Nutrition for Small Ruminants

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Ruminant Nutritionist
Tennessee Farmers Cooperative

One dct = 500 goats.

Source: USDA Agricultural Census
Goat Nutrition Basics

• Browsers
• Ruminants
• Prehensile lips
• Lower incisors & upper dental pad
• Upper & lower molars

Nutrition Basics

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Nutrition Basics

- Browsers
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Diet Preferences

<table>
<thead>
<tr>
<th>Forage type</th>
<th>Cattle</th>
<th>Sheep</th>
<th>Goats</th>
<th>Horses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grasses (Pastures)</td>
<td>70%</td>
<td>60%</td>
<td>20%</td>
<td>90%</td>
</tr>
<tr>
<td>Forbs (Weeds)</td>
<td>20%</td>
<td>30%</td>
<td>20%</td>
<td>4%</td>
</tr>
<tr>
<td>Browse (Shrubs)</td>
<td>10%</td>
<td>10%</td>
<td>60%</td>
<td>6%</td>
</tr>
</tbody>
</table>
Caloric density

- 1 lb chips = 2.4 lbs corn = 6.15 lbs hay
Digestive Capacity

Cellulose

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Cellulose

Ruminant Digestive System

- Primary fermentation vat
- 5-10 gallons (mature goat)
- Contents in 3 layers: liquid, fibrous mat, gas
- Cud-chewing, saliva
Rumen microbes

- Bacteria, protozoa, & fungi
- 150+ species identified
- Five major groups:
  - Fiber fermenting bacteria
  - General purpose bacteria
  - NSC fermenting bacteria
  - Secondary feeders
  - Protozoa
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![Image of rumen microbes with labeled parts: abomasum, omasum, reticulum, and rumen]
Crepuscular feeders

Minutes per hour spent

6 AM  6 PM  6 AM

Time Grazing

Time Ruminating

4/21/2017
Rumen

- Papillae lining
- VFA absorption
  - Acetate, propionate, & butyrate
    - Propionate highest energy content
    - Acetate used in udder to produce milkfat

![Rumen papillae and reticulum folds](image-url)
Papillae

Omasum

• “Many plies”
• Absorbs excess water from digesta
Abomasum

- “True” stomach – acid digestion
- Similar to humans, pigs, etc.

Phosphorus

- Most known functions
- Energy utilization
- “Fertility mineral”
- Expensive – supplement strategically
Copper

- Deficiency causes delayed puberty and poor fertility
- UT Mineral Survey
  - Most TN soils deficient
  - Sulfur antagonist
- Sheep
- COWP

Zinc

- Affects testicular development
- Deficiency causes reduced sperm production, delays maturation of sperm
- Immune system
Manganese

- Energy metabolism
- Deficiency...
  - Do not show heat
  - Decreased conception
  - Increased abortion
  - Low birth weight

Selenium

- Interacts with Vitamin E
- Significantly reduced fertility
- Southeastern soils are deficient
- Retained placentas
- Sperm production, motility
Value of a Mineral Supplement?

- Content (% or ppm) of each mineral
- Feeding rate
- Source (Bioavailability)
  - Inorganic
  - Organic
  - Hydroxy

“Organic” trace minerals

- Attaching an Amino Acid to a mineral source
- Examples: Zinpro-40 and Zinpro 4-Plex
- 4-Plex contains Cobalt, Copper, Manganese and Zinc
- Yeast derived Selenium (Se Methionine)
Reproduction

• Seasonal breeders
  • August – February
• Induced ovulators
• 150 day gestation
• Twinning is normal
• Respond to flushing

Reproduction

• Estrogenic compounds
• Phytoestrogens
• Legumes – clover, alfalfa, soybeans
• Reproductive management, herd health more important
Goat Lactation Cycle

1. Transition
2. Early Lactation
3. Late Lactation
4. Dry period

![Goats](image)

Goat Lactation Cycle

![Graph](image)

*Figure 2: Relationships of milk yield (—), body weight (— - -) and feed intake (*** of lactating goats.*
Transition

- Transition from...
  - Pregnant to empty
  - Dry to lactating
  - Low energy to high energy diet
- DMI decreases at kidding
- Gradually increase intake of lactation ration over 7-10 days

