healed prior to the marketing of finished lambs.

Do not shear if cold weather is likely and lambs don’t have adequate protection (e.g. shelter belts). Unprotected lambs will achieve poor growth rates and are at risk of mortality.

A pre-feedlot crutch may be useful for lambs that do not require shearing.

Shy feeders

Industry findings suggest that 5% to10% of lambs will not adapt to the feedlot. When percentages exceed this range, a careful review of feeding and management procedures is recommended.

Remove shy feeders from the feedlot. They may be sold, placed on pasture or fodder crop or penned separately. It is not uncommon for the majority of shy feeders to then gain weight, due to a reduction in social stress in their new environment.

Designing the ration

All feedlot rations should contain grain, roughage and necessary minerals, such as ground limestone and salt.

Salt may not be necessary if it is present in the water supply. Additional additives may be needed to improve overall lamb performance, depending largely on the quality of the major ingredients of the ration.

These additives could include protein supplements, urea, vitamins, and substances to reduce dust levels in the ration. Others may be added to address potential health problems; for example, to reduce the risk of acidosis.

Feed contamination by moulds, dust or rodents is a common reason for failure. Mouldy hay and rodent contamination reduce palatability, resulting in a reduction in feed intake.

Dust may be controlled by adding water, vegetable oil and/or molasses, singularly or in combination, at 0.5% to 4% of the ration.

Grain

The energy concentration of the ration is a critical factor influencing lamb growth rate, and therefore the efficiency of the feedlot.

The energy content of feeds is defined in terms of megajoules of metabolisable energy per kilogram of feed dry matter (MJ ME/kg DM) or simply M/D. The average energy contents of commonly used feeds are listed in Table 3.

A ration providing a minimum of 12 MJ ME/kgDM is recommended, and generally required if growth rates in excess of 250 g per head per day are targeted. If growth rates are low, reassess the feed and management program.

A sudden change from one grain source to another can cause digestive upsets, live weight loss and/or death. The problem can also occur when feeding different batches of pelleted feed.

Avoid losses by organising all grain requirements before starting to feed. Check with the pellet manufacturer to see if a change to the pellet ingredients was made between batches.

If changing grains is unavoidable, start the change before running out of the first grain source.

Gradually introduce the new grain by replacing 20% of the old grain with 20% of the new grain (on a weight basis) each day over five days.

If lambs begin to scour during the changeover period, or appear to have digestive problems, hold the ration constant and provide additional roughage until droppings return to normal.

Lambs may not have eaten for a day or more due to wet weather, transport, digestive upsets and/or preparation for entry to the feedlot. When this happens, limit access to grain and provide high-quality hay until the lambs' appetites are satisfied.

Cereal grains

There is considerable variation in quality within grain types. Whenever possible, an analysis of feed components should be obtained.

Cereal grains are a concentrated source of energy, with much of that energy stored as starch. They are usually the cheapest form of energy. Cereal grains also contribute to the protein component of the ration.

Grains usually comprise 65% to 85% of the finishing ration. There is no advantage in cracking, rolling or flaking grains for lambs. Doing so may increase the incidence of digestive upsets by increasing the surface area availability of starch molecules to bacterial breakdown.

Generally:

- all cereal grains have been used successfully for feedlotting
- wheat, triticale and rye are high-starch grains and present the highest risk of acidosis
- barley is of similar energy value to wheat, but the possibility of digestive upsets is lower due to lower starch, higher oil and higher fibre contents
- oats have the lowest and most variable energy content. They are generally the safest cereal grain to feed, due to lower starch and higher oil contents. Lower digestibility and higher fibre contents may reduce growth rates if oats make up more than 30% of a ration
- sorghum and maize are high-energy grains, but protein content can be extremely variable. Much of the starch contained in these grains may bypass rumen digestion and be broken down within the small intestine. Hind gut acidosis risk is therefore high when using such grains.

  Additionally, sorghum contains tannins that may reduce protein availability, while maize may cause yellow fat in lamb carcases when used at rates of more than 20% of a ration.

Grain legumes

Grain legumes are also high in energy and substantially higher in protein than cereal grains.

On an energy basis they are usually more expensive than cereal grains. They are commonly included to raise the protein content to required levels.

