26. Supplementary Feeding for Wool Growth and Reproduction

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Learning objectives

On completion of this topic you should be able to:

- Explain the differences between the processes of supplementation, substitution and complementation
- Discuss why true supplementation does not often occur under grazing conditions
- Define the factors which influence the level of substitution between pasture and supplement
- Define the grazing situations in which substitution and complementation are likely to occur
- Use this information and information about the nutrient requirements of grazing animals to devise supplementary feeding regimens for different classes of livestock

Key terms and concepts

Intake, supplementation, substitution, complementation, nutrient requirements.

Introduction to the topic

In many grazing systems, there are times of the year when animals will require supplementation because the nutrient supply from grazing does not meet their demands for nutrients. Feed supplements used in the various grazing industries include not only feed purchased off-farm, but also feed grown on-farm (e.g., wheat) or formulated on-farm from a mixture of grown and purchased commodities. In grazing enterprises, the cost of supplementary feeding is one of the major discretionary expenditures faced by farmers and, equally importantly, is also a major contributor to the so-called ‘down-side risk’ in farm income. This is the increased year-to-year variability in farm income generated by the costs of extra supplementary feeding in bad seasons which, because stocking rates are frequently suboptimal, is often not compensated for by the extra income generated in good years. Increases in the efficiency of supplementary feeding are of thus economic importance and will have a major effect on farm income.

26.1 Supplementary feeding and wool growth

Given the high rate of cell division and protein synthesis in the wool follicle, one would anticipate a high sensitivity of the follicle processes and fibre growth to changes in the supply of energy, protein, lipids, vitamins and minerals and indeed, this is the case.

The wool growth response to protein and energy supply

For the majority of diets consumed by grazing sheep (6 to 9MJ/kg DM), consumed at typical rates (800 to 1500g DM/day), wool growth rate will be limited by the supply of protein to the intestines and within that, limited by the supply of cysteine to the wool follicle. In general, wool growth increases in a linear fashion with the amount of digestible protein leaving the stomach (DPLS), with an efficiency of utilisation of DPLS for wool growth of about 0.12. However, once the DPLS/ME ratio exceeds 12g/MJ, energy supply becomes limiting and further increases in wool growth require an increase in energy intake.
Wool contains about 10% cysteine compared to <2% in other tissues of the body. This cysteine arises from microbial cysteine entering the intestines, dietary cysteine which has escaped rumen degradation, and cysteine which is produced from methionine by the transsulphuration pathway.

The other sulphur-containing amino acid, methionine, also increases wool growth and by an amount more than that expected by its increasing the supply of cysteine through transsulphuration. Methionine is a precursor for polyamine synthesis and polyamines are important in fibre growth. It is also a precursor for S-adenosylmethionine, the major donor of methyl groups in the body. Methyltransferase of cysteine may regulate gene activity and DNA repair. There are also many other key metabolites produced from methyl reactions involving methionine. It is therefore highly likely that there is a role for methionine in follicle metabolism, other than as a precursor of cysteine.

The importance of sulphur-amino acid supply for wool growth is borne out by the fact that many studies have recorded increases in wool growth in response to provision of extra cysteine or methionine. It is unlikely that there would be economic responses to supplementation with cysteine or methionine as such, but there may be to provision of extra sulphur-amino acid from rumen-resistant plant proteins. The above ‘efficiency of wool growth’ in response to DPLS supply assumes that the composition of the DPLS is ‘normal’, that is, the protein is largely of microbial origin. Diets containing protein sources which are not only rich in sulphur and other essential amino acids, but also resistant to rumen degradation, would produce a greater wool growth response i.e., the efficiency of wool growth per unit DPLS would exceed 0.12. This may in part underpin the response to seed proteins containing high levels of rumen-resistant, high-cysteine proteins such as sunflower seed albumin (White et al. 2001).