Early Lactation

- Peak milk production at 6-9 weeks
- Peak DMI lags behind
- Body reserves make up the deficit
- Goal: consume as much nutrition as possible without disrupting rumen function
- 1 lb grain per 2 lbs milk
Late Lactation

• Declining milk production allows replenishment of body stores
• Rebreeding can occur once a positive energy balance is regained
• Should end lactation in same body condition as desirable to begin lactation
  • More efficient to add weight now vs. dry period

Dry Period

• 60 days that determine success of next lactation
• Rest & restore rumen and udder
• Maximum fetal growth
• Prepare immune system for kidding, colostrum production
• Ensure adequate body condition to enter lactation
• Avoid high Ca or high K forages
• Adapt to lactation diet
Replacements

• Critical to future success of the enterprise
• Should have greatest genetic potential
• Goal: Grow efficiently from birth, breed, and begin lactating at 12 months of age (dairy)

Replacements

• Colostrum is vital
  • Laxative
  • Nutrition
  • Antibodies
Replacements

• Colostrum is vital
  • Laxative
  • Nutrition
  • Antibodies
• Colostrum supplements

Table 2: Effects of nursing method and age at weaning on performance of does' kids

<table>
<thead>
<tr>
<th>Age at Weaning (days)</th>
<th>Artificial</th>
<th>Milk replacers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goat kids (days)</td>
<td>25.3</td>
<td>23.2</td>
</tr>
<tr>
<td>12-week kids</td>
<td>12.2</td>
<td>18.0</td>
</tr>
<tr>
<td>Milk replacers</td>
<td>15.5</td>
<td>15.0</td>
</tr>
</tbody>
</table>
Replacements

- Kids are born “pre-ruminants”
- Milk bypasses the rumen, directly into abomasum
- Rumen size & function develop gradually as forage & grains are consumed

Creep feeding

- Physical means of exclusively supplementing kids
- Not the most cost-effective gains
- Eases the burden on the doe
Weaning

• Doelings can be weaned when they reach 2.5X birth weight and
• They are consuming at least 1 ounce of starter feed/hd/d

Post-weaning

• Primary emphasis on rumen development & gut capacity
• Secondary emphasis on rate of gain
  • Avoid fattening
• Breeding size at 7 months (again, dairy)
• Ionophores, coccidiostats
Feeds vs. Ingredients

Ethanol production
Distiller’s grains

Corn syrup
Corn syrup

Gluten pellets
Oilseeds

Soybean meal
Soyhulls

Soyhull pellets
18% Pelleted Goat Starter - RUM

- Monensin for the prevention of coccidiosis
- 18% protein
- Minerals balanced for kids
- Feed continuously as the only ration up to 5 to 6 weeks of age

16% Pelleted Goat Grower - RUM

- Monensin for the prevention of coccidiosis
- 16% protein
- Feed continuously as the only ration to goats 6 weeks of age or older
16% Pelleted Goat Grower - DEC

- Versatile feed for supplementing mature and growing goats
- Deccox for prevention of coccidiosis
- Formulated to be fed at 1 lb/100 lbs BW

16% Coarse Goat Feed

- Non-medicated for use in dairy or meat goats
- Coarse formulation with visible grain
- Provide 1 lb grain per 2 lbs milk produced; no more than half of diet DM as grain
16% Pelleted All Purpose Goat Feed - RUM

- Versatile feed for supplementing mature and growing goats
- Monensin for coccidiosis prevention

16% Pelleted Milk Goat Enhancer

- Multiple sources of soluble protein & high level of NSC to support lactation
- Selenium yeast
- Added vitamin E for udder health & reducing SCC
- Organic Zn for hoof health
- High level of digestible fiber for rumen health, improved milkfat
### 17% Pelleted Show Goat Grower - RUM

- High energy feed for finishing show goats
- Organic trace minerals
- Direct-fed microbials to aid digestion
- Allows maximum expression of genetic potential

