SHEEP NUTRITION AND FEEDING

- *References: NRC (1985), Kott (1998) in Kellems & Church (1998), and Jurgens (2002).*

INTRODUCTION

1. **General**

   A. Supplying energy and nutrients to satisfy their needs is the largest single cost associated with producing sheep regardless of the type of operation.
   B. The production of sheep is controlled by the efficiency in converting feed resources into products of economical value, i.e., meat, wool, and milk.
   C. Diets must be formulated and fed in such ways that support optimum production and efficiency, and also minimize nutritionally related problems.
   D. Throughout the world, the common denominator in sheep production is "pasture & forage," and productivity/quality of the pasture, rangeland, and forage crop can influence success of sheep production.
   E. Most of the world's sheep are located in arid to semiarid ecosystem, i.e., arid rangeland of Australia, Africa, South America, and SW US.
   F. About 5% of all ewes fail to lamb and about 15 to 20% of all lambs born die between birth and weaning. Although there are many causes, faulty nutrition is a major contributing factor in such losses, thus affecting the success of sheep production.

2. **Nutrient Needs**

   A. Water:

      1) Daily water consumption in ewes varies from 0.72 gal during the cold winter months to 2.2. gal during the summer months.
      2) Water intake increases with the increased intake of DM, protein, or minerals, the temperature above 70°F, and the stage of production such as during the late gestation and lactation.
      3) Sheep can get water from feed, snow and dew, oxidation of feed or metabolic water, as well as drinking water. Thus, depending on the situation, perhaps, can get by without drinking water!?

   B. Energy;

      1) Inadequate energy limits performance of sheep more than any other nutritional deficiency, especially during the late gestation and lactation.
      2) Deficiency? - Results in reduced growth, fertility, wool quantity and quality, etc.
      3) Generally, can satisfy the needs with good quality pasture, hay, or silage, but may need supplement (e.g., grains) immediately before and after lambing and conditioning for breeding, and also for finishing lambs.

C. Protein

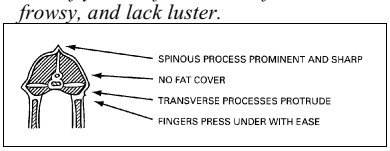
1) In most instances, the amount of protein is more critical than quality, i.e., microbial protein is often adequate.
2) Green pastures provide adequate protein. But, with mature and bleached or have been dry for an extended period of time, may need additional protein.
3) Bypass protein might be beneficial in some instances, and can use nonprotein nitrogen or NPN in some instances.

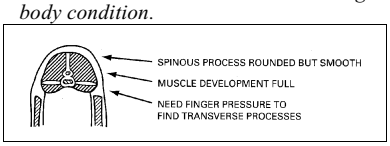
D. Minerals & vitamins

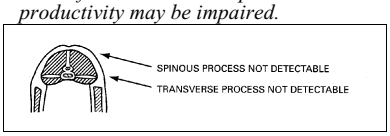
1) In practice, the true "dietary" requirements vary considerably, depending on the amount and nature of minerals (& also their associated minerals).
2) Most requirements can be met with normal grazing and their feeding habits, but a trace mineral salt containing Na, Cl, I, Co, Fe, Mn, and Zn is usually fed free-choice.
3) Although sheep need all the fat-soluble vitamins, normally, the forage & feed supply all the vitamins in adequate amounts. But, vitamin A (e.g., grazing on dry or winter pasture for an extended period time) and vitamin D (e.g., under confinement) may be deficient under certain circumstances.
4) The B vitamins are synthesized in the rumen, thus usually there is no need for supplementation.

Ewe body condition scores (Kott, 1998)

Score	Description
1:	*An extremely emaciated ewe, with no fat between skin and bone. Ewes in this body condition have no fat and very limited muscle energy reserves. They appear weak and unthrifty. Wool fleeces are often tender, frowsy, and lack luster.*
2:	*Ewes in this body condition have only a slight amount of fatty tissue detectable between skin and bone. Spinous processes are relatively prominent. These ewes appear thrifty but have only minimal fat reserves.*
3:	*Ewes in this body condition have average flesh but do not have excess fat reserves. This condition score includes ewes in average body condition.*
4:	*This condition score includes ewes that are moderately fat. Moderate fat deposits give sheep a smooth external appearance.*
5:	*Ewes that are extremely fat. Excess fat deposits can easily be seen in the brisket, flank, and tailhead regions. These ewes have excess fat reserves to the point that productivity may be impaired.*







3. **Body Condition Scores**

A. The use of body weight alone is not adequate because of differences in mature body size among different breeds and within a breed, thus useful to consider body condition scoring along with the body weight.
B. Conditioning scoring is a system to describe or classify breeding animals by differences in relative body fatness - Subjective system but provides fairly reliable assessment of body composition.
C. Example? - See the table/figures.

1) Scores of 1 to 10 can be used but scores between 1 and 5 are commonly used in the US.

2) Usually, 90% or so of ewes fall withing the 2, 3 or 4 range, and 70 to 80% of animals usually fall within a range of 2 conditioning scores.
3) Usually, more individual variation in older ewes than young, developing breeding animals (i.e., ewe lambs up to 2 yr old).
4) Perhaps, scoring 10 to 20% of the flock might be adequate?

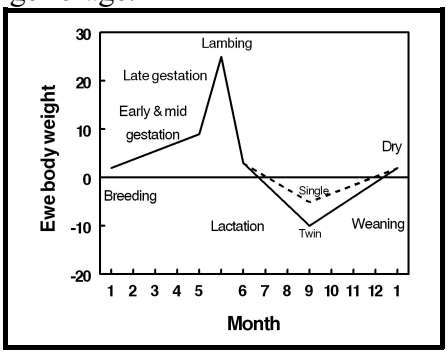
FEEDING EWES

1. General

1) Ewes are the backbone of the sheep enterprise. Raising lambs & producing wool.
2) The nutritional status of the ewe during the all stages of production is critical for optimum production, even though breeding and selection programs should not be overlooked.

   a) Nutrition during pregnancy? - Determine the number of lambs born alive and lamb birth weight, and also survivability?
   b) Nutrition during lactation? - Critical for milk production.

3) Optimum feeding systems vary based on the production system, i.e., intense feeding of "confined sheep" to supplementation of flocks "on range forage."
4) How the ewe should be fed? - Monitoring changes in body weight during lactation. [See the figure on "Weight changes expected for a 150-lb ewe throughout various stages (Kott, 1998)"]



   a) Should lose about 5 to 7% of the body wt during lactation, recover this during the post-weaning period, and then gain weight appropriately during gestation.
   b) Nutritional needs differ depending on the size, body conditions, and levels of production, thus may be useful to divide the flock into groups of ewes with similar needs?