**Vitamins and wool growth**

Several of the vitamins play vital roles in protein synthesis, sulphur amino acid metabolism, nucleic acid synthesis, or gene expression and keratinisation. For example, pyridoxine (vitamin B6) is required for amino acid metabolism in general, and in the transsulphuration reaction in which methionine is converted to cysteine. It is also essential for polyamine synthesis and is involved in glycogen metabolism. Folic acid is essential for transferring one-carbon fragments from serine, glycine, and histidine to other amino acids, purines and thymidine, thereby contributing to cell division and protein synthesis. Vitamin B12 is a cofactor in methionine synthetase involved in methionine conservation and the provision of methyl groups to a range of molecules.

While microbial synthesis of the B group vitamins in the rumen means adult ruminants are unlikely to suffer deficiencies of these vitamins, perturbations to rumen function may reduce microbial supply. The presence of ‘antivitamin’ compounds in feeds (eg antithiaminase in bracken fern) may also induce a deficiency.

The fat soluble vitamins A and D3 probably have direct effects on follicle function, as both have specific receptors in various parts of the follicle. Vitamin A affects keratin gene expression as well as cell division in the follicle bulb. Vitamin E may play a role with selenium in maintaining the redox potential of the follicle cells but there is no evidence of direct effects of vitamin E on fibre growth. Similarly vitamin K has not been directly implicated in follicle function.

Despite the involvement of these vitamins, there are very few direct demonstrations of a vitamin deficiency affecting wool growth and economic responses of wool growth to vitamin supplements are unlikely under most grazing conditions.

**Minerals and wool growth**

Minerals can influence wool growth by:

1. Reducing feed intake (sodium, potassium, sulphur, phosphorus, magnesium, cobalt and zinc),
2. Altering rumen function and hence the supply of nutrients flowing from the rumen (sulphur, sodium, potassium and cobalt), or
3. Directly disrupting metabolism within the sheep (zinc, copper, selenium, iodine and cobalt).

The wool matrix contains significant quantities of calcium, potassium, sodium, zinc, copper, manganese, iron and selenium, but only copper, zinc, iodine and possibly selenium alter wool growth and follicle function directly. Cobalt has no direct role, but as part of the vitamin B12 molecule, may alter fibre growth.
Copper and zinc
A deficiency of copper in the ration of sheep, or an inadvertent deficiency induced by high levels of sulphur and molybdenum in the diet, results in the production of weak, lustrous wool lacking crimp. In black sheep, there is depigmentation of the wool due to low activity of the enzyme tyrosinase which catalyses the hydroxylation of tyrosine to L-3,4-dihydroxyphenylalanine (dopa) and the subsequent oxidation of dopa to dopaquinone. The latter is essential for melanin synthesis (see review by Hynd 2000). Copper is thought to be essential for the oxidation of thiol groups to form the disulphide linkages required for keratin formation. Care is required in the use of copper supplements, because of the susceptibility of sheep to copper toxicity.

Zinc deficiency in sheep results in a marked reduction in wool growth, over and above that associated with the reduced feed intake induced by the deficiency (White et al. 1994). Some fibres are shed, and the fibres that are produced lack crimp, are lustrous, and brittle. Cell division in the follicle bulb is marginally reduced by zinc deficiency but the major effect appears to be on the keratinisation of the fibre.

Selenium
Selenium deficiency reduces wool growth without a reduction in feed intake. While the exact mechanisms involved are not known, many of the selenoproteins are antioxidants and affect the redox status of cells. Uncontrolled peroxidation during severe selenium deficiency causes necrosis due to oxidative damage to cellular macromolecules. A lesser deficiency may result in a milder oxidative stress caused by increased concentrations of peroxides of hydrogen and lipids. Oxidative stress causes gene repression through modulation of transcription factors.

