Grazing Sheep Nutrition – Focus on Feeding Ewes in Breeding and Gestation

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Overview

• There are key factors in sheep that influence nutrition
  • Genetics
  • Feed Intake
  • Environment - Stress
Nutrition – Seedstock / Show Sheep

• **What makes these sheep different?**

• Genotype/phenotype
  • Differences in body composition, feed intake, etc.
Spectrum of Feed Sources

Drylot/Barn
- Grains
- Hay
- Supplemented minerals

Pasture/Feedlot
- Grains
- Hay
- Supplemented minerals

Pasture/Range
- Forages
- Supplemented minerals
Ewe Nutritional Management

- Traditional Thinking – There are basically three periods of critical importance when feeding ewes
  
  1. Breeding
  
  2. Late gestation
  
  3. Early lactation
Influences of Breeding Success

Fig. 1. Estimated lambing rates of the inseminated ewes (n=231) in Experiment 2 according to age (a), body weight (b) and BCS (c).

Fukui, 2010
Body Condition Scores – Sheep/Goats

Condition 1 - Emaciated
- Spine prominent and sharp
- No fat cover
- Transverse process sharp
- Fingers easily pass under

Condition 2 - Thin
- Spine prominent and smooth
- Thin fat cover
- Muscles medium depth
- Transverse process rounded
- Fingers go under with pressure

Condition 3 - Average
- Spine rounded and smooth
- Moderate fat cover
- Muscles full
- Transverse process smooth and rounded
- Fingers need hard pressure to find ends

Condition 4 - Fat
- Spine detected only as a line
- Fat cover thick
- Muscles full
- Transverse process cannot be felt

Condition 5 - Obese
- Spine not detectable; fat dimple over spine
- Fat cover very thick
- Muscles very full
- Transverse process not detectable

Adapted from “Body Condition Scoring of Sheep” by J.M. Thompson and H. Meyer (Oregon State University)
Body Condition Score

1 or 1.5

3 or 3.5

4 or 5.5

BCS – one of the most critical factors influencing reproductive success
## Nutrient Requirements - 154 lb. ewe

<table>
<thead>
<tr>
<th>Production Stage</th>
<th>DM (lb/d)</th>
<th>TDN (lb/d)</th>
<th>CP (lb/d)</th>
<th>DE (Kcal/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maint</td>
<td>2.6</td>
<td>1.5</td>
<td>0.25</td>
<td>3,000</td>
</tr>
<tr>
<td>Flush/Breed</td>
<td>4.0</td>
<td>2.3</td>
<td>0.36</td>
<td>4,600</td>
</tr>
<tr>
<td>Early Gest</td>
<td>3.1</td>
<td>1.7</td>
<td>0.29</td>
<td>3,400</td>
</tr>
<tr>
<td>Late Gest</td>
<td>4.2</td>
<td>2.8</td>
<td>0.47</td>
<td>5,600</td>
</tr>
<tr>
<td>Lactation</td>
<td>6.2</td>
<td>4.0</td>
<td>0.92</td>
<td>8,000</td>
</tr>
</tbody>
</table>

Total Digestible Nutrients (TDN) - old system of measuring energy of feeds
Digestible Energy – energy digested and absorbed by the animal
Metabolizable Energy – energy used by the organs and is available for use
Net Energy – energy actually used for body functions – maintenance, growth, lactation
Ewe Management: Relative Energy Demands

- Maintenance: 162 days
- Flushing
- Breeding
- Late Gestation
- Lambing
- Peak Lactation
- Weaning

Energy Required vs. Time
Ewe Management: ‘Pre’ Pre-breeding

- Starts as early as ewe lambs in the creep!

- Underfed ewe lambs (pre-weaning) have delayed first estrus and lower ovulation rates
Ewe Management: Pre-breeding

• Flushing
  • Increasing dietary energy levels
    • Start 2-3 weeks before breeding
    • Continue through breeding interval
      • Need optimum nutrition when egg attaches to uterine wall

• Results of flushing
  • Increased ovulation rate
Increasing Ovulation Rate

• Driven by positive energy balance

• Effects include –
  • Weight gain
  • Increasing BCS
  • Increased growth hormone production
  • Increased IGF-1 and leptin production
  • Increased insulin response

• Insulin increases FSH $\rightarrow$ follicular development
Nutrients Capable of Flushing

- Starch and Glucose – yes *IDEAL*
- Hay and Forages – not effective alone
- Protein Feeds – not when fed in excess

Excess N from protein can impair oocyte viability

- Fat Supplements – effective with starch
Guiding Principles in Feeding Ewes During Breeding

- Select a clean, high quality grain source or complete feed supplement
- Provide access to a high quality forage source
- Consistent Feeding Practices
- Focused use of micronutrient supplements
Transitioning from Flush Ration

• Maintain flush feeding 2-3 weeks after ewes are marked
  • Embryos are implanting

• Drastically increasing feed energy = lower progesterone

• Added unsaturated fatty acids can enhance progesterone

• Reduce energy gradually to maintenance levels
Early-Mid Gestation Feeding

• Fertility of progeny starts in the uterus!