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>MIN. (%)</th>
<th>MAX. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>14.0</td>
<td>18.0</td>
</tr>
<tr>
<td>Wheat</td>
<td>8.5</td>
<td>12.5</td>
</tr>
<tr>
<td>Oats</td>
<td>5.0</td>
<td>10.0</td>
</tr>
<tr>
<td>Alfalfa</td>
<td>4.0</td>
<td>8.0</td>
</tr>
<tr>
<td>Soybean</td>
<td>0.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Salt</td>
<td>0.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Magnesium</td>
<td>0.03</td>
<td>0.07</td>
</tr>
<tr>
<td>Iron</td>
<td>0.03</td>
<td>0.07</td>
</tr>
<tr>
<td>Copper</td>
<td>0.02</td>
<td>0.06</td>
</tr>
<tr>
<td>Zinc</td>
<td>0.02</td>
<td>0.06</td>
</tr>
<tr>
<td>Iodine</td>
<td>0.002</td>
<td>0.005</td>
</tr>
</tbody>
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### Supreme Goat Mineral

- Premium vitamin & mineral supplement for goats
- Organic trace minerals
- Selenium yeast
- Kelp meal
- ¼ oz/hd/d consumption
<table>
<thead>
<tr>
<th>Trace Mineral salt?</th>
</tr>
</thead>
</table>

**Product name:** CO-OP LAMB STARTER/CREEP-BOY

**Stated purpose:** For the prevention of不可缺少的

**Guaranteed nutrient analysis:**
- Calcium: 1.42%
- Phosphorus: 1.22%
- Sodium: 0.18%
- Magnesium: 0.01%
- Copper: 500 ppm
- Zinc: 500 ppm
- Iron: 500 ppm

**Ingredients, largest to smallest:**
- Corn
- Wheat
- Soybean meal
- Linseed meal
- Zinc oxide
- Copper sulfate
- Manganese sulfate
- Vitamin A acetate
- Vitamin D3

**Specific feeding directions:** For creep feed in gestating ewes and lambs; for lamb. Feed 1 to 3 lbs. per day for each 100 lb. of body weight. For lambs, feed 1 to 3 lbs. per day.

**Precautionary statement:** Do not use if moldy or infested. Store in a cool, dry place. Keep out of reach of children.

**Manufacturer’s name/address:** CO-OP MINERALS

**Item number:** 353

**Net weight statement:** 50 lbs (22.7 kg)
Ionophores

- Lasolocid, Monensin Sodium
- Bovatec, Rumensin
- Increases rumen propionate production
- Increases feed efficiency ~10%
- “Free” energy from same diet
- Toxic to equines

Veterinary Feed Directive (VFD)

- Effective January 1, 2017, in accordance with the US Food and Drug Administration’s (FDA) Veterinary Feed Directive (VFD) ruling, the use of all medically important antibiotics (those important in human and animal health) in feed will require a VFD, and use of medically important antibiotics in water will require a prescription from a licensed veterinarian.
Veterinary Feed Directive (VFD)

- Sheep (breeding)
- Chlortetracycline
- 80 mg/hd/d
- Reducing the incidence of (vibrionic) abortion caused by *Campylobacter fetus* infection susceptible to Chlortetracycline
- No extra-label (off-label) use

Veterinary Feed Directive (VFD)

Minor Species

The Animal Medicinal Drug Use Clarification Act (AMDUCA) does not permit extralabel use of medicated feeds. However, there are some minor species that cannot be practically medicated in any way other than through the use of medicated feeds. Furthermore, minor species such as fish and game birds have very few drugs approved for their use. In such situations, a veterinarian may determine that extralabel use of medicated feed is needed to prevent suffering and death in these minor species.
Diseases Related to Nutrition

Polioencephalomalacia

- PEM
- Thiamine deficiency
- Heavy grain/low fiber
- Thiamine I.V. from veterinarian - not feed additive
**Listeriosis**

- Sporadic bacterial infection
- “Circling disease”
- Disoriented, facial paralysis, leaning against stationary objects
- Penicillin, dexamethasone per DVM

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**Ketosis**

- *Pregnancy toxemia, twin lamb disease*
- Limited physical space
- Unable to meet energy demands
- Mobilizes fat stores
- Depression, incoordination, grinding teeth
- Treat with oral propylene glycol
- Prevent by feeding high energy diet multiple times per day
Enterotoxemia