Iodine
Lack of iodine reduces the production of the thyroid hormones which interact with intracellular transcription factors to modulate gene expression (Taylor and Brameld 1999). A deficiency of thyroid hormones causes abnormal follicle development in the fetus, and in adult sheep, reduces wool growth and quality (Hynd 1994). In extreme cases the follicles of thyroid deficient sheep cease fibre production completely (Hynd 1994).

Although a number of mineral deficiencies will thus have consequences for wool growth, with the exception of supplementation to overcome frank deficiencies and increase intake, economic responses to mineral supplementation are not likely.

26.2 Supplementary feeding and pregnancy
The nutrients required for the actual process of ovulation are quantitatively very small but nevertheless, the actual number of ova released at estrus is markedly dependent on the female's long-term nutritional status and on the nutritional status immediately prior to ovulation.

Ovulatory responses to improved nutrition in the few weeks before mating (flushing) may be influenced by the plane of nutrition during the period when ovarian follicles leave the primordial pool, approximately 6 months before ovulation. It has been recognised for many years that poor nutrition at this more remote time can reduce ovulation rate, but this adverse effect of earlier limitations of nutrition on ovulation rate can be prevented by pre-ovulatory 'flushing'. The nutritional mechanism of these responses is not well understood, but seems to involve direct effects of branched-chain amino acids. As the data in Table 26-1 show, feed-restricted Merino ewes that lost one-seventh of their body weight between 6 and 4 months before ovulation, but recovered this loss over the next 3 months, responded to a 10-day pre-ovulatory lupin grain supplement (500 g per head per day) with an average 0.57 extra ovulations per ewe (1.63 vs 1.06) compared with their previously restricted but 'unflushed' contemporaries. The practical importance of this observation relates to the fact that, 6 months prior to the next season's matings, many adult ewes are in early lactation and undergoing an associated substantial negative energy balance. Thus, in order to overcome the adverse effect of this period of undernutrition on ovulation rate in the following breeding season it may be sensible to make pre-ovulatory 'flushing' an integral part of the ewe's pre-mating management.
Table 26.1 Ovulation rates in Merino ewes in relation to an 8-week period of feed restriction 6 months prior to ovulation (cf. Control = no restriction), ± a daily supplement of 500 g lupin grain for the 10 days before ovulation.
Source: Adapted from Nottle et al. (1997) and Robinson et al. (2002).

<table>
<thead>
<tr>
<th>Feed restricted</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lupin supplement</td>
<td>-</td>
</tr>
<tr>
<td>Ovulation rate</td>
<td>1.06</td>
</tr>
<tr>
<td>Weight 10d before ovulation</td>
<td>51</td>
</tr>
</tbody>
</table>

For ewes in sub-optimal body condition, increases in ovulation rate have been achieved with an immediate pre-ovulatory period of lupin grain supplementation (flushing) for as little as 4 days, but a longer period (10-14 days) is usually recommended.

Despite the tiny size of the fertilized egg (diameter c.150 µm) and its minute requirement for nutrients, high feeding levels are often recommended during early pregnancy. Results from numerous recent experiments, however, demonstrate that high feed intakes post-mating decrease pregnancy rates and litter sizes by reducing blood progesterone to concentrations that compromise embryo survival, with 11- and 12-day-old embryos being particularly vulnerable. Thus, for ewes of body condition score 3 to 3.5 at mating, supplementary feeding during the first month of pregnancy is probably not required and a maintenance level of feeding is now regarded as optimal for achieving maximum embryo survival.

26.3 Supplementary feeding and lactation

In early lactation, nutrient requirements are intimately associated with the feeding which has occurred during pregnancy. Much of the development of udder secretory tissue occurs in the last third of pregnancy, with only a small amount occurring in the first month of lactation. Severe undernutrition in the last weeks of pregnancy can result in a small udder, which has little colostrum present at parturition, and a delay of several hours in the initiation of full lactation. In sheep, this may have a major effect on lamb survival, especially as the lambs are likely to be small and lacking body reserves at birth.

