Feeding for 2: Understanding How to Feed the Goat and her Rumen

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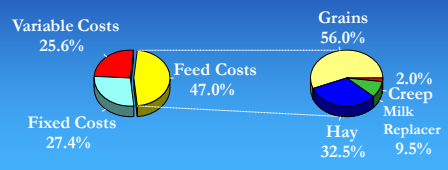
The Marvels of Ruminant Digestion

- This goat weighed 200 lb and produced 3,454 lb of milk in a 305 day lactation
- Milk Composition:
  - 4% lactose
  - 3.5% protein
  - 3.6% fat
- Required daily synthesis:
  - 250 g Lactose
  - 180 g Protein
  - 185 g Fat
- Fermentation precursors:
  - Propionate = lactose
  - Acetate, Butyrate = fat
  - Microbes = protein

Production Costs

Yearly costs per doe raising 2 kids, 100 doe facility



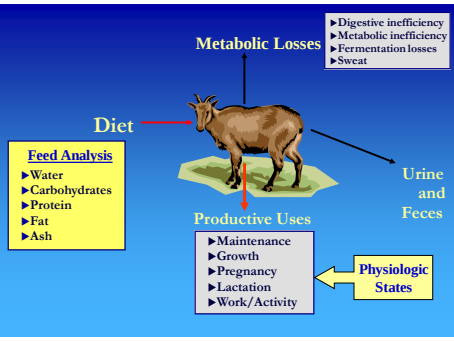
Learning Objectives

- To understand how to feed goats emphasizing how to properly feed the rumen microbes for feed efficiency
- Recognize the role of forage quality in meeting energy, protein and other nutrient needs at differing physiologic states
- Gain some insight to basic dietary guidelines for evaluating goat diets

Essential Nutrients

- Water – 2-5x dry matter intake
- Energy (CHO, Fats, Protein)
- Amino Acids (Protein)
- Minerals
  - Macro – Ca, P, Mg, K, Na, Cl, S
  - Micro – Co, Cu, Fe, I, Mn, Se, Zn
- Vitamins
  - Fat-soluble – A, D, E, K
  - Water-soluble – B-complex, C, Choline
- Fiber (?)

Substances that are required in the diet to support body functions and productivity



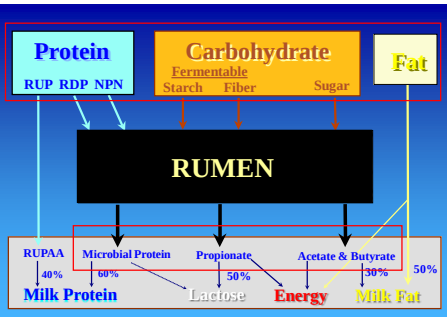
Animals consume amounts of nutrients and not percentages!

How Does a Goat Use Feed?

- Is a goat a small cow?
- What is a rumen?
- Why are microbes important to the goat?
- Is this really going to be complicated?

Unique Characteristics

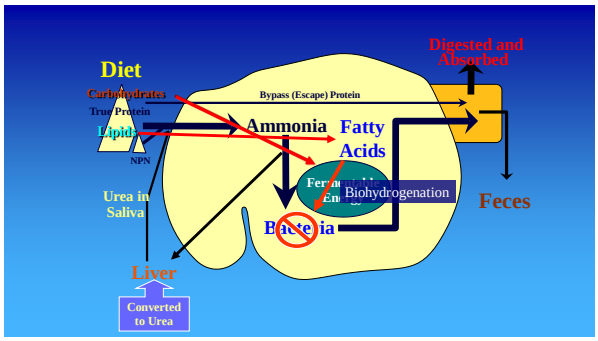
- Browser not grazer
  - Selective feeding behaviors
- Good chewing activity
  - Less processing
- Small body size
- High intake capacity
  - 4-6 % of body weight
  - Faster rate of passage