Generally:

- lupins are higher in protein than all cereal and legume grains. They are a reasonably safe grain due to their low starch content, and are often the cheapest form of protein
- field peas and faba beans have lower protein values and higher starch levels than lupins. Care should be taken when including these in a feedlot ration, due to acidosis risk
- processing grain legumes is unnecessary. The risk of grain poisoning is increased if peas or beans are cracked or rolled. Precautionary measures are required, to minimise this risk
- grain legumes can play an important role in raising the ration's protein content to the required level. This can usually be achieved at no more, and often less than 20% of the ration.
- due to their relatively high cost compared with cereal grains, the addition of grain legumes will increase the cost per tonne of the ration.

Other Feeds/Additives

Other concentrate feeds for potential use in feedlot rations include molasses, oilseeds (e.g. cottonseed, linseed, sunflower) and the meals derived from oilseeds.

Meals are protein-rich feeds which provide high levels of bypass protein and a convenient source of most vitamins and minerals.

When using oil seeds or meals, ensure the oil content of the total diet does not exceed 7% to 8%, as high oil/fat contents may affect rumen function, the efficiency of digestion and palatability, due to rancid flavours.

Meals may also create problems in self-feeder systems, due to bridging or blocking of feed flow. Use at a rate of less than 15% if possible.

Roughage

As with all ruminants, lambs need roughage to ensure the efficient functioning of the digestive system.

Roughage usually comprises 10% to 30% of the finishing ration. If the roughage is high quality (M/D greater than 9) it can be included at up to 30% of the ration.

Good-quality legume hays can make a substantial contribution to dietary protein, as well as helping to ensure that energy levels of the total ration remain high.

High-quality silage has been used successfully as the roughage component of rations, usually when used within a total mixed ration.

High silage use, however, may create issues with gut fill, excess non-protein nitrogen and ammonia production within the rumen, and reduced cud chewing and saliva production. The latter reduces sodium and potassium bicarbonate production, reducing the buffering effect on rumen acid levels and increasing acidosis risk.

Low-quality roughages, such as straws, should only be included at 10% to 15% of the ration. They reduce the energy content of the ration, and therefore the potential growth rate of lambs. They are also less palatable, but hammer milling and mixing with the grain will encourage intake.

Intake can also benefit from the addition of a 4:1 water/molasses mix. This has the added benefit of reducing ration dust problems.

High-quality hay should always be fed during the lambs' first few days in the feedlot, to ensure they start eating as quickly as possible. If necessary, poorer hay can be substituted for the good hay during the grain introduction period.

As with grain, a feed analysis provides a valuable guide for purchasing roughages and for ration formulation.

Calculating a ration's energy and protein contents

Energy

Energy is provided through the breakdown of carbohydrates, protein and oils/fats within the rumen and small intestine.

The 'form' in which a grain's energy is stored will influence metabolisable energy levels, rumen function, health (e.g. acidosis risk), growth rates and feed conversion efficiencies.

While starch is the most common form of carbohydrate found in cereal grains, excess protein can be used to provide additional energy for feedlot lambs; however, it is less efficient than starch digestion in terms of energy production.

Oils/fats are energy-rich forms which provide as much as 2.25 times the energy of starch. Unfortunately, levels exceeding 7% to 8% in diets can lead to a decrease in rumen efficiency, poor growth rates and poor feed conversion efficiencies.

Protein

Protein is necessary for muscle development, wool production and appetite. Inadequate protein

can lead to a reduction in rumen bug numbers and activity, a reduction in intake and slower growth rates.

Crude protein (CP) requirements vary according to the ration's energy content, as well as a lamb's age and live weight.

Younger, lightweight lambs require higher levels of protein at any given energy intake due to their higher requirement for muscle development (as shown in Table 3).

Heavier and older lambs require a lower protein content to achieve a balanced ration. Older lambs have undergone the majority of their structural development, and partition more energy to fat deposition.

The higher levels of 'bypass protein' within meals may be particularly beneficial in the diets of lightweight lambs, while the protein requirements of larger and older lambs are usually met by cereal grain and pulses.

Urea is a cheap form of non-protein nitrogen that the rumen microbes are able to turn into protein for the lamb's use. Urea can be included (usually at 1% to 2% of dry matter) to raise the crude protein content of the ration.