Nutrition earlier in pregnancy, before the period of mammary development, may affect milk production via placental size and secretion of placental lactogen. Growth of the placenta, which in sheep is completed by 90 days of pregnancy, can be affected by severe underfeeding. If nutrition in late pregnancy is good, this does not lead to a reduction in lamb birth weight, but Dove et al. (1994) found effects of mid-pregnancy feeding on milk yield and lamb growth, even when birth weight was not reduced. This may be related to nutritional effects on placental size and thence, placental lactogen concentrations. In sheep, plasma lactogen concentrations increase until close to the end of pregnancy, are affected by placenta size and by the number of foetuses carried.

If there is underfeeding in early lactation, milk production may be affected by the amount of body reserves available for utilisation after lambing. Although undernutrition in pregnancy increases the utilisation of body reserves before lambing, the level of reserves is also affected by deposition and utilisation of fat occurring before mating and in early and mid-pregnancy.

Responses to supplements of energy and protein

There are three important principles concerning the response to variation in intake of ME and MP intake during lactation:

1. For a particular level of ME intake there is a critical MP intake, below which milk yield will decrease.
2. The minimum ratio of MP:ME increases with increasing level of milk yield.
3. An increase in MP intake without a change in ME intake will result in an increase in milk production and mobilisation of body reserves, if the ewe has not reached her potential yield.

In early lactation, when energy requirements are high and voluntary intake has not reached its peak, protein intake is likely to have a critical effect on milk production. The extent of the response to protein intake, however, depends on the level of body reserves in the ewe in early lactation.
Responses to protein sources of low degradability in the rumen are most likely in early lactation, when voluntary intake is low and the ewes are in negative energy balance. In one report (Robinson 1983), the responses of milk yield to supplements of approximately 70 g per day of groundnut, soyabean, meat and bone, linseed, fish and blood meal were broadly related to the degradability of the protein in the rumen. Dove et al. (1985) supplemented ewes grazing short pasture with an energy source, with or without formaldehyde-treated soya-bean meal, and the presence of the protected protein increased milk yield by 33% (Table 26.1 above).

26.4 Supplementary feeding of animals grazing rangeland

Under the extensive grazing conditions common to rangelands, supplementation programs to overcome seasonal nutrient deficiencies usually need to be low in cost and targeted at reproducing or young growing livestock, which often have to contend with RDP-deficient pastures. Under these conditions it has been shown that an RDP supplement in the form of urea is both cheap and effective. In sheep-grazing systems, 8 g urea per head per day can improve ewe survival rates, lamb birth weights, milk production by ewes and, as a consequence, lamb growth rates and survival. Urea supplementation of non-reproducing sheep that are consuming similar pastures has also been shown to reduce or prevent liveweight loss. When urea is being used it is advisable to also provide a sulphur source so that the N:S ratio in the supplement is between 10:1 and 13:1, in order that the requirements of the rumen microorganisms for sulphur be met. Ammonium sulphate has been found to be a suitable sulphur source.

When the only water available to grazing sheep is in troughs, an effective method of supplementing with urea is to dissolve it in the drinking water; ensuring that all sheep receive the urea supplement. Reliable commercial devices that deliver predetermined amounts of urea into water lines and troughs are now available. Urea can also be provided as a dry lick by mixing it with salt and feeding it out in troughs. A feeding regimen that has been recommended is to give sheep free access to salt for two weeks to satisfy any ‘salt hunger’ they may have and to then add urea to the salt in the ratio of one part urea to four parts salt. After a further four weeks the urea to salt ratio is increased to 1:3 and 5% ammonium sulphate is added to the mix. Adult sheep should consume 24-30 g of this mix per day. Troughs should have covers or drain holes to prevent accumulation of rainwater with high concentrations of dissolved urea.