2. Choosing a Lambing System

A. Considerations for early lambing - January through February

   a) Prices? - Highest in May and June, which coincides with marketing of most early lambs.
   b) Labor? - Good care and management is needed during flushing, breeding, and lambing periods, but more labor should be available to provide extra care and attention during lambing.
   c) Lambing facilities? - Should be adequate, even though no need for a fancy or expensive accommodation.

d) More ewes can be carried in the flock for a given acreage of pasture.
e) Less serious parasite problems!?

B. Considerations for late lambing - March through April

a) Prices? - Substantially lower in the fall and early winter when late lambs are marketed.
b) Labor? - Less care & management is needed before & during the breeding season for good conception.
c) Lambing facilities? - Do not have to be as good as for early lambs.
d) Roughages provide most feed needed for both ewes and lambs, and lambs can be marketed from pasture (or cornfields) with a minimum of concentrate feeding. But, need high quality pastures!
e) Parasite problems are serious, and need prevention and control.

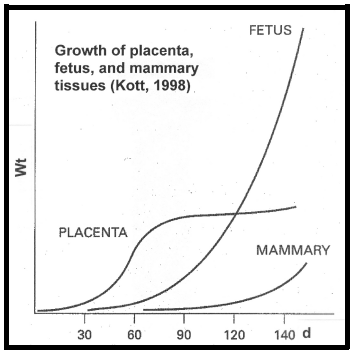
3. **Flushing & Breeding**

A. Flushing?

1) Increase the intake of ewes prior to and during mating to increase ovulation rate (& also have some beneficial effects of increased body weight?), thus lambing rate.
2) Start about 2 wk before breeding until 2-3 wk into the breeding season.

B. Accomplished by turning ewes onto a lush, high-quality pasture just prior to breeding. If not, can be done by supplementing ¼ to ½ lb of grain or pellets/day.
C. Mature ewes may respond better vs. yearlings or fat ewes (or, ewes in good body condition), thus flushing may not be economical for ewe lambs/yearlings (no lambs in previous year) or fat ewes.
D. Both energy and protein intake might be important based on some data, but, perhaps, energy intake is the single most important factor?
E. Based on many studies, can expect the increase in the lambing rate by 10 to 20%.

4. **Gestation**



A. See the figure on "Placenta, fetal, and mammary growth during pregnancy (Kott, 1998)."
B. Many lamb deaths shortly after birth can be attributed to nutrition during gestation because of placental growth, fetal development, and mammary gland development.
C. The mature (3 to 8 years) ewe during the first 15 wk of pregnancy:

1) Assuming no substantial weight loss during the previous lactation, can be fed to just maintain her "normal" weight from weaning her lambs until about 15 wk into her next pregnancy.

2) Nutritional needs are slightly higher than the maintenance, but severe under- or over-nutrition during this phase can be detrimental.
3) Pasture and other "field feeds," when available, are adequate for maintaining ewes and used often because of the cost.
4) When harvested feed must be fed, a variety of feeds or combination can be used, e.g., hay, haylage, and corn or sorghum silage.

D. Last 6 wk of gestation:

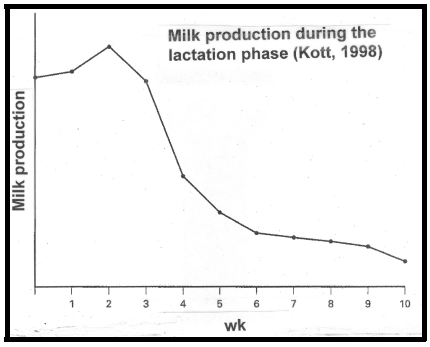
1) About 70% of fetal growth during this phase, thus this is the most critical period!
2) Poor nutrition? - May result in lighter lambs at birth, nonuniform birth wt in twin and triplets, impaired wool follicle development, lower energy reserves of newborns, etc.

a) Birth wt (may vary from 3.5 to 20 lb) is a major factor affecting lamb mortality.
b) Although other factor are involved, nutrition, especially energy, during the last month can play a major role in determining the birth wt.
c) Need 50 or 75% more feed if bearing single or twin lambs, respectively.
d) Also, nutrition during this phase can influence milk production after parturition.

5. Parturition

A. Generally, recommended to provide a good-quality forage and plenty of fresh water.
B. Start feeding grain or supplement about 12 to 24 hr after lambing.

6. Lactation



A. Nutrient needs? - Usually 2 to 3 times greater during lactation than during maintenance.
B. Ewes with twin lambs produce 20 to 40% more milk than those with singles, thus have higher nutrient requirements.
C. Milk production:

a) Peaks early (2 to 3 wks after lambing) and then declines. See the figure on "Ewe's milk production (Kott, 1998)."
b) Ewes produce 3 to 6 + lb milk daily.
c) Milk provides essentially all the lamb's nutritional needs during the first mo. and a significant proportion during the first 2 mo.

D. Lambs can be weaned successfully at 8 wk (perhaps earlier). More efficient to feed the lamb directly than to feed the ewe to feed the lamb beyond 8 to 10 wk.
E. How to feed ewes?

1) Not necessary to feed the ewe very much for a day or so after lambing. Important to have plenty of fresh water and a light feed during this period though.
2) By the third day, can be brought up to a regular ration (as-fed basis) - e.g., 2½ - 3 lb each of hay and ground ear corn, 4 - 5½ lb hay plus 1 to 1½ lb shelled corn, 8 to 10 lb corn silage plus ¾ to 1½ lb shelled corn + ½ lb soybean meal, or 10 lb alfalfa haylage plus 1½ lb shelled corn.
3) Daily feed intake can be increased by feeding frequently:

    a) A rule of thumb? If the ewe is nursing one lamb, feed once a day, if she is nursing two lambs, twice a day, etc.
    b) Splitting the amount fed per day into more frequent feedings reduces the potential for acidosis when more concentrates are fed.

F. Ewes lambing in late April and May:

1) Normally on pasture. The pasture should be productive, and should provide most of the needs unless it is overstocked.
2) Can be fed supplemental grain if needed, and also can be trained to return to drylot for grain feeding.
3) If pasture is short, lambs can be kept in drylot, and ewes kept with them during the day, then turned to pasture during the evening and night.

G Fall lambing ewes (September and October):

1) Most flocks would lamb on pasture, which should have been set aside for them - Should provide most of the needs during the first 4 to 6 wk of lactation.
2) After that, start supplemental grain feeding depending on the ewe & lamb conditions. Keep lambs in drylot and bringing the ewes to the lambs for nursing during the day. If so, lambs should be creep fed.

H. The mineral requirements during lactation are greater than during other periods - A greater intake of feed may provide all the increased needs, but free-choice feeding of a complete mineral is suggested as insurance.

I. Late lactation (last 4 - 6 wk)? Milk production is low and minor importance for lambs after 8 - 10 wk, and their nutritional needs can be met by good quality pasture or range.

J. Range supplements?

1) Range sheep production is entirely dependent on weather and moisture conditions, and the necessity of supplementation is variable between ranges and between years.
2) Supplementation usually increases production, but may not be economical to supplement for maximum production because of the increased costs.