In the process of conversion into protein, urea is temporarily converted to ammonia by rumen microbes. A sudden surge of rumen ammonia can be fatal, so it is important that urea is evenly mixed in the ration and its concentration slowly increased over 7–10 days during introduction.

A mix-all is one method of incorporating urea. An alternative is to spray a 50% urea solution evenly onto the feed. This means dissolving 10 kg of urea in 20 L of warm water to treat one tonne (dry matter) of ration.

This inclusion of urea as 1% of the ration will increase the crude protein content of the total ration by about 2.5%. Urea should not contribute more than 25% to a ration's total crude protein content, and should not be included at levels greater than 3%, due to the likelihood of urea poisoning.

Small (< 30 kg) lambs should not be fed rations containing urea, as their rumens are not yet fully functional and cannot efficiently utilise the non-protein nitrogen urea supplies.

The average crude protein contents of commonly used feeds are shown in Table 2. Where possible, have each of the major feeds analysed for protein, as individual grain and roughage types vary.

Table 2. Average energy and protein content of various feeds. These values are on a dry matter basis. As grains, hays and meals contain about 10% water, an adjustment of this magnitude may need to be made to 'as fed' feeding levels.

Feed	Energy M/D	Crude protein %
Grains		
Maize	13.5	10.0
Grain sorghum	12.4	10.0
Wheat	13.0	13.5
Barley	13.0	11.3
Oats	11.5	10.5
Rice	13.0	8.0
Triticale	13.0	13.0
Lupins	13.0	32.0
Peas	13.0	24.5
Grain by-products		
Mill mix	11.5	16.5
Rice pollard/polishings	14.0	14.0
Hays		
Lucerne	9.2	17.0
Clover	9.0	15.5
Pasture		
Mainly clover	8.5	14.0
Mainly grass	8.0	10.0
Oaten	8.0	9.0
Wheaten	8.0	9.0
Soybean	8.5	15.0
Sorghum/millet	8.0	8.0
Peanut	8.5	9.5
Low quality roughages		
Oat, barley or wheat straw	6.0	4.0
Cottonseed hulls	4.5	5.0
Silages		
Lucerne silage*	8.5	17.0
Maize silage*	9.5	8.0
Protein meals		
Peanut meal	11.5	42.0
Cottonseed meal†	11.0	43.0
Sunflower meal†	10.0	32.0
Safflower meal†	11.0	45.0
Copra meal†	12.0	20.0

Soybean†	13.0	49.0
Miscellaneous		
Brewers grains (dry)	10.0	20.0
Molasses 80% DM	13.0	4.5
Sheep and cattle nuts	11.0	15.0

* Silage protein is very soluble, so use values of 70% of that shown when formulating rations.

† Solvent extracted

Table 3. Crude protein requirements of balanced rations for lambs*

Ratio	Lamb live weight			
	20 kg	30 kg	40 kg	50 kg
Energy M/D	Crude protein (%)			
13	**18.2**	**17.5**	**16.8**	**15.5**
12	**16.5**	**15.8**	**13.8**	**12.6**
11	**14.5**	**13.5**	**11.0**	**10.0**
10	**12.8**	**11.8**	**9.2**	**8.6**

Source: Grazfeed®

*Predictions assume ration protein degradability in the rumen of 80% at maintenance.

The following example shows how to calculate the energy and protein content of a mixed ration containing different proportions of various feeds.

The amount of energy and protein contained in these feeds was obtained from Table 2

	ME/kgDM	Protein (%)
• 35% wheat	13.0	13.5
• 30% barley	13.0	11.3
• 10% lupins	13.0	32.0
• 25% Lucerne hay	9.2	17.0

Using the following process, energy content of this ration is:

$$\frac{(35 \times 13.0)+(30 \times 13.0)+(10 \times 13.0)+(25 \times 9.2)}{100}$$

$$= \frac{455 + 390 + 130 + 230}{100}$$

$$= \frac{1205}{100}$$

$$= 12.1 \text{ MJ/ kg DM}$$

The ration's crude protein content would be 15.6% using the same process but substituting the energy values used for protein values for each feed.