A number of proprietary blocks containing urea are available but they have varying compositions. Some are based on molasses, others have high concentrations of salt and most contain added minerals and/or vitamins. It is usually more convenient to purchase rather than produce blocks on farm but purchased blocks will usually be more expensive than farm-produced blocks. Care should be taken when feeding proprietary blocks to ensure that they do not contain nutrients that could be toxic. For example, some blocks with high inclusion rates of copper are designed for use in copper-deficient areas but, if they are fed to sheep in areas that are not copper deficient, copper toxicity could result.

A further method of supplementing livestock with urea is to dissolve it in a molasses/water mix and give animals access to the mixture by means of a roller drum floating on top of the urea/molasses mixture. Molasses contains approximately 7 g sulphur per kg DM so there is no need for additional sulphur in a urea and molasses mix. Animals must not have direct access to the mixture or they will drink it and suffer from urea poisoning.

The phosphorus concentrations in dry pastures, especially subtropical or tropical pastures, can be below theoretical requirements even for non-reproducing animals. However, except in the case of mulga (see below), no positive response to phosphorus supplementation of sheep on theoretically phosphorus-deficient pastures has been recorded, even though cattle grazing the same pasture types do respond. The reasons for the lack of response by sheep are not clear but have been ascribed to the fact that sheep select a diet with a higher nutrient content than do cattle and that sheep have a smaller skeletal mass. Notwithstanding this, many advisers recommend that when sheep grazing dry pastures are supplemented with an RDP source they also be provided with a phosphorus supplement.
Protein supplements

Weaners and females in late pregnancy or lactation may have protein requirements in excess of microbial protein supply and, if they are grazing dry pastures with low protein concentrations, they may respond to UDP as well as RDP supplementation. Protein supplementation is usually expensive so careful consideration should be given to the cost:benefit ratio of a supplementation programme before it is implemented. Several experiments have shown that protein supplementation of ewes grazing rangeland during the last trimester of pregnancy and during lactation can increase the birth weight of lambs, milk production of ewes and growth rate and survival of lambs. However, the responses obtained to protein supplements may not be entirely due to their UDP content. Proteins also provide RDP that may be more slowly released in the rumen than RDP from urea and so be used more efficiently by the rumen microbes. Proteins are also a source of ME which can promote synthesis of additional microbial protein. The recommended level of protein supplementation for late pregnant and lactating sheep is 50 and 75 g per head per day, respectively. Whole cottonseeds and lupins can be fed on the ground while meals should be fed out in troughs. It may be necessary to entice sheep to accept some protein sources by mixing them with small quantities of molasses or salt until the required level of intake is reached.

Energy supplements

Energy supplements are not usually an option in extensive grazing due to their high cost. The usual procedure is to utilise standing dry paddock feed as efficiently as possible with strategic use of urea or protein supplements that usually stimulate intake of dry roughage and hence improve the ME intake by animals.

Molasses has been shown to be useful as an energy supplement under extensive grazing conditions. It contains approximately 11 MJ of ME kg\(^{-1}\) DM. Molasses plus either 3% urea (M3U) or 8% urea (M8U) has been successfully used for sheep, with the mixture provided \textit{ad libitum} in open troughs. Three percent urea provides the RDP required by rumen microbes to digest the organic matter in molasses but it has been found, especially with cattle, that over-consumption of M3U can occur, with the inherent danger of toxicity. Increasing the urea concentration to 8% makes the mixture somewhat unpalatable and restricts intake. With both M3U and M8U the urea must be thoroughly and evenly dissolved into the molasses to prevent potential urea toxicity. Liveweight maintenance of dry animals would be all that could be expected with a dry grass diet supplemented with urea and molasses. If a higher level of response was required, for example growth of weaners or maintenance of pregnant or lactating ewes, then up to 10% protein meal (for example cottonseed meal) could be mixed into molasses.