7. **Postweaning**

A. This is the time of rest for the ewes, but also the time that the ewes can be "conditioned" for the breeding period.
B. Still, desirable to use the poor-quality pasture or feed so that better quality forages can be saved for more critical periods.

FEEDING VERY YOUNG LAMBS

1. General

A. Lambs:

1) Born with a nonfunctional rumen, thus need dietary sources of nutrients such as milk and milk replacer.
2) Important to make sure that a lamb nurses within 1 hr or its chance of survival is rather limited. But, most lambs nurse within 30 min after birth.
3) With access to dry feed immediately, some degree of rumen functionality become apparent within 2 wk or so.
4) With continued consumption of dry feed, milk is no longer essential for efficient growth by 45 to 60 d of age.

B. Colostrum:

1) Not only important in terms of nutrition but also plays an important role in disease resistance because it contains antibodies.
2) Also, important as a laxative to clean out the fecal matter accumulated during fetal life.
3) Transfer of antibodies through the umbilical cord does not occur in sheep and cattle as it does in many other animals.
4) If colostrum is not available (or insufficient; at least 6 to 8 oz!?) from the ewe, then should provide colostrum from another ewe; Or, frozen ewe or cow colostrum warmed to body temperature with a bottle is an adequate alternative.

C. Most of lamb death losses are due to starvation during the first week after birth. May require rearing on milk replacer to save those lambs?

1) Lambs that are orphans due to death of the mother, one side of udder nonfunctional on ewe with twins, mis-mothered, etc.
2) A weak lamb(s) twins or in triplets.
3) Any lamb showing symptoms of progressive weakness during the first week after birth, which can be traced to inadequate milk supply.

2. Milk Replacer

A. Raising lambs on milk replacer is relatively time consuming and expensive process, thus should be as short as possible. Can be weaned from milk replacer at 3 wk of age?

B. The decision to switch to milk replacer? Should be made as soon after birth as possible. Perhaps, easier to train?
C. Place lambs in a warm, dry enclosed area with others on milk replacer, and they should not be allowed to hear their dams.
D. May want to inject with the followings when they are placed in the nursery? - Vitamin A, D, E, Se (in low Se areas), etc.
E. Typical composition of milk replacers (DM basis)? - e.g., fat, 30-32%; CP, 22-24%; and lactose, 22-25%.
F. The dry replacer should be diluted with water to a minimum of 17 to 20% DM (i.e., 1¾ to 2 lb milk replacer per gallon of water).
G. Make sure that the milk replacer contains a high dose of antibiotics to avoid scours and other digestive disorders.
H. Use one of the multiple nipple pails or similar systems for self feeding the milk replacer (should be cold), or hand feed with warm milk.

3. **Creep Feeding**

A. Healthy baby lambs show interest in dry feed at 10 days of age, thus they might be able to start on dry feed very early?
B Creep feeding:

1) Advantages?

a) Increased weight gains, especially in twins & triplets. Up to 0.25 lb /d more?
b) Can be marketed at younger age. Perhaps, 1 to 2 mo earlier?
c) Moving lambs to the drylot earlier, which allows more ewes on available pasture.

2) To be successful, start as soon as possible. May want to set up when lambs are 7 to 10 d of age & on the location where they spend most of their time.

C. Scientifically formulated and commercially prepared complete creep feeds:

1) Often available in pelleted form & in 50-lb bags, which make creep feeding simple.
2) Relatively costly, but lambs don't consume much during this period, so can be justified?

D. Examples of palatable feeds offered to lambs (in addition to commercial feeds)? - Cracked, shelled corn, bran, rolled oats, molasses, soybean meal, and high quality, leafy alfalfa hay.
E. Make fresh feed available in clean bunks at least twice daily. Should give only the quantity lambs clean up between each feeding.
F. When feeding simple cracked corn and hay-based creep rations, a complete supplement should be top-dressed on corn to provide added CP, Ca, vitamin E, Se, antibiotic, etc.

4. Weaning

A. Artificially reared lambs weighing 25 lb can be weaned at 25 to 30 days of age.
B. Lambs raised by ewes in peak milk production are seldom weaned, and lambs are not normally weaned before 7- to 8-wk old and weighing more than 40 lb.
C. To reduce weaning stress, a lamb should be consuming about a pound of palatable, nutritious dry feed daily.
D. May want to keep lambs in familiar surroundings at weaning and no change in their diet for about a week or so.
E. Very early weaned 25-lb lambs need an 18-19% CP, high-energy, well-fortified diet until reaching about 50 lb. Can be fed as a "typically weaned lamb" thereafter.

FEEDING GROWING AND FINISHING LAMBS

1. General

A. Under excellent forage conditions, lambs may reach slaughter weight while nursing ewes. Typical in high mountain ranges?
B. Most of lambs produced in the US, however, are not slaughter at weaning, and must be finished by the producer or sold to commercial lamb feedlots.
C. Feeder lambs:

1) Most are available in the fall from western & southwestern ranges.
2) Usually about 5 to 6 mo of age and weigh between 60 to 90 lb.
3) But, many producers are beginning to wean & market lambs at an earlier age. It is especially true for fall- or winter-born lambs.
4) Might be more profitable for some producers to wean lambs early & feed them to slaughter market wt. For instance, market their grains through lambs when grain prices are relatively low?
5) Many are placed on high-quality pastures or crop aftermath such as alfalfa fields & beet tops before a short feedlot phase.

D. Slaughter or market lambs?

1) Should have between 0.1 and 0.2" in backfat.
2) Between 95 to 145 lb because of differences in frame size among lambs, i.e., 95-105 lb for small-frame, 105-120 lb for medium-frame, and 120-145 lb for large-frame lambs.

E. Feedstuffs?

1) Many types can be used to furnish necessary nutrients to economically finish lambs.

2) With high-concentrate diets, can expect the fastest gain but may not be the most economical!? Programs using pastures or crop aftermath may be more economical, even though gains would be slower!
3) Lightweight lambs (50-70 lb) can use more roughage but heavier lambs (70-80 lb) need more concentrates. Thus, perhaps lightweight or small-frame lambs might be more suitable for pasture finishing, and heavyweight or larger-frame lambs might do better in the drylot?

2. Handling New Lambs

A. To succeed in a feeder lamb finishing, the first 2 to 3 wk after arrival are crucial!
B. Death loss? - High during the first 2-3 wk & about 2% for the total finishing period with good management.
C. Unload lambs to a dry, clean area and let them rest before processing. Also, important to provide shelter from wind, rain, and snow!
D. Offer grass or grass-legume hay and clean, fresh water. Getting lambs to drink water is the key to getting them on feed quickly.
E. Adapt lambs to their rations gradually, especially when changing to grain-based diets, to avoid digestive upsets (acidosis).