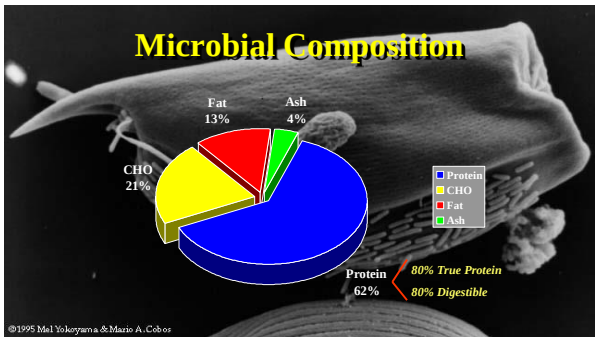


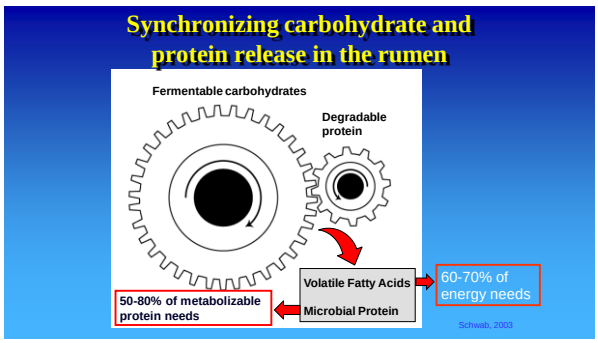
Class of Organism	Primary Substrate	Specific Requirement	Primary Endproduct	pH Tolerance
Cellulolytic Bacteria	Hemicellulose, Cellulose, Pectins	Ammonia, Isoacids, Cofactors	Acetate, Succinate, Formate, CO_2	6.2-6.8
General Purpose Bacteria	Cellulose, Starch	Ammonia, Amino Acids	Propionate, Succinate, Butyrate, Ammonia	5.5-6.6
NSC Bacteria	Sugars, Starch	Amino Acids, Ammonia	Propionate, Lactate, Butyrate, Ammonia	5.0-6.6
Secondary Feeders	Succinate, Lactate, Fermentation Endproducts	Amino Acids	Ammonia, Isoacids, Propionate	6.2-6.8
Protozoa	Sugars, Starch, Bacteria	Amino Acids	Acetate, Propionate, Ammonia	6.2-6.8
Methanogens	CO_2, H_2, Formate	Coenzyme M, Ammonia	Methane	6.2-6.8

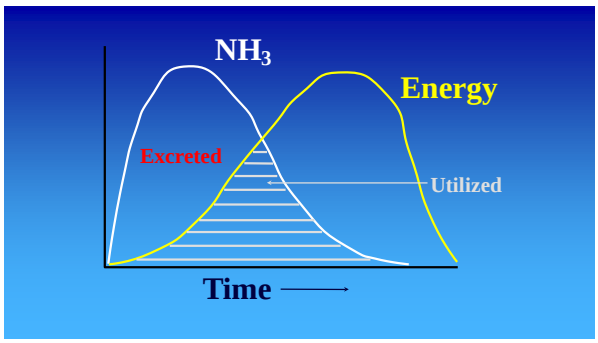
Factors Affecting Rumen Environment

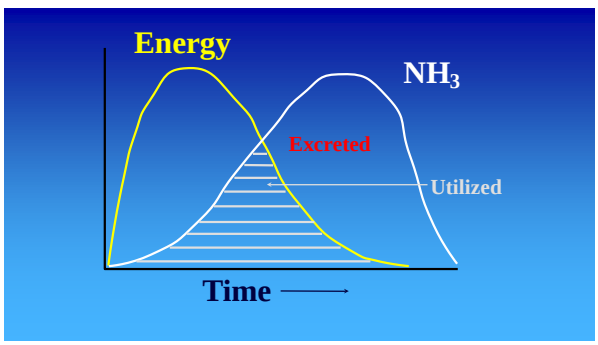
- Dietary composition
  - Essential nutrients
  - Feed additives
  - Toxic compounds
- Feeding management
  - Feed availability
  - Feeding delivery
- Feed ingredient processing
  - Particle size reduction
  - Nutrient alteration
  - Effective fiber


Diet
Carbohydrates
True Protein
Lipids
NPN
Bypass (Escape) Protein
Digested and Absorbed
Ammonia
Fatty Acids
Biohydrogenation
Feces
Urea in Saliva
Liver
Converted to Urea


Microbial Composition
Fat 13%
Ash 4%
CHO 21%
Protein
CHO
Fat
Ash
Protein 62%
80% True Protein
80% Digestible
©1995 Mel Yokoyama & Mario A. Cobos


Synchronizing carbohydrate and protein release in the rumen
Fermentable carbohydrates
Degradable protein
Volatile Fatty Acids
Microbial Protein
60-70% of energy needs
50-80% of metabolizable protein needs
Schwab, 2003


NH3
Energy
Excreted
Utilized
Time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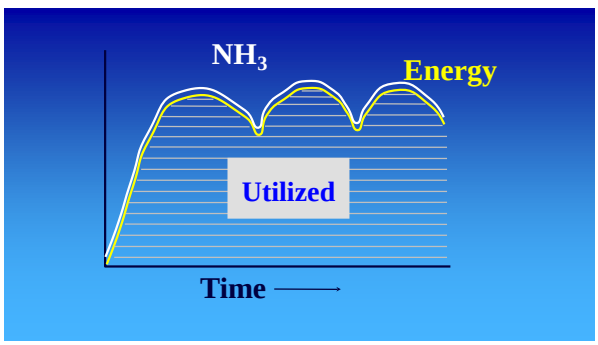

NH3
Energy
Utilized
Time

Relative rates of rumen degradation of common NFC and protein sources

Faster

Sugar	Urea
Wheat flour	Hay silage
Bakery product	Wheat midds
High-moisture corn	Corn gluten feed
Steam-flaked corn	Canola meal
Ground barley	Soybean meal
Ground corn	Heat-treated soybean
Ground sorghum	Distillers grains
	Corn gluten meal

Slower

de Ondarza, 1999

Feeding Programs

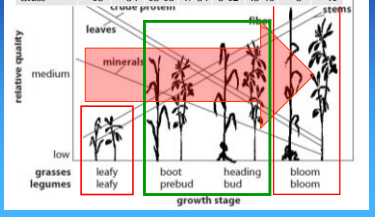
- Water
- Energy
- Protein
- Minerals
- Vitamins
- Fiber – fill capacity

Is Forage Quality Important?