Hay or forage supplements

Pasture hay in large bales is made in some extensive areas following periods of good pasture growth. This hay can be fed back to sheep when standing dry pastures become scarce. However, the protein content and digestibility of such pasture hays can often be low, especially if they have been harvested after pastures have flowered and it is possible to improve the RDP content of such hay by injecting a solution of urea and molasses into the bales three to four days before they are fed out. A suggested solution is 20 kg urea, 50 kg molasses and 4 kg ammonium sulphate dissolved in 70 litres of water. This solution is injected into the bales under pressure at the rate of 100 litres per tonne of hay.

Mulga (\textit{Acacia aneura}) is a tree legume that is distributed over a wide area of semi-arid and arid Australia. Mulga leaves are readily eaten by sheep, constituting up to 10% of the diet in normal seasons and up to 100% of the diet when fed under drought conditions. Sheep offered a diet containing only mulga maintain or slowly lose live weight. Although mulga has a DMD of 50% and a CP content of 10-14%, the digestibility of the protein is low (35-40%) because high concentrations of condensed tannins bind the protein during rumen digestion. The low protein digestibility results in mulga-fed sheep being sulphur- and sometimes RDP-deficient.

The digestibility of mulga protein can be improved by dosing sheep daily with the polymer polyethylene glycol (8 g per head) which displaces tannins from tannin-protein complexes in the gut. However, because of the cost of the chemical and labour, this is not an economical approach.
A dry lick containing (per head per day) RDP (6-12 g), sulphur (1-1.5 g), phosphorus (1-2 g) and sodium (1-2 g) is recommended for dry sheep consuming diets of dry grass and mulga. Pregnant or lactating sheep consuming similar diets would require protein supplementation as well.

Saltbushes (Atriplex sp.) and bluebushes (Kochia sp.) dominate a large area of the Australian semi-arid and arid rangelands. These species contain relatively high levels of crude protein (approximately 18%) that are maintained during periods when native pastures are dry. Although this suggests a role for these plants as supplements for grazing sheep, published reports indicate that performance of sheep consuming diets containing these shrubs and dry pasture was little better than that of sheep consuming dry pasture alone. The shrubs do, however, have a place as a drought reserve.

### 26.5 Supplementary feeding: Further practical considerations

In grazing systems, the economics of supplementary feeding are influenced not only by the nutritional principles discussed above, but by practical considerations including the timing of supplementary feeding, the rate at which animals become accustomed to the supplement, the variability of supplement intake within the group of animals and how frequently the supplement needs to be fed. Supplementary feeding should also be considered in relation to helminth control.

As a general comment, supplements are often introduced into the system later than they should be, in response to physical symptoms in animals or indications that animals are not growing well. It is better to assess the need for supplements in terms of objective measurements of the amount and nutritive value of available herbage. Techniques for doing this can be learnt through programs such as ProGraze and the need for supplements then assessed using PC-based packages such as GrazFeed™ (Freer et al. 1997).

There are occasions on which it is appropriate to introduce animals to supplements very gradually (e.g., wheat feeding) but in general, the profitability of supplementary feeding will be compromised if animals take a lengthy period to become accustomed to the supplement. The rate at which young animals become used to a supplement can be greatly reduced by earlier exposure to the supplement, especially in the presence of older animals. For example, Green et al. (1984) gave unweaned Merino lambs access to supplement, in the presence or absence of their mothers. The lambs were weaned at 10 weeks of age and then tested for acceptance of the supplement at 3, 6, 12, 24 and 34 months of age. Sheep initially exposed to wheat with their mothers always ate much more than either control (unexposed) sheep or those exposed to wheat without their mothers. Similarly, Mulholland (1986) reported that the presence of 5% of ‘trainer ewes’ (ewes previously exposed to lupins) was sufficient to ensure that lambs rapidly accepted the supplement under grazing condition. These results strongly suggest that there would be economic value in exposing young animals to supplements in the presence of experienced older animals, as a means of ensuring later rapid acceptance of the supplement.

