THE OHIO STATE UNIVERSITY
COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES

Feeding Ewe Lambs for Maximum Growth and Reproduction

Francis L. Fluharty, Ph.D.

Department of Animal Sciences

The Ohio State University

Hierarchy of Nutrient Use

- Maintenance
- Development
- Growth
- Lactation
- Reproduction
- Fattening

Considerations

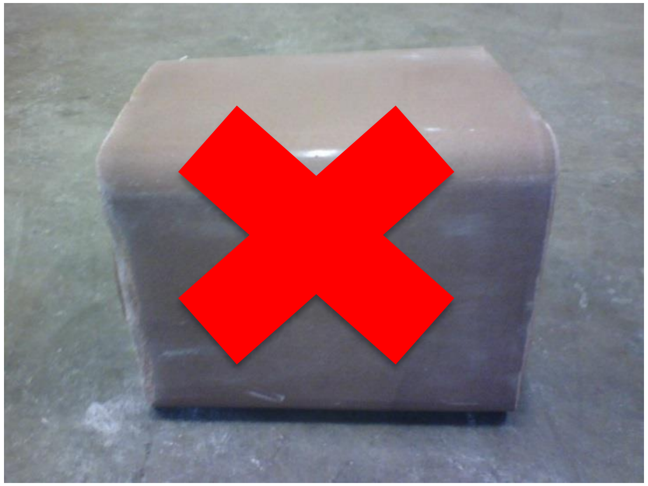
- Ewe lambs should be approximately 70% of mature weight at breeding and 85% of mature weight at lambing. This means that they are still growing while pregnant, and their nutrient requirements must be met as well as those of the fetus.
- During the last few weeks of late gestation, they must produce colostrum, too, which increases their nutrient requirements.
- Feed replacement ewe lambs separate from mature ewes!!!

Let's Consider Nutrients

- **Energy**: comes from VFA's as a result of the digestion of cellulose and starch.
- **Protein**: comes from feed protein and microbial protein.
- **Vitamins**: fat soluble and water soluble. We supplement the fat soluble vitamin E (which helps with our selenium deficiencies), vitamin A comes from forage, and vitamin D comes from the sun (even in Ohio). The B vitamins are produced by the rumen bacteria.

Let's Consider Nutrients

- **Minerals**:



- A TM salt block is Not a mineral program!

  Trace Mineral blocks usually result in only half the needed intake, at most. They usually contain Iron Oxide, to make the block look red, but it is unavailable to the animal.

Some Functions of Minerals & Vitamins

Energy Metabolism!!!

Immune function!!!

Enzyme co-factors!!!