- What is forage quality?
- Why is it important?
- How can it be measured?
- How does it impact my feeding program?

Plant Maturity

	CP%	TDN%	CP%	TDN%	CP%	TDN%	CP%	TDN%
Alfalfa	>19	> 64	17-19	56-60	13-16	50-55	<13	< 50
Grass	>18	> 54	13-18	47-54	8-12	43-46	< 8	< 41



Forage Quality and Feed Intake

Calculated Dry Matter Intake Capacity (% of BW)

Forage Quality	Forage NDF %	NDF Intake (% of BW) 1.2	1.0	0.8	0.6
Excellent	38	3.16	2.63	2.11	1.58
	42	2.86	2.38	1.90	1.43
	44	2.61	2.27	1.74	1.36
	46	2.73	2.17	1.82	1.30
	50	2.4	2.0	1.60	1.20
	54	2.22	1.85	1.48	1.11
	58	2.07	1.72	1.38	1.03
	62	1.94	1.61	1.29	0.97
Poor	66	1.82	1.52	1.21	0.91

Profitable Goat Production

- High quality forage and browse
- Strategic use of concentrates
- Maximize neonatal survivability
- Maximize milk production, composition

To be economically viable, goats should get most required nutrients from forages

Supplement Use

- Supplements must match your forage program!
- Energy and Protein
- Minerals
  - Macro
  - Micro
- Vitamins
- Additives

Supplement Use

- Depends upon the difference between nutrients provided by forage and nutrient requirements of goat
- Energy supplements – promote growth, milk production, late pregnancy
  - Grain sources – corn, oats, barley
  - Lipid sources – whole beans, limited use
- Protein supplements
  - Match to forage quality
  - Plant and animal sources

Energy Sources

- Cereal grains (starch-based)
  - Corn, barley, oats, wheat
  - Availability differences
- Readily fermented in rumen
- Risk potential for acidosis
- Fermentable fiber
  - Soyhulls
  - Wheat midds, bran
  - Beet, citrus pulp
- Moderate to readily fermented in rumen
- Minimal effect on pH, but adversely affected by low pH

Energy Sources

- Fat supplementation
- Limited due to negative effects on rumen
- Sources:
  - Endogenous fat
  - Vegetable fats
  - Rumen inert fats
- Endogenous fats from forage ingredients (1-3% DM)
- Limit vegetable fat sources to 3% DM
- Use inert fat sources if additional energy needed

Protein Feeding

- Essential for growth, pregnancy and lactation
- Meet rumen needs (6-8% CP minimum)
- Watch overuse of bypass protein sources (distillers, corn byproducts)
- Rumen degradable sources:
  - Alfalfa, Alfalfa pellets
  - Soybean or canola meal
- Rumen undegradable sources:
  - Heat-treated soybean
  - Distillers, brewer's grains
  - Corn gluten meal

Supplement Use

- Minerals and Vitamins
  - Probably to primary need
  - Must match intake to composition
  - Properly formulated to forage program
  - Sources of minerals, vitamins
- Feeding methods
  - Free choice (0.3 oz/day)
  - Force fed

Macrominerals

- Mostly from forage with some Ca-P supplementation
  - Legumes: excessive Ca
  - Grasses: moderate to low Ca
- Maintain dietary Ca:P ratio of 2:1, though don't increase P excessively
- Limestone, Dicalcium phosphate
- Possibly add Mg on grasses (4 K:1 Mg)

Microminerals

- Forage is inadequate supply
- Supplement feed or free choice mineral
- Only provide ONE source of salt!
- Intake rate for free choice salt averages 0.25-0.33 oz/day (depends on salt content)
  - Selenium: 90 ppm (0.09 %)
  - Copper: < 30 ppm (sheep); > 1500 ppm (goats)

Vitamins

- Metabolic regulators, immune response
- B-vitamins provided by "healthy" rumen
  - Yeast products
  - Probiotics (?)
- Vitamins A, D, E to be supplemented
  - Minimal need when on good pasture
  - Definitely needed with feeding of stored forages

Diet Formulation Process

- Start with forage available
  - 1% BW as forage NDF (26-28% DM)
  - Max total NDF at 1.4% BW
- Add energy sources up to intake potential leaving 1% for mineral
- Replace some energy with protein source to meet needs
- Add mineral/vitamin supplement to meet needs (1% dietary DM)

Summary

- Many equally satisfactory methods sheep and goats can be fed to meet their nutrient needs
- No specific feed ingredient needed, only need is for essential nutrients
- Feed the rumen first!
  - Energy and protein sources
  - Ensure adequate NDF intake
- Supplements as necessary based on forage program

Questions?