This ration would supply enough protein for lambs heavier than 30kg live weight (see Table 3) but would be protein deficient if fed to lighter weight lambs based on an energy content of 12.1 MJ /kg DM.

Producers may also use the Lamb Feedlot Calculator - www.sheepcrc.org.au or the drought feed calculator phone app, downloadable free from the apple app Store or Google Play.

Minerals

Lambs need a range of minerals to maintain good health. Of the major minerals required, only three (calcium, sodium and selenium) have been recognised as likely to be deficient in feedlot rations. Most cereal-based grain rations will provide adequate levels of remaining minerals.

Selenium deficiency is related more to soil selenium levels and may be area-specific (e.g. tablelands). If a deficiency is likely, selenium supplementation is recommended. It is usually administered with a 5-in-1 vaccine that includes selenium.

Cereal grains are low in calcium, and supplementation is needed for all high-grain diets.

To correct the deficiency, add 1.0% to 1.5% by weight of finely ground limestone (calcium carbonate). This also reduces the risk of acidosis.

Alternatively, acid salts (e.g. ammonium chloride, magnesium sulphate) may be added to the ration (add 0.5% on a weight basis) to stimulate the absorption of calcium from within the lamb's small intestine, to counteract calcium/phosphorus imbalances.

A low calcium to phosphorous ratio may lead to urinary calculi (bladder stone) development. Acid salts acidify urine and assist with dissolving bladder stones, however; they are extremely bitter and may affect ration intake.

Cereal grains are also low in sodium. This deficiency need not be corrected if the feedlot water contains reasonably high levels of salt.

If additional sodium is needed, however, fine salt should be added at a rate of 0.5% to 1.5%. Lower rates can be added if sodium bicarbonate is used in the ration. Salt will increase ration intake and encourage water consumption. The latter will help reduce the risk of bladder stones.

Vitamins

As lambs are held in feedlots for only a short time, vitamin deficiencies are unlikely. Vitamins A, D, E and B_{12} can be added as a vitamin/mineral premix to the ration, by oral drenching with a commercial supplement at feedlot entry or via vaccination.

Vitamin supplements are recommended when it is known that the lambs have not had recent access to green pasture, or where their previous history is unknown, particularly during drought.

High-quality green hay or silage will help to correct many mineral and vitamin deficiencies.

Health and Disease

General

There are numerous health and disease issues commonly found within feedlot systems. Many are easily preventable, through vaccination (clostridial diseases, arthritis, scabby mouth) or grazing management (mineral and vitamin deficiencies) prior to entering the feedlot.

Management within the feedlot is also an important means of preventing the outbreak and spread of ailments such as pinkeye, pneumonia/pleurisy, prolapse, salmonellosis and coccidiosis.

Urea poisoning and the negative effects of toxins (mould and fungal) are specific feed-related issues that can be prevented through careful ration preparation and testing.

Following are three of the more common health and/or disease issues found within feedlot systems. See veterinary advice to confirm diagnosis and treatment.

Acidosis (Grain poisoning)

Lambs that are not accustomed to grain are prone to acidosis. Lambs eating relatively small amounts of grain, or pelleted ration with high starch content, can develop acidosis due to the production of high concentrations of lactic acid within the rumen. Lactic acid accumulation can cause distress, diarrhoea and/or death.

Grain poisoning is most likely to occur when:

- lambs are being introduced to grain
- there is a sudden increase in grain intake (e.g. following wet weather)
- there is a change of grain source in the ration.

Gradual introduction of the grain content in the ration is essential if grain poisoning is to be avoided (see Tables 4 and 5).

Loose droppings are an early indication of digestive disorders. If this occurs, maintain the ration at the existing grain level until droppings firm.

Sometimes it will be necessary to drop back to the previous level of grain feeding. If the droppings develop a watery consistency, return to hay-only feeding and recommence grain introduction when droppings have returned to normal.

Symptoms of acidosis in lambs may include scouring, abdominal pain, a sluggish and dehydrated or bloated appearance, and a characteristic arching of the back.

Treating lambs suffering from acidosis is difficult and rarely successful, unless lambs are identified and treated within the early stages of developing the disorder.