- Overeating, pulpy kidney
- *Clostridium perfringens*, type D
- Sudden death
- Energy-rich diets
- Vaccinate

Cyanide Poisoning

- *Prussic acid, hydrocyanic poisoning*
- Wilt, frost, drought causes accumulation of HCN
- Cherry tree, corn, sudangrass, Johnsongrass, sorghum
- Hemoglobin unable to release oxygen
- Avoid grazing affected forage
Nitrate Toxicity

- Nitrate converted to nitrite in rumen
- Binds hemoglobin
- Fast-growing plants
- Difficulty breathing, trembling, weakness, death
- I.V. methylene blue
- Avoid suspect forages

Urea Toxicity

- Ruminants utilize NPN
  - Microbes overwhelmed
    - High levels diet NPN
    - Inadequate CHO
- Trembling, twitching, incoordination
- Drench cold, weak acetic acid
- Raw soybeans
  - Fat
  - Urease, trypsin inhibitor
Footrot

• Similar to cattle
• Control with trimming, footbaths
• Zinc methionine

Urinary Calculi

• Kidney stones
• Related to Ca:P ratio
• Ample fresh, clean water
• Ammonium Chloride
Feeding Equipment

Mineral, Grain, & Hay Feeders

- Feed (forage & purchased) is the largest cost in livestock operations
- Feeders should minimize waste
- Accessible by all ages
- Trough space
- Durable (goat-proof)
- Clean and disinfect
- Portable
Mineral, Grain, & Hay Feeders

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Mineral, Grain, & Hay Feeders
Non-Automatic

- Physically delivered – lots of labor required
- Lower cost initially - potentially higher cost in the long run

Waterers
Automatic Water Delivery

• Minimal manual effort
• Constant supply of fresh water
• Risk of water line breakage
• Higher cost in the short run

Waterers
Waterers

Extension Publications

• “Solar Powered Livestock Watering Systems” (PB 1640)
• “Alternative Livestock Watering Systems” (PB 1641).
Nutrition of Large-Breed Dogs

Predator control

- Guard dogs
  - Anatolian,
Predator control

- Guard dogs
  - Anatolian, Pyrenees, Komondor
- Burro
Feeding large-breed dogs

• > 50 lbs mature wt.
• Extremely rapid growth rate
• Most occurring between 3 and 6 months
• Sensitive to deficiencies or excesses

Feeding large-breed dogs

• Developmental orthopedic disease (DOD)
  • Hypertrophic osteodystrophy (HOD)
  • Osteochondrosis (OC)
  • Osteochondritis dissecans (OCD)
  • Retained cartilaginous core
  • Panosteitis
  • Hip dysplasia (HD)
  • Canine elbow dysplasia (CED)
Feeding large-breed dogs

- Hypertrophic osteodystrophy
- Decreased blood flow to metaphysis
- Failure of ossification
- Results in inflammation and necrosis
- Irreversible deformities in bones and joints

Feeding large-breed dogs

- Undernutrition rare
- Overnutrition, imbalances common
- Energy, calcium, phosphorus, vitamin D all play a role
Feeding large-breed dogs

• Undernutrition rare
• Overnutrition, imbalances common
• Energy, calcium, phosphorus, vitamin D all play a role

Feeding large-breed dogs

• Energy
  • Overfeeding high-fat, nutrient-dense food
  • Need 3.5-4.0 kcal/g
  • Fat < 15%
  • Protein not an issue
Feeding large-breed dogs

• Calcium
  • Passive absorption until after 6 months
  • Most rapid growth at 3-5 months
  • ~1% in feed

Feeding large-breed dogs

• Phosphorus
  • Better regulated
  • NRC 1.2-1.4:1
  • Improper ratio affects hormonal balance
  • ~0.8% in food
  • Resist the temptation to top-dress!
Feeding large-breed dogs

• Vitamin D
  • Required by dogs – must be supplemented in diet
  • Affects Ca & P absorption

Feeding strategies
• Use a quality large-breed puppy food
• Several meals daily
• Monitor body condition – adjust as needed
• Transition to adult maintenance food at 12 months
Feeding large-breed dogs

Feeding large-breed dogs