☛ Most feedlot operators try to shear all lambs during the feeding period:

1) Feed consumption and gain may improve with shearing, especially in warm weather.
2) Lambs with No. 1 pelt (0.5 to 1" of wool) usually sell at a premium to full-fleeced lambs. Usually need 40 to 60 days to produce a No. 1 pelt after shearing.

3. Feeding Method?

A. Pasture feeding - Pasture can be used for the entire fattening period or for the early part and then placed in the feedlot for finishing.

1) Plants must be palatable and nutritious, and generally the most nutritious ones are the legumes or a mixture of legumes and grasses, which can reduce bloat problems.
2) May be less expensive per pound of gain, but it takes longer to finish lambs.

B. Hand feeding - Fed twice daily on a regular basis:

1) Has the advantage of being able to identify sick or off feed animals easily.
2) Feeding silage? - Usually the method of choice.

C. Self feeding:

1) Rations generally contain between 60 and 85% concentrate.
2) In recent years, grain, as a source of energy, has become less costly in relation to hay, and the current practice is to feed rations containing more grain.

☛ Regardless of feeding method used, care should be taken in changing from high-forage to high-grain diets (i.e., change "gradually"). If not, may have problems with acidosis, diarrhea, and enterotoxemia.

4. Growing or Finishing Lambs on Pasture

A. Using pasture or field crop residues can reduce the production cost!

1) Can be used to clean weed fields, fence rows, soybean stubble, and corn fields.
2) Lush, cool-season grasses or alfalfa provide excellent fall & winter (in some areas) pasture.

B. Depending on the targeted marketing date, supplemental concentrates can be fed ad libitum throughout the finishing period or during the last 30 to 40 days.

1) Grazing cool-season grasses? - Need only an energy source such as whole grains.
2) Cleaning fields? - May need grain-protein supplement.

C. In many areas in the US, the most profitable pasture is winter wheat, oat, or rye. A possibility of nitrate poisoning preclude their use in some areas though!

5. Finishing Lambs in Drylot

A. Feedlots vary from large outside lots with self feeders to complete confinement pen on slotted floors.
B. Equipment used also varies considerably - e.g., Automated feeders, bunk fence-line feeders (feed twice a day), self feeders, or hay and grain feeders for hand feeding.

Estimated production of a 100-pound lamb fed varying grain (barley)-to-roughage (alfalfa) rations [Kott (1998)]

Grain (%)	Hay (%)	Intake, as fed (lb/d)	Gain (lb/d)	Feed:gain (lb//lb)
0	100	7.40	0.38-0.43	17.17-19.24
20	80	6.50	0.51-0.57	11.50-12.86
40	60	5.75	0.60-0.67	8.64-9.66
60	40	5.20	0.68-0.75	6.89-7.70
80	20	4.75	0.74-0.83	5.73-6.39

*Based on NE equations reported by NRC (1985).

C. No best ration for feedlot lambs, and rations are based on locally available feeds & prices. Thus, may consist of any combination of hay & grains, ranging from all hay to 20% hay % 80% grain. (See the table)
D. A simple diet of shelled corn, long alfalfa hay, and supplement can be hand-fed to growing-finishing lambs (see the table).
E. Feed bunk management practices to follow?

1) At least 12 linear inches of feed bunk space are needed per lamb. Make sure all lambs come to the troughs at each feeding time.

Feeding guide for hand feeding growing-finishing lambs, simplified ration (Kott, 1998)

Wt (lb)	Feed intake (lb/d)	Alfalfa hay (lb/d)	Protein suppl. (lb/d)	Grain (lb/d)	Composition			
					CP	TDN	Ca	P
50	2.0	0.4	0.5	1.1	18.4	73.4	0.85	0.46
70	2.5	0.5	0.5	1.5	16.7	75.4	0.73	0.43
80	3.0	0.6	0.5	1.9	15.6	76.1	0.65	0.40
90	3.5	0.7	0.5	2.3	14.8	76.6	0.60	0.39
100	4.0	0.8	0.5	2.7	14.2	77.0	0.55	0.37
105	4.5	0.9	0.5	3.1	13.8	77.3	0.52	0.36

Source: Thomas, V.M. 1990. In: A Practical Guide to Sheep Disease Management. N. Gates ed. News-Review Publishing Co., Moscow.

2) Start lambs on a complete feed (pellet/complete ground-mixed), and make sure that they eat feed readily.
3) Change to a simplified ration gradually over a 7-10 day period by top dressing shelled corn and supplement:

    a) Corn-supplement would be increased while the starter ration would be reduced.
    b) Restrict hay to about ½ lb/lamb/day, and should be fed in separate bunks.

4) Feed twice daily at regular times. Shelled corn is put in feed bunks, and supplement is top dressed or premixed with shelled corn.
5) Feed high-quality alfalfa hay twice daily, following feeding of corn and supplement. Important to feed only the amount they can clean up!
6) Reduce the concentrate feed fed by one half for one or two feedings if the lambs do not clean up the feed from one feeding to the next.
7) Observe the consumption of corn and supplement carefully. Supplement should not be left uneaten in the bunks & also pay attention to sorting by lambs.
8) For spring and summer feeding, place feed bunks in the shade.
9) Be sure plenty of fresh, clean water is available, and salt should also be provided free-choice.

6. **Other Considerations?**

A. Research does not clearly show the need for vitamin supplementation for early lambs, but it has become a common practice to fortify diets with vitamins A, D, and E.

    1) Vitamin A? - The more dehydrated alfalfa or alfalfa in the ration, the lower the level of fortification needed.
    2) Vitamin D? - Lambs kept indoors in strict confinement would need a high level of fortification. Natural feedstuffs and sun are uncertain sources of vitamin D!
    3) Vitamin E? - In areas where white muscle disease or vitamin E/Se deficiency problems are known to exist, fortification at a higher level would be needed.

B. Nitrogen to S ratio:

    1) Should maintain a dietary N to S ratio of 10:1, i.e., a diet containing 13% CP (2.1% N) would require 0.21% S.
    2) Most grains contain 0.10 to 0.15% S, thus possible that lambs on high-grain diets may be deficient in S, especially when a portion of the protein in the diet was from urea.

C. Ca:P ratio for wether lamb diets? Should be at least 2:1 to minimize urinary calculi problem.

POTENTIAL NUTRITIONAL PROBLEMS

- The incidence of nutritional problems with finishing lambs depends on the severity of stress, individual variation, and management practices.

1. Enterotoxemia

A. Perhaps, the most common nutritionally related problem, which is caused by the toxins produced by *Clostridium perfringens* type D, and usually affects larger, fast-gaining lambs.
B. Treatments/prevention:

1) For young lambs under 2 mo of age, should use antitoxin to provide an immediate immunity, which can last 2 to 3 wk.

a) Being used to stop death losses following an outbreak of entertoxemia.
b) Being used to immunize feedlot lambs on a short-term feeding for up to 3 wk.