Lambs should be removed from feedlot pens and drenched with 60 g of Causmag (magnesium oxide) or 15 g of sodium bicarbonate in 1 L of water, in an effort to neutralise acids produced within the rumen.

Alternatively, drenching with 10–20 mL of paraffin or light vegetable oil and/or dishwashing liquid will enable lambs to belch the gas and foam that has formed within the rumen during early stages of acidosis.

Gas and foam can cause distension of the rumen, which restricts lung movement and frequently leads to death by asphyxiation. Affected sheep should be given hay until they recover.

Numerous additives may be used in rations to reduce the likelihood of acidosis. Most do not prevent lactic acid production, but may help to reduce its effects on the lamb. The following are the most commonly used additives.

- **Sodium bentonite** is clay that swells when in contact with rumen fluids, slowing down the passage of food in the gut. It binds acid ions to its surface and reduces the risk of excessive starch fermentation. It may reduce ration intake and lower feed digestibility. Add at a rate of 1% to 2% (w/w).
- **Sodium bicarbonate** is an alkali, and acts as a ‘buffer’ against moderate increases in acidity following the intake of starch-rich grains. It is safe to feed throughout the feedlot process. Once lambs are accustomed to a ration it may be removed. However, you should be wary of periods when lambs may ‘go off’ feed.

Reintroduce sodium bicarbonate within the grain ration or in loose lick troughs within the feedlot if this occurs. Add at a rate of 1% to 2% (w/w). May be removed within two weeks of lambs starting the finishing ration.

- **Ground limestone** will help correct calcium deficiencies and buffer against acid production within the rumen and small intestine. Add at a rate of 1% to1.5% (w/w).
- **Acid Buf** is a seaweed extract high in calcium and magnesium carbonate. It is a buffer with a high surface area structure capable of binding acid ions. It is slow-acting, and provides prolonged buffering within the rumen. Add at a rate of 1% to 2% (w/w).
- **Bovatec** is an ionophore that modifies rumen fermentation and changes volatile fatty acid patterns within the rumen. Registered to prevent coccidiosis, Bovatec may also reduce acidosis risk and improve feed conversion efficiencies, but may also reduce intake. Add 30 to75 g per tonne of feed.
- **Virginiamycin** is an S4 antibiotic that prevents the growth of lactic acid producing bacteria within the rumen. It requires veterinary approval for use. Discuss the use of antibiotics, such as Virginiamycin, with your processor, as several export markets do not allow antibiotic use.

Laminitis

Laminitis is similar to ‘founder’, an ailment commonly found in horses. Affected animals appear lame and are hesitant to stand or move unless provoked.

A form of acidosis, laminitis is caused by the release of toxins within the bloodstream following consumption of excess dietary energy or protein.

Affected animals may recover within several days. Provision of reasonable-quality roughage and/or removal of affected animals from the feedlot will facilitate recovery.

Bladder stones

Also known as water belly and urinary calculi, bladder stones commonly develop when rations are low in calcium relative to phosphorus. High magnesium intakes, low roughage, poor water quality and low water intake may also lead to the formation of ‘stones’ within the bladder and/or kidney tracts.

If blockage of urine flow occurs, the lamb’s bladder will eventually burst, leading to the swollen ‘water belly’ appearance, and death of the affected animal.

Prevent formation of stones by adding limestone to increase calcium intake on high-grain diets. You need to ensure that the calcium to phosphorus ratio within the ration is greater than 1.5:1.

Ensure that rations contain adequate fibre and that good-quality water is available, to stimulate intake. Adding salt to rations will help increase water intake. Alternatively, the addition of anionic (acid) salts at 0.5% (w/w) may improve calcium mobilisation within the small intestine and acidify urine to help dissolve forming stones.

Starting to feed

Rations used for feedlotting fall into two broad categories: the starter and the finisher.

- The starter ration allows lambs to become accustomed to the high grain content of the finisher ration, while minimising the risk of grain poisoning.
- The finisher ration should be high in energy, low in roughage and well-balanced for protein, as this will optimise growth rate within the limitations of feed availability and cost. Lambs may eat 4%–5% of their live weight on diets with an 80% or higher grain component.

Table 4 is a guide to average performance levels of 40 kg lambs in a well-managed feedlot on a good-quality finisher ration. The range is what might be expected in similar circumstances across a range of lamb weights and ages.