In livestock which have not been exposed to supplements, there can be substantial variability in supplement intake between animals. Low supplement intakes in some livestock (‘shy feeders’) then result in a lower mean response and a more variable response to the supplement. The impact of shy feeders on the response to the supplement can be reduced by the training described above, and also by less frequent feeding of supplements (e.g., every third day rather than daily) or by offering supplements in self-feeders. There is usually little penalty incurred in supplement response by feeding supplements less frequently than daily, and there may be some advantage, especially for wool growth and particularly with cereal grains.

Finally, the supplementation of animals can be a waste of time and money if they are severely affected by intestinal parasites. It follows from this that to make the best use of supplements in grazing systems, a sound program for the control of intestinal parasites should be in place. In young animals and in periparturient ewes, there is increasing evidence that protein supplementation can offset the effects of intestinal parasites or assist in the development of resistance. However, supplementation is not a replacement for a good worm control program.
26.6 Conclusion

Supplementary feeding is a deceptively simple concept but in practice, requires the assessment of information concerning the current state of the animals and their body reserves, the amount and nutritive value of the herbage on offer, and the nutritive value and amount of the supplement which is to be fed. There are usually marked interactions, sometimes positive, sometimes negative, between supplement and herbage intakes. This means that the ultimate mix of nutrients absorbed from the gut of the animal is not easy to predict. Absorbed nutrients also interact with energy from the body reserves of the animal.

The livestock producer is also faced with questions concerning the supplement and labour costs of supplementary feeding (cost per kg DM v. cost per MJ ME v cost per g CP; daily v. infrequent feeding) and must also consider the target market. For example, in finishing lambs, should the aim be rapid weight gain to dispose of animals early, or slower weight gain to target a later, higher-priced market? Similarly, if supplementation for wool growth increases wool fibre diameter, how does the price penalty of increased diameter compare with the extra income from more wool and the possible price premium of increased wool strength?

Given the complexity of the decisions involved in supplementary feeding, it is perhaps not surprising that responses to supplements can be variable in either physical or financial terms. One approach to assisting the decision making involved has been to incorporate current knowledge about supplementary feeding into computer-based ‘decision support tools’ (e.g., Freer et al., 1997). Such tools can then be used by farmers or their advisers to simplify the process of establishing a supplementary feeding program.

Readings

The following readings are available on CD:
   • Doyle, P.T., 1987 ‘Supplements other than Forage’.
   See in particular the following chapters;

Activities
Multi-Choice Questions
Useful Web Links
Assignment Questions

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Submit answers via WebCT
Available on WebCT
Choose ONE question from ONE of the topics as your assignment. Short answer questions appear on WebCT. Submit your answer via WebCT
Summary
When grazing animals are supplemented, their herbage intake rarely stays the same and usually decreases when the supplement is eaten (substitution). If the supplement makes good the supply of a nutrient which was limiting intake (e.g. rumen-degradable protein for animals grazing low-quality roughage) then roughage intake may increase (complementation). These processes help explain the variability in response to supplements. While supplements can be classed as energy or protein supplements, conserved forages or fodder crops, this is only a classification of convenience.

For wool growth, the main limitation is protein and especially sulphur-amino acid supply. The upper limit of the wool-growth response to protein supplementation is set by energy intake. In reproducing animals, ovulation rate can be increased by short-term protein supplementation but excessive supplementation in early pregnancy can reduce embryo survival. Severe under-nutrition during mid- to late pregnancy can reduce milk production in lactation. In early lactation, protein supplements may increase milk yield but in females with good body fat reserves, may also increase weight loss. Under rangeland conditions, energy supplements are too expensive and the need is usually for cheap supplements of rumen-degradable N (e.g. urea). Young animals can be ‘trained’ to eat supplements either by exposure to them at a very early age or by offering them when ‘experienced’ animals are also present. Problems with ‘shy feeders’ can be overcome with less frequent feeding of supplements. In all supplementation programs, it is important to control intestinal parasites.

References