2) Vaccination? - With bacterin or toxoid will provide a more long-term prevention.

a) The vaccination program is effective for 5-6 mo. Some producers will vaccinate the pregnant ewe about a month before lambing.
b) Early-weaned? Should be vaccinated twice (2 to 3 wk apart) prior to weaning.
c) Older feeder lambs that are transported to the finishing area should be vaccinated twice during the first 2 wk after arrival.

☛ There may be a reaction at the injection site, which may persist for at least 30 days, thus not to use bacterin if intended to slaughter within that time period.

2. Urinary Calculi

A. Commonly occur in rams or wethers in drylot.
B. Prevention?

1) Maintaining a proper Ca to P ratio would help. The ratio closer to 1:1? - Greater the probability of having the problem.
2) Providing a continuous supply of clean, cool water with adequate water space can be useful in prevention. Addition of salt or trace mineral salt may enhance water intake, thus less calculi problem?
3) Ammonium chloride or ammonium sulfate at 0.5% may reduce the incidence?

3. Rectal Prolapse

A. The tendency to develop prolapse may be associated with genetics, but . . .
B. Feeding pelleted, high-roughage rations may increase the incidence of rectal prolapse.
C. Excessive dustiness of the ration may lead to increase coughing, thus increase prolapse?

D. Lambs with short-docked tails are more prone to develop prolapse vs. long docks.

FEEDING REPLACEMENT EWES AND RAMS

1. General

A. Sheep production economics are dictated by the overhead costs of maintaining ewes.
B. Nutrients needs for replacement ewe lambs after weaning will vary with the age of lambs at their first breeding.
C. Two options in terms of breeding replacement ewes?

1) Breed ewe lambs to lamb at 1-yr-old, or
2) More traditional approach of breeding ewes at yearlings to lamb first as 2-yr-olds.

2. Breeding Ewe Lambs

A. More producers are replacing ewes with selected ewe lambs rather than yearlings.
B. Advantages of breeding ewes as lambs (7 to 8 mo of age) to lamb at about a year of age:

1) Gets ewes into production about a year earlier, thus reducing maintenance cost.
2) Shortens generation interval, resulting in more rapid gain from selection.
3) Increases lifetime production.
4) Identifies ewes that are more productive.

C. If they are to be bred to lamb when they are 12 to 14 mo of age, nutrition between weaning and breeding must be on a high plane.

1) In general, ewe lambs' weight must be about 65% of their mature body weight at start of the breeding season.

a) For more traditional breeds, such as Ramboullet, Targhee, Columbia, and Suffolk, perhaps, 70% of their mature body wt? - e.g., Columbia with mature body wt of 165 lb, ewe lambs should weigh 115 lb at the start of the breeding season.
b) Others that may contain one-quarter or more of Finn breed? - Can get by with 60 to 65% of their target body wt? Example - If mature ewes weigh 145 lb, then ewe lambs should weigh between 87 & 94 lb at the beginning of the breeding season.

2) Most early-born ewe lambs (January- or February-born) - Should be fed relatively high-energy creep and starter rations.

a) Most feeding program after weaning should produce 0.4 to 0.5 lb of gain/day?

b) That target weight gain is not possible with good-quality forage alone (e.g., may be only 0.25 to 0.33 lb/day with alfalfa hay), thus need to feed some grain!

3) After identifying the selected ewe lambs at about 90 to 120 days of age (80 to 90 lb):

a) Remove them from the market lamb finishing lot and off the high-energy finishing type ration.
b) Replacement ewe lambs should neither get fat nor have the udder infiltrated with fat cells. Could easily happen to ewe lambs left in a finishing lot too long!

3. Breeding Yearling Ewes

A. Generally, producers will not try to breed ewe lambs under range conditions.
B. Replacement ewes are bred frist at 18 to 19 mo of age to produce their first lambs when they are 2 yr of age.
C. Nutrition may not be nearly critical as ewe lambs, and the nutritional needs can be met fairly easily, except when grazing on mature or weathered grasses during the winter.
D. Can be moved to farm areas & let them graze crop aftermath/pastures, or even fed forage diets in drylot. Supplement would be needed only when they are wintered on dryland pastures.

4. Feeding Rams

A. Replacement ram lambs (about 130 lb) or yearlings (about 220 lb) need, respectively, 5 to 5½ lb or 6½ to 7 1b of feed/day to gain at the recommended rate of 0.3 to 0.4 lb/day.
B. Summer pasture alone is not adequate & good pasture could take the place of only about half the hay.
C. Continue to feed grain during the breeding period.
D. Mature rams should be provided with a maintenance ration (pasture) throughout the year, except during a 30- to 45-day period prior to breeding:

1) Should be gaining approximately 0.3 to 0.5 lb/day during that period.
2) Can be done by feeding dehydrated alfalfa pellets or a combination of hay and grain with no more than ⅓ of the ration composed of grain.

E. Feedstuffs should be similar to those a ram will be consuming during the breeding season so that he will not go off feed.

UREA AND FEED ADDITIVES & IMPLANTS

1. Urea

A. Urea & other nonprotein N can be used to replace up to ⅓ of the protein equivalent of the sheep ration. About 1.5% urea would be the maximum amount usable in a grower-finisher lamb diet.
B. Increased attention may be needed in mixing procedures and during the adjustment or early stages of the feeding period.
C. Should not be used in creep, range sheep, or lamb rations containing low or limited energy.
D. The usefulness of urea depends on the amount of fermentable energy present in a feed and the amount of ammonia formed by protein degradation by bacterial fermentation of the feed in the rumen.

2. Additives and Implants

A. The inclusion of antibiotics in creep rations for suckling lambs and lamb-finishing rations can improve gain and feed efficiency. The greatest response under stressful conditions?
B. Chlortetracycline or oxytetracycline is particularly effective for protecting against low level disease infections and also offering some protection against enterotoxemia.
C. Aureomycin (chlortetracycline)? - 20 to 50 g/ton to stimulate gains and improve feed efficiency.
D. Terramycin (oxytetracycline)? - 10 to 20 g/ton to stimulate gains and improve feed efficiency, and 10 mg/lb BW (7-14 d) as an aid in the prevention or treatment of bacterial diarrhea.
E. Lasalocid (Bovatec)? - 20 to 30 g/ton complete feed for prevention of coccidiosis.
F. Ralgro? - Results from implanting lambs with Ralgro (12 mg) are rather inconsistent.
G. Ammonium chloride or sulfate? - Addition of 0.5% ammonium chloride or sulfate to diets can be used to prevent problems with urinary calculi in wethers.