Table 4. expected range in performance of a pen of lambs with an average liveweight of 40Kg.

	Average 40 kg	Range 30–50 kg
Intake (kg DM/day)	1.6	1.0 to 1.8
Live weight gain (g/day)	250	200 to 320
Feed conversion	6.5:1	10:1 to 5:1

Starter rations

Lambs not accustomed to grain must be gradually introduced to the high-grain diet of the finisher ration.

The starter ration is actually a series of rations. The first is a total roughage ration that is gradually replaced by grain until the desired concentration is obtained; for example, 70% grain concentrate to 30% hay.

If grain is mixed with processed hay (Table 5), the mixture should be provided ad lib in troughs or self-feeders.

Table 5. Guide to the proportions of concentrate to hay for introducing lambs to high-grain rations.

Day	Concentrate % including grain, and protein meals	Hay % chaffed and mixed
Until all lambs are feeding	0	100
2 to 4	20	80
5 to 7	40	60
8 to 10	50	50
11 to 13	60	40
14 and on (Finisher ration)	70 to 85%	15 to 30%

A minimum 14-day changeover period is needed to ensure that lambs do not suffer from digestive disorders.

Keep lambs on the hay-only ration until all lambs are feeding. Likewise, lambs should remain on the low-grain ration until all lambs have started grain feeding.

With starter rations, where the hay and grain are fed separately (Table 6), grain must be fed in troughs where adequate space is available to allow all lambs access.

Table 6. Grain introduction schedule when using unprocessed hay (high quality hay always freely available and grain fed separately)

Day	Concentrate head/day
Until all lambs are feeding	Nil (hay only)
2 to 4	100 g
5 to 7	250 g
8 to 10	400 g
11 to 13	550 g
14 and on (Finisher ration)	700 g *

* After 2–3 days of feeding at this level, ad lib feeding is possible.

It is critical to use good-quality lucerne or pasture hay for the early starter rations. This will encourage lambs to accept the new feeding system. If it is necessary to use poor-quality hay in the finisher ration, introduce it gradually towards the end of the grain introduction period.

Finisher rations

The final or finisher ration should be a high energy ration consisting of 65% to 85% concentrate (principally cereal grain), and 15% to 35% roughage (hay or silage). Ensure energy and protein levels within the ration are balanced and meet the lambs' age and weight requirements (see Table 3).

Higher growth rates and an efficient feed conversion can only be obtained via a well-balanced high-energy ration. If low-quality roughage is used, the concentrate portion of the ration can be increased and the roughage component reduced to 10%.

Three example finisher rations are shown below.

Ration 1	ME supplied	Protein supplied %
70% wheat (13 M/D; 12% CP)	9.1	8.4
29% lucerne hay (9 M/D; 16% CP)	2.6	4.6
1% urea (0 M/D; 250% CP)		2.5
1.5% lime		
1.5% salt		
Totals	11.7 M/D	15.5% CP

Ration 1 should be capable of achieving growth rates of about 270 g a day, but this will vary with age and weight. Protein should be adequate, except for light lambs (see Table 3).

Ration 2	ME supplied	Protein supplied %
65% wheat (13 M/D; 12% CP)	8.5	7.8
20% clover hay (9 M/D; 14% CP)	1.8	2.8
15% lupin (13 M/D; 30% CP)	2.0	4.5
1.5% lime		
1.5% salt		
Totals	12.3 M/D	15.1% CP

Ration 2 should be capable of achieving growth rates of about 290 g a day, but this will vary with age and weight. The ration is probably protein-deficient for light lambs (see Table 3)

Ration 3	ME supplied	Protein supplied%
65% barley (13 M/D:12% CP)	8.5	7.8
14% wheat straw (5 M/D:4% CP)	0.7	0.6
15% lupin (13 M/D:30% CP)	2.0	4.5
5% lucerne hay (10 M/D:16% CP)	0.5	0.8
1% urea (0 M/D:250% CP)		2.5
1.5% lime		
1.5% salt		
Totals	11.7 M/D	16.2% CP

Ration 3 should be capable of achieving growth rates of about 270 g a day, but this will vary with age and weight. Protein should be adequate for all lambs (see Table 3).

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