• Underfed ewe lamb fetuses have delayed first estrus and lower ovulation rates

Fetal Ovarian Development in Utero

- Mating
- Day 30
- Day 50
- Day 65
- Day 110
- Birth

Adapted from Robinson et al, 2006
Early-Mid Gestation Feeding

• Reduced early fetal growth = ↓ time to puberty

• Fetal programming
  • Reproductive success of progeny
  • Day 0-30 gestation – ovary development in lambs
  • Day 50-65 – follicle development

<table>
<thead>
<tr>
<th>Treatment group</th>
<th>n</th>
<th>Live weight (kg)</th>
<th>BCS</th>
<th>No. of ovulations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Females</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>28</td>
<td>48.6 ± 0.96</td>
<td>2.5 ± 0.03</td>
<td>1.46 ± 0.10 a</td>
</tr>
<tr>
<td>L</td>
<td>21</td>
<td>48.2 ± 1.03</td>
<td>2.5 ± 0.03</td>
<td>1.17 ± 0.09 b</td>
</tr>
</tbody>
</table>

Rae, 2002
Forage Choices

• Alfalfa Hay
• Grass Hay
• Oat/Grain Hay
Minerals Required by Sheep

- Calcium and Phosphorus
- Sodium and Chloride
- Electrolytes – Mg, K, S
- Iron
- Iodine
- Copper and Molybdenum
- Zinc
- Manganese
- Selenium
- Cobalt
Complexities of Mineral Nutrition

- Variation in requirements
  - Ca (grams) v. Se (ppm)

- Sources vary in absorption
  - Oxide forms are generally low

- Interactions/antagonism

- Requirements change with age
Calcium and Phosphorus

- Ratio of Ca:P is still critical
  - 2:1 or at least more Ca than P

- Calcium easy to supplement

- Legume hays are high in Ca
Phosphorus Concerns - Urolithiasis

- Struvite crystal formation in urinary tract
- High risk – mature males on high P diet
Mitigating Risks of Urinary Calculi

• Use mineral supplements with no added P to mature rams

• Feed ammonium chloride when feeding grain to rams
Oxidative Stress in Livestock

- Formation of free radicals during normal metabolism
Causes of Oxidative Stress in Livestock

- Disease (parasites)
- Rapid growth
- Activation of Immune System
  - Temperature change
  - Environmental changes
Where Do Minerals Fit In?

• Antioxidants
  • Chemicals capable of removing oxidizing compounds (i.e. free radicals)
  • Some are enzymes – some are specific molecules

• Primary antioxidant enzymes used by cells
  • Super oxide dismutase – (Cu, Zn, Mn, Fe, Ni)
  • Catalase (Iron)
  • Glutathione peroxidase – (Se, Vitamin E)
Selenium

• Only nutrient currently regulated by FDA (0.3 ppm in feed)

• Sheep can tolerate more in their diet – depending on source

• Toxicity arises when consuming organic form or when injected
# Range of Safety Margins

Adapted from Davis et al., 2006. Tolerance of inorganic selenium by range type ewes during gestation and lactation. J. Anim. Sci. 84:660-668

<table>
<thead>
<tr>
<th>Trace Mineral</th>
<th>Requirement&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Maximum Tolerable Level&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Requirement to Tolerable level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cobalt</td>
<td>0.2&lt;sup&gt;c&lt;/sup&gt;</td>
<td>10</td>
<td>50</td>
</tr>
<tr>
<td>Copper</td>
<td>10</td>
<td>100</td>
<td>10</td>
</tr>
<tr>
<td>Iodine</td>
<td>0.50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>Iron</td>
<td>50</td>
<td>1000</td>
<td>20</td>
</tr>
<tr>
<td>Manganese</td>
<td>20</td>
<td>1000</td>
<td>50</td>
</tr>
<tr>
<td>Selenium</td>
<td>0.1</td>
<td>10</td>
<td>100</td>
</tr>
<tr>
<td>Zinc</td>
<td>30</td>
<td>500</td>
<td>16.7</td>
</tr>
</tbody>
</table>

<sup>a</sup> NRC (1996)-Requirements are for gestating and early lactating beef cows.

<sup>b</sup> NRC (1980)

<sup>c</sup> Stangl et al (2000)-Requirement suggested to be 0.2-0.3 ppm
Copper and Molybdenum

• Susceptibility of sheep to Cu toxicity is well described

• Copper absorption reduced by Molybdenum and/or Sulfur
Sulfur and Molybdenum Induced Copper Deficiency

- Normal Diet
- High Sulphur Diet

Wood samples from Shetland sheep with secondary Cu deficiency caused by Mo toxicity.

This ewe died of acute Cu def, Liver: 16 mg copper, Kidney: 26 mg copper.
Copper

• Required by sheep in many areas of metabolism

• Sheep store copper well in liver, but no bile excretion

• Stress can release stored copper – immune response
Zinc

• Zinc is critical for cell replication – growth and reproduction
• Oxide form is poorly used by sheep
• Too much Zn reduces absorption of Fe and Cu

Al-Saad et al. 2010. Clinical, Hematological, Biochemical and Pathological Studies on Zinc Deficiency (Hypozincemia) in Sheep
Manganese

• Critical for normal reproduction – especially ewes

• Involved in proper collagen formation in fetal lambs

• Grazing animals get plenty of Mn from forage and soil

• However - high Ca, P, or Iron may induce a Mn deficiency
Summary

Drylot/Barn
- Supplement carefully
- Add Mn, Se, Zn to ewe & ram diets
- No P in mix

Pasture/Feedlot
- Be selective in supplementation
- Test pasture forage
- Supplement rams

Pasture/Range
- Test forages
- Salt, iodine
- Ca, P when ewes are on dry grass
General Considerations

• Keep ewes in positive energy balance
• Use Consistent Feeding Practices
• Use Probiotics to maintain gut health
• Provide loose salt/mineral w/ Se and Vit. E
• Vitamin supplement
Thank you