NUTRIENT REQUIREMENTS TABLES
(Based on NRC, 1985)

1. **Table 1. Daily Nutrient Requirements of Sheep** [TDN = total digestible nutrients; DE = digestible energy; ME = metabolizable energy]

Body weight (kg)	Weight change/day (g)	Dry Matter[a] Intake (kg)	Dry Matter[a] Percent Body weight.	Energy[b] TDN (kg)	Energy[b] DE (Mcal)	Energy[b] ME (Mcal	Crude protein (g)	Ca (g)	P (g)	Vitamin A activity (IU)	Vitamin E activity (IU)
Ewes[c]											
Maintenance											
50	10	1.0	2.0	0.55	2.4	2.0	95	2.0	1.8	2,350	15
60	10	1.1	1.8	0.61	2.7	2.2	104	2.3	2.1	2,820	16
70	10	1.2	1.7	0.66	2.9	2.4	113	2.5	2.4	3,290	18
80	10	1.3	1.6	0.72	3.2	2.6	122	2.7	2.8	3,760	20
90	10	1.4	1.5	0.78	3.4	2.8	131	2.9	3.1	4,230	21
Flushing - 2 Weeks prebreeding and first 3 weeks of breeding											
50	100	1.6	3.2	0.94	4.1	3.4	150	5.3	2.6	2,350	24
60	100	1.7	2.8	1.00	4.4	3.6	157	5.5	2.9	2,820	26
70	100	1.8	2.6	1.06	4.7	3.8	164	5.7	3.2	3,290	27
80	100	1.9	2.4	1.12	4.9	4.0	171	5.9	3.6	3,760	28
90	100	2.0	2.2	1.18	5.1	4.2	177	6.1	3.9	4,230	30
Nonlactating - First 15 weeks gestation											
50	30	1.2	2.4	0.67	3.0	2.4	112	2.9	2.1	2,350	18
60	30	1.3	2.2	0.72	3.2	2.6	121	3.2	2.5	2,820	20
70	30	1.4	2.0	0.77	3.4	2.8	130	3.5	2.9	3,290	21
80	30	1.5	1.9	0.82	3.6	3.0	139	3.8	3.3	3,760	22
90	30	1.6	1.8	0.87	3.8	3.2	148	4.1	3.6	4,230	24
Las 4 weeks gestation (130-150% lambing rate expected) or last 4-6 weeks lactation suckling singles[d]											
50	180 (45)	1.6	3.2	0.94	4.1	3.4	175	5.9	4.8	4,250	24
60	180 (45)	1.7	2.8	1.00	4.4	3.6	184	6.0	5.2	5,100	26
70	180 (45)	1.8	2.6	1.06	4.7	3.8	193	6.2	5.6	5,950	27
80	180 (45)	1.9	2.4	1.12	4.9	4.0	202	6.3	6.1	6,800	28
90	180 (45)	2.0	2.2	1.18	5.1	4.2	212	6.4	6.5	7,650	30
Last 4 weeks gestation (180-225% lambing rate expected)											
50	225	1.7	3.4	1.10	4.8	4.0	196	6.2	3.4	4,250	26
60	225	1.8	3.0	1.17	5.1	4.2	205	6.9	4.0	5,100	27
70	225	1.9	2.7	1.24	5.4	4.4	214	7.6	4.5	5,950	28
80	225	2.0	2.5	1.30	5.7	4.7	223	8.3	5.1	6,800	30
90	225	2.1	2.3	1.37	6.0	5.0	232	8.9	5.7	7,650	32
First 6-8 weeks lactation suckling singles or last 4-6 weeks lactation suckling twins[d]											
50	-25 (90)	2.1	4.2	1.36	6.0	4.9	304	8.9	6.1	4,250	32
60	-25 (90)	2.3	3.8	1.50	6.6	5.4	319	9.1	6.6	5,100	34
70	-25 (90)	2.5	3.6	1.63	7.2	5.9	334	9.3	7.0	5,950	38
80	-25 (90)	2.6	3.2	1.69	7.4	6.1	344	9.5	7.4	6,800	39
90	-25 (90)	2.7	3.0	1.75	7.6	6.3	353	9.6	7.8	7,650	40
First 6-8 weeks lactation suckling twins											
50	-60	2.4	4.8	1.56	6.9	5.6	389	10.5	7.3	5,000	36
60	-60	2.6	4.3	1.69	7.4	6.1	405	10.7	7.7	6,000	39
70	-60	2.8	4.0	1.82	8.0	6.6	420	11.0	8.1	7,000	42
80	-60	3.0	3.8	1.95	8.6	7.0	435	11.2	8.6	8,000	45
90	-60	3.2	3.6	2.08	9.2	7.5	450	11.4	9.0	9,000	48
Ewe Lambs											
Nonlactating - First 15 weeks gestation											
40	160	1.4	3.5	0.83	3.6	3.0	156	5.5	3.0	1,880	21
50	135	1.5	3.0	0.88	3.9	3.2	159	5.2	3.1	2,350	22
60	135	1.6	2.7	0.94	4.1	3.4	161	5.5	3.4	2,820	24
70	125	1.7	2.4	1.00	4.4	3.6	164	5.5	3.7	3,290	26
Last 4 weeks gestation (100-120% lambing rate expected)											
40	180	1.5	3.8	0.94	4.1	3.4	187	6.4	3.1	3,400	22
50	160	1.6	3.2	1.00	4.4	3.6	189	6.3	3.4	4,250	24
60	160	1.7	2.8	1.07	4.7	3.9	192	6.6	3.8	5,100	26
70	150	1.8	2.6	1.14	5.0	4.1	194	6.8	4.2	5,950	27
Last 4 weeks gestation (130-175% lambing rate expected)											
40	225	1.5	3.8	0.99	4.4	3.6	202	7.4	3.5	3,400	22
50	225	1.6	3.2	1.06	4.7	3.8	204	7.8	3.9	4,250	24
60	225	1.7	2.8	1.12	4.9	4.0	207	8.1	4.3	5,100	26
70	215	1.8	2.6	1.14	5.0	4.1	210	8.2	4.7	5,950	27
First 6-8 weeks lactation suckling singles (wean by 8 weeks)											
40	-50	1.7	4.2	1.12	4.9	4.0	257	6.0	4.3	3,400	26
50	-50	2.1	4.2	1.39	6.1	5.0	282	6.5	4.7	4,250	32
60	-50	2.3	3.8	1.52	6.7	5.5	295	6.8	5.1	5,100	34
70	-50	2.5	3.6	1.65	7.3	6.0	301	7.1	5.6	5,450	38

First 6-8 weeks lactation suckling twins (wean by 8 weeks)											
40	-100	2.1	5.2	1.45	6.4	5.2	306	8.4	5.6	4,000	32
50	-100	2.3	4.6	1.59	7.0	5.7	321	8.7	6.0	5,000	34
60	-100	2.5	4.2	1.72	7.6	6.2	336	9.0	6.4	6,000	36
70	-100	2.7	3.9	1.85	8.1	6.6	351	9.3	6.9	7,000	40
Replacement Ewe Lambs[c]											
30	227	1.2	4.0	0.78	3.4	2.8	185	6.4	2.6	1,410	18
40	182	1.4	3.5	0.91	4.0	3.3	176	5.9	2.6	1,880	21
50	120	1.5	3.0	0.88	3.9	3.2	136	4.8	2.4	2,350	22
60	100	1.5	2.5	0.88	3.9	3.2	134	4.5	2.5	2,820	22
70	100	1.5	2.1	0.88	3.9	3.2	132	4.6	2.8	3,290	22
Replacement Ram Lambs[c]											
40	330	1.8	4.5	1.1	5.0	4.1	243	7.8	3.7	1,880	
60	320	2.4	4.0	1.5	6.7	5.5	263	8.4	4.2	2,820	
80	200	2.8	3.5	1.8	7.8	6.4	268	8.5	4.6	3,700	
100	250	3.0	3.0	1.9	8.4	6.9	264	8.2	4.8	4,700	
Lambs Finishing - 4 to 7 Months Old[f]											
30	295	1.3	4.3	0.94	4.1	3.4	191	6.6	3.2	1,410	20
40	275	1.6	4.0	1.22	5.4	4.4	185	6.6	3.3	1,880	24
50	205	1.6	3.2	1.23	5.4	4.4	100	5.6	3.0	2,350	24
Early Weaned Lambs - Moderate Growth Potential[f]											
10	200	0.5	5.0	0.40	1.8	1.4	127	4.0	1.9	470	10
20	250	1.0	5.0	0.80	3.5	2.9	167	5.4	2.5	940	20
30	300	1.3	4.3	1.00	4.4	3.6	191	6.7	3.2	1,410	20
40	345	1.5	3.8	1.16	5.1	4.2	202	7.7	3.9	1,880	22
50	300	1.5	3.0	1.16	5.1	4.2	181	7.0	3.8	2,350	22
Early Weaned Lambs - Rapid Growth Potential[f]											
10	250	0.6	6.0	0.48	2.1	1.7	157	4.9	2.2	470	12
20	300	1.2	6.0	0.92	4.0	3.3	205	6.5	2.9	940	24
30	325	1.4	4.7	1.10	4.8	4.0	216	7.2	3.4	1,410	21
40	400	1.5	3.8	1.14	5.0	4.1	234	8.6	4.3	1,880	22
50	425	1.7	3.4	1.29	5.7	4.7	240	9.4	4.8	2,350	25
60	350	1.7	2.8	1.29	5.7	4.7	240	8.2	4.5	2,820	25

[a]To convert dry matter to an as-fed basis, divide dry matter values by the percentage of dry matter in the particular feed; [b]One kilogram TDN = 4.4 Mcal DE ; ME = 82% of DE. Because of rounding errors, values in Table 1 and Table 2 may differ; [c]Values are applicable for ewes in moderate condition. Fat ewes should be fed according to the next lower weight category and thin ewes at the next higher weight category. Once desired or moderate weight condition is attained, use that weight category through all production stages; [d]Values in parentheses are for ewes suckling lambs the last 4-6 weeks of lactation; [e]Lambs intended for breeding; thus. maximum weight gains and finish are of secondary importance; [f]Maximum weight gains expected.

2. Table 2. Nutrient Composition in Diets for Sheep (100% DM Basis)[a] [TDN = total digestible nutrients; DE = digestible energy; ME = metabolizable energy]

Body weight (kg)	Weight change/day (g)	Energy[b] TDN[c] (%)	DE (Mcal/kg)	ME (Mcal/kg)	Concentrate (%)	Forage (%)	Crude protein (%)	Ca (%)	P (%)	Vitamin A activity (IU/kg)	Vitamin E activity (IU/kg)
Ewes[d]											
Maintenance											
70	10	55	2.4	2.0	0	100	9.4	0.20	0.20	2,742	15
Flushing - 2 Weeks prebreeding and first 3 weeks of breeding											
70	100	59	2.6	2.1	15	85	9.1	0.32	0.18	1,828	15
Nonlactating - First 15 weeks gestation											
70	30	55	2.4	2.0	0	100	9.3	0.25	0.20	2,350	15
Las 4 weeks gestation (130-150% lambing rate expected) or last 4-6 weeks lactation suckling singles[e]											
70	180 (0.45)	59	2.6	2.1	15	85	10.7	0.35	0.23	3,306	15
Last 4 weeks gestation (180-225% lambing rate expected)											
70	225	65	2.9	2.3	35	65	11.3	0.40	0.24	3,132	15
First 6-8 weeks lactation suckling singles or last 4-6 weeks lactation suckling twins[e]											
70	-25 (90)	65	2.9	2.4	35	65	13.4	0.32	0.26	2,380	15
First 6-8 weeks lactation suckling twins											
70	-60	65	2.9	2.4	35	65	15.0	0.39	0.29	2,500	15
Ewe Lambs											
Nonlactating - First 15 weeks gestation											
55	135	59	2.6	2.1	15	85	10.6	0.35	0.22	1,668	15
Last 4 weeks gestation (100-120% lambing rate expected)											
55	160	63	2.8	2.3	30	70	11.8	0.39	0.22	2,833	15
Last 4 weeks gestation (130-175% lambing rate expected)											
55	225	66	2.9	2.4	40	60	12.8	0.48	0.25	2,833	15
First 6-8 weeks lactation suckling singles (wean by 8 weeks)											
55	-50	66	2.9	2.4	40	60	13.1	0.30	0.22	2,125	15
First 6-8 weeks lactation suckling twins (wean by 8 weeks)											
55	-100	69	3.0	2.5	50	50	13.7	0.37	0.26	2,292	15
Replacement Ewe Lambs[f]											
30	227	65	2.9	2.4	35	65	12.8	0.53	0.22	1,175	15
40	182	65	2.9	2.4	35	65	10.2	0.42	0.18	1,343	15
50-70	115	59	2.6	2.1	15	85	9.1	0.31	0.17	1,567	15
Replacement Ram Lambs[f]											
40	330	63	2.8	2.3	30	70	13.5	0.43	0.21	1,175	15
60	320	63	2.8	2.3	30	70	11.0	0.35	0.18	1,659	15
80-100	270	63	2.8	2.3	30	70	9.6	0.30	0.16	1,979	15
Lambs Finishing - 4 to 7 Months Old[g]											
30	295	72	3.2	2.5	60	40	14.7	0.51	0.24	1,085	15
40	275	76	3.3	2.7	75	25	11.6	0.42	0.21	1,175	15
50	205	77	3.4	2.8	80	20	10.0	0.35	0.19	1,469	15
Early Weaned Lambs - Moderate and Rapid Growth Potential[g]											
10	250	80	3.5	2.9	90	10	26.2	0.82	0.38	940	20
20	300	78	3.4	2.8	85	15	16.9	0.54	0.24	940	20
30	325	78	3.3	2.7	85	15	15.1	0.51	0.24	1,085	15
40-60	400	78	3.3	2.7	85	15	14.5	0.55	0.28	1,253	15

[a]Values in Table 2 are calculated from daily requirements in Table 1 divided by DM intake. The exception? Vitamin E daily requirement/head are calculated from vitamin E/kg diet x DM intake; [b]One kilogram TDN = 4.4 Mcal DE. ME = 82% of DE. Because of rounding errors, values in Table 1 and Table 2 may differ; [c]TDN calculated on following basis: 55 & 50% TDN on the DM and as-fed basis, respectively, for hay, and 83 and 75% TDN on the DM and as-fed basis for grain; [c]Values are for ewes in moderate condition. Fat ewes should be fed according to the next lower weight category and thin ewes at the next higher weight category. Once desired or moderate weight condition is attained, use that weight category through all production stages; [e]Values in parentheses are for ewes suckling lambs the last 4-6 weeks of lactation; [f]Lambs intended for breeding, thus maximum weight gain and finish are of secondary importance; [g]Maximum weight gains expected.

3. Table 3. Net Energy Requirements for Lambs of Small, Medium, and Large Mature Weight Genotypes[a] (kcal/d) [NEm = net energy for maintenance; NEg = net energy for gain; growthTDN = total digestible nutrients; DE = digestible energy; ME = metabolizable energy]

Body Weight (kg)[b]:	10	20	25	30	35	40	45	50
NEm Requirements[c]:	315	530	626	718	806	891	973	1053
NEg Requirements								
Mature Weight & Daily Gain (g)[b]								
Small mature weight lambs[d]								
100	178	300	354	406	456	504	551	596
150	267	450	532	610	684	756	826	894
200	357	600	708	812	912	1,008	1,102	1,192
250	446	750	886	1,016	1,140	1,261	1,377	1,490
300	535	900	1,064	1,219	1,368	1,513	1,652	1,788
Medium mature weight lambs[e]								
100	155	261	309	354	397	439	480	519
150	233	392	463	531	596	658	719	778
200	310	522	618	708	794	878	960	1,038
250	388	653	771	884	993	1,097	1,199	1,297
300	466	784	926	1,062	1,191	1,316	1,438	1,557
350	543	914	1,080	1,238	1,390	1,536	1,678	1,816
400	621	1,044	1,234	1,415	1,589	1,756	1,918	2,076
Large mature weight lambs[f]								
100	132	221	262	300	337	372	407	439
150	197	332	392	450	505	558	610	660
200	263	442	524	600	674	744	813	880
250	329	553	654	750	842	930	1,016	1,099
300	394	663	785	900	1,010	1,116	1,220	1,320
350	461	775	916	1,050	1,179	1,303	1,423	1,540
400	526	885	1,046	1,200	1,347	1,489	1,626	1,760
450	592	996	1,177	1,350	1,515	1,675	1,830	1,980

[a]Approximate mature ram weights of 95, 115, and 135 kg, respectively; [b]Weights and gains include fill; [c]NEm = 56 Kcal·$W^{0.75}$·d^{-1}; [d]NEg = 317 kcal·$W^{0.75}$·LWG, kg·d^{-1}; [e]NEg =276 kcal·$W^{0.75}$·LWG, kg·d^{-1}; [f]NEg = 234 kcal·$W^{0.75}$·LWG, kg·d^{-1}.

4. Table 4. NEpreg (NEy) Requirements (Kcal/day) of Ewes Carrying Different Numbers of Fetuses at Various Stages of Gestation[a,b]

Number of Fetuses	Stage of Gestation (days)					
Being Carried	100	%	120	%	140	%
1	70	100	145	100	260	100
2	125	178	265	183	440	169
3	170	243	345	238	570	219

[a]For gravid uterus (plus contents) and mammary gland development only; [b]% = As a percentage of a single fetus's requirement.

5. Crude Protein Requirements for Lambs of Small, Medium and Large Mature Weight Genotypes (g/d)[a,b]

Body Weight (kg):	10	20	25	30	35	40	45	50
Mature Weight & Daily Gain (g)								
Small mature weight lambs								
100	84	112	122	127	131	136	135	134
150	103	121	137	140	144	147	145	143
200	123	145	152	154	156	158	154	151
250	142	162	167	168	168	169	164	159
300	162	178	182	181	180	180	174	168
Medium mature weight lambs								
100	85	114	125	130	135	140	139	139
150	106	132	141	145	149	153	151	149
200	127	150	158	160	163	166	163	160
250	147	167	174	175	177	179	175	171
300	168	185	191	191	191	191	186	181
350	188	203	207	206	205	204	198	192
400	209	221	224	221	219	217	210	202
Large mature weight lambs								
100	94	128	134	139	145	144	150	156
150	115	147	152	156	160	159	164	169
200	136	166	170	173	176	174	178	182
250	157	186	188	190	192	189	192	195
300	179	205	206	207	208	204	206	208
350	200	224	224	224	224	219	220	221
400	221	243	242	241	240	234	234	234
450	242	262	260	256	256	249	248	248

[a]Approximate mature ram weights of 95, 115, and 135 kg, respectively; [b]Weights and gains include fill.

6. Table 6. Macromineral and Micromineral Requirements of Sheep (Dry Matter Basis)

Nutrient	Requirement	Maximum Tolerance[a]
Macromineral, %		
Sodium	0.09-0.18	
Chlorine	-	
Calcium	0.20-0.82	
Phosphorus	0.16-0.38	
Magnesium	0.12-0.18	
Potassium	0.50-0.80	
Sulfur	0.14-0.26	
Micromineral, mg/kg or ppm		
Iodine	0.10-0.80[b]	50
Iron	30-50	500
Copper	7-11[c]	25[d]
Molybdenum	0.5	10[d]
Cobalt	0.1-0.2	10
Manganese	20-40	1,000
Zinc	20-33	750
Selenium	0.1-0.2	2
Fluorine	-	60-150

[a]NRC (1980); [b]High level for pregnancy and lactation in diets not containing goitrogens; should be increased if diets contain goitrogens; [c]Requirement when dietary Mo concentrations are < 1 mg/kg DM; [d]Lower levels may be toxic under some circumstances.

7. Vitamin E Requirements of Growing-Finishing Lambs and Suggested Levels of Feed Fortification to Provide 100% of Requirements

Body Weight (kg)	α-Tocopheryl Acetate		Feed	To Concentrate		To 15% Protein Supplement	
	(mg/1amb/day)	(mg/kg diet)	(kg)	(mg/kg)	(mg/ton)	(mg/kg)	(mg/ton)
10	5.0	20	0.23	20	18,200	133	120,000
20	10.0	20	0.45	20	18,200	133	120,000
30	15.0	15	0.96	15	13,600	100	90,000
40	20.0	15	1.30	15	13,600	100	90,000
50	25.0	15	1.60	15	13,600	100	90,000