Nervous system

Antioxidant

Hemoglobin

Cell membranes

Muscle contraction

RNA and DNA

Digestion

Blood clotting

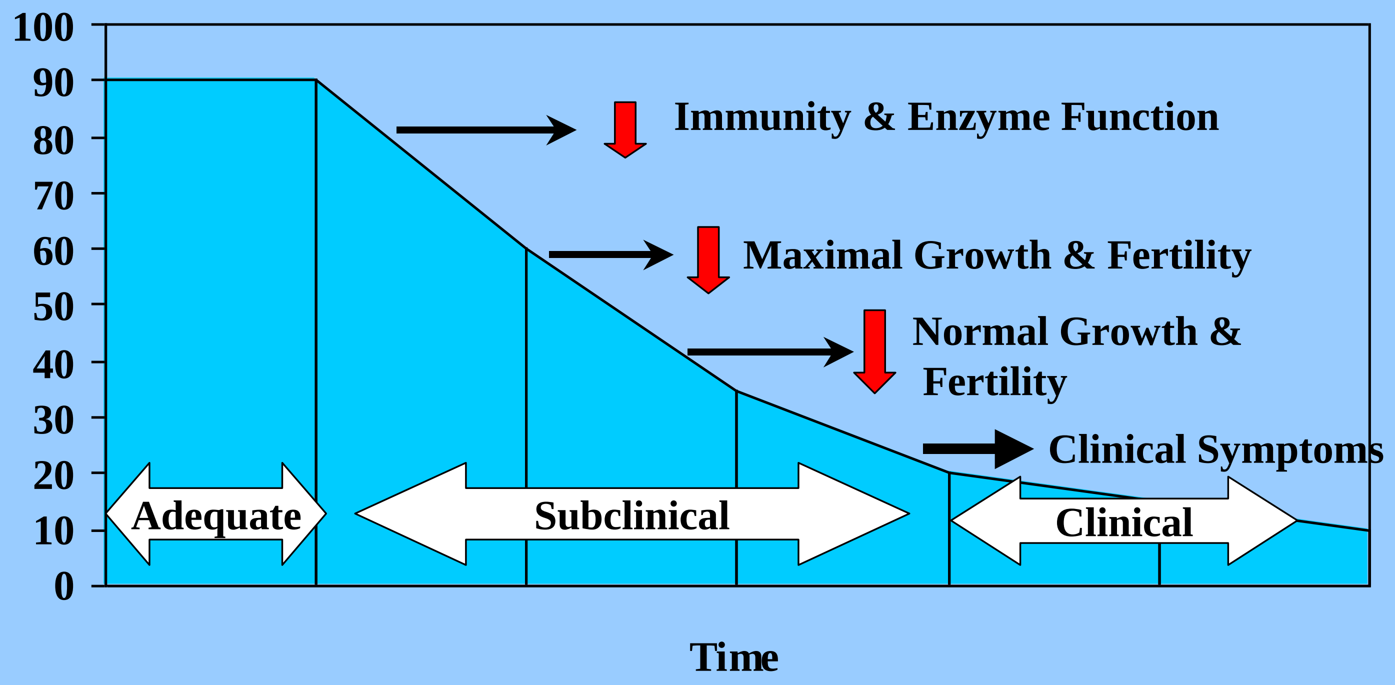
Bone formation

Hormone synthesis

Several other biological processes

Impact of Decline in Trace Mineral Status on Animal Performance

Dr Gordon Carstens Texas A&M University



Source: http://www.multiminglobal.com/aus/ViewDocument.asp?DocID=244

Mineral availability and soil pH, and The Reason Soil Tests are Important!

Mineral	4.0	5.0	6.0	7.0	8.0	9.0
Nitrogen	Low	Low				Low
Phosphorus	Low					
Potassium	Low	Low				
Sulfur	Low	Low				
Calcium	Low	Low	Low			
Magnesium	Low	Low	Low			
Iron					Low	Low
Manganese	Low				Low	Low
Boron	Low				Low	Low
Copper & Zinc	Low				Low	Low
Molybdenum	Low	Low	Low			

Source: Dr. Jeff Lehmkuhler

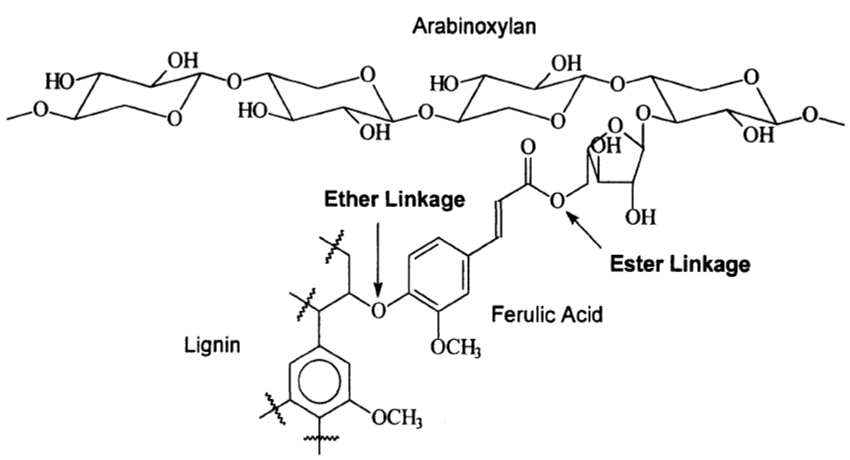
Adapted from Miller and Reetz, 1995

Let's Consider Nutrients

- **Water**: We will come back to this one in a minute.

Eastern Forages: In General

- High rainfall leads to lower energy and **higher lignin** levels compared with western forages, but our clay and loam soils lead to more soil N uptake, which leads to higher protein.



Source: Moore and Jung: Lignin and Fiber Digestion, Journal of Range Management, Vol. 54, No. 4 (Jul., 2001), pp. 420-430

Rumen Contents Average 88% Water

THE RUMEN ENVIRONMENT

Temperature

Averages 39ºC (102.2ºF)

Range 38º to 40º C (100.2 to 104ºF)

pH

5.5 to 6.8 for animals fed a corn-based or forage-based diet, respectively

Composition of rumen gases:

CO_2 – 65%

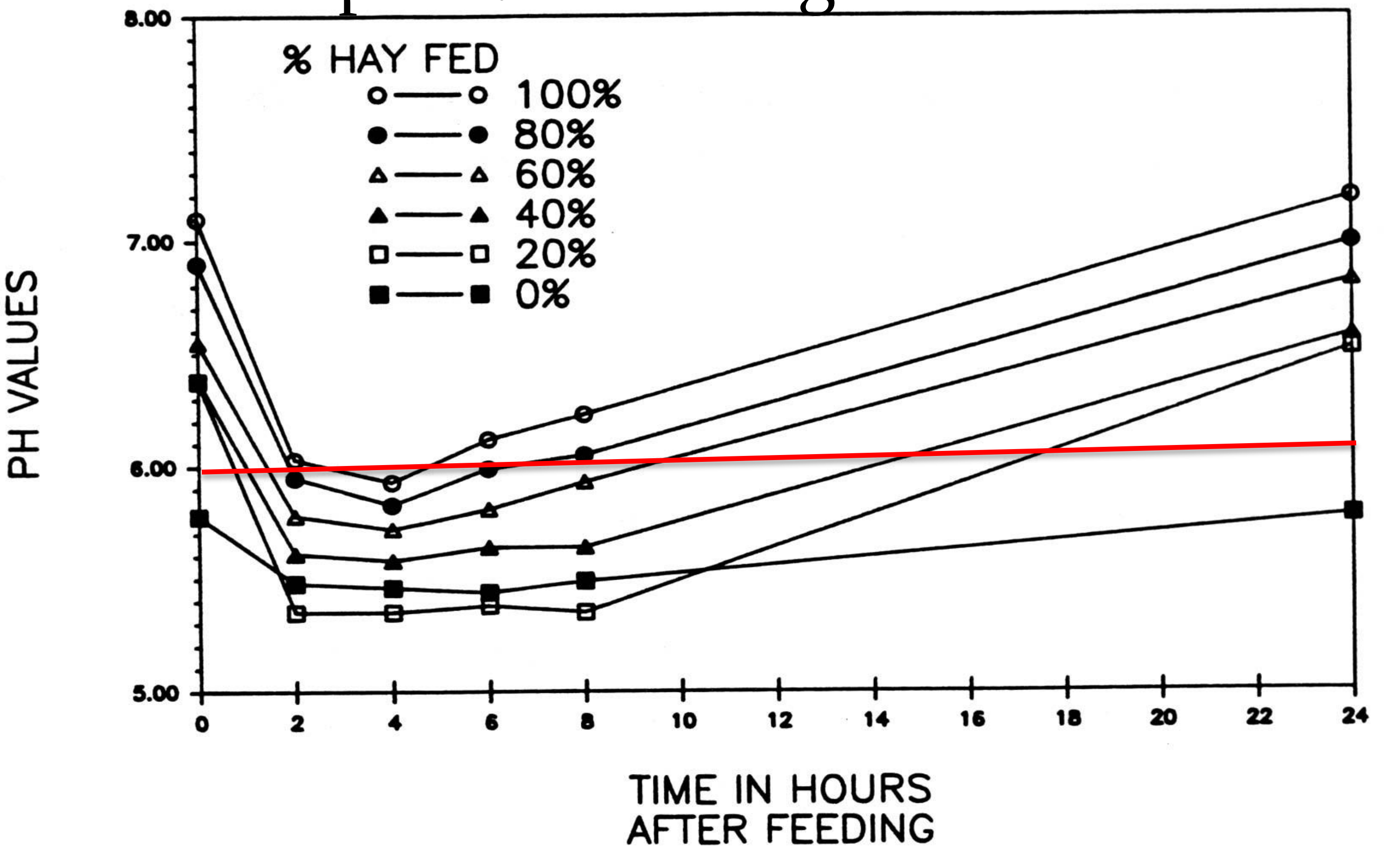
CH_4 – 27%

H_2 - 0.2%

N_2 - 7%

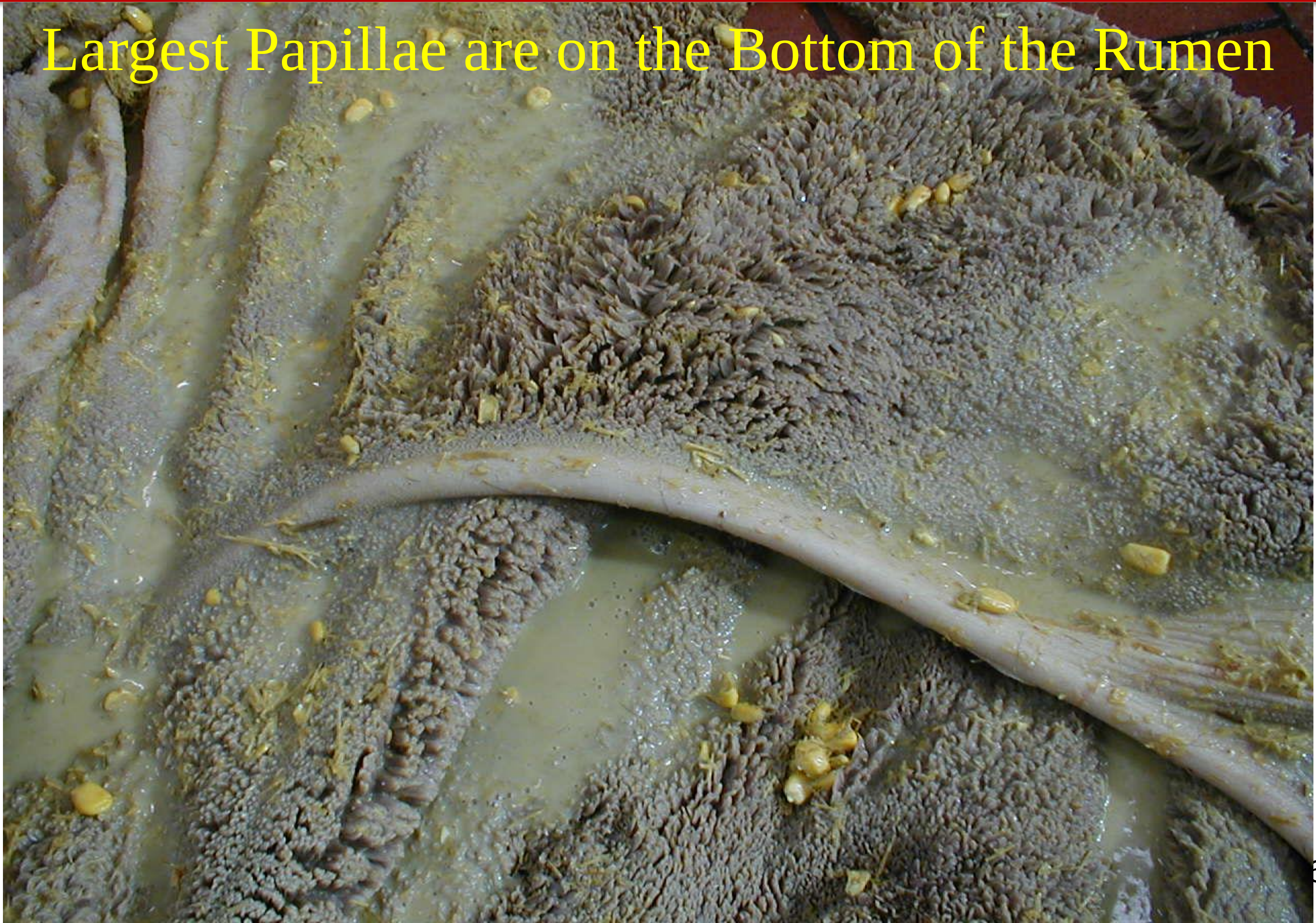
Traces of H_2S, CO and O_2

pH Decline After Feeding on Various Diets: Below pH 6.0 fiber digestion decreases



“Healthy” Papillae

Largest Papillae are on the Bottom of the Rumen



The Reticulum Traps Large Feed Particles

Implications

Feed particles must be broken down to less than ½ inch to pass out of the rumen.

Long-stemmed hay drastically reduces digestible energy intake as the animal expends energy ruminating (regurgitating and re-chewing).



How Much Energy Does it Take to Reduce This:

To This:

Form of Alfalfa on Lamb Performance and Carcass Characteristics

Item	Pellets	P + H	Haylage	SEM
Animal No.	24	24	24	
Initial wt. lb.	115.8	115.5	115.8	.09
Final wt. lb.	147.7	148.6	148.6	1.3
Days on feed	54a	61a	82b	3 (P<.01)
DMI, lb/d	5.14a	4.43b	3.66c	.11(P<.01)
ADG, lb/d	.61a	.55a	.41b	.02(P<.01)
HCW, lb	73.4	73.2	71.7	.9
Backfat, in.	.23	.22	.21	.02
LEA, sq. in.	2.77	2.85	2.71	.08

Particle size has a huge impact on DMI, ADG, and days on feed, but NOT on carcass characteristics (even at small particle sizes).

Fluharty et al., 2017

Reticulum and Omasum

Omasum and Abomasum

The Abomasum Functions Like Our Stomach

Not all Average Daily Gain is the Same

- Visceral organs (rumen, reticulum, omasum, abomasum, small intestine, cecum, and large intestine) increase in weight as the forage content of the diet increases.
- Increased organ weight results in decreased feed efficiency and an increased maintenance requirement.
- Maintaining visceral organs requires 40 to 50% of an animal's daily energy intake, and 30 to 40% of an animal's daily protein intake with a forage based diet.
- Research I conducted in the 1990's found a 15 to 20% increase in organ mass when lambs were grazed on forage (alfalfa) versus being fed grain (corn) at the same energy and protein intake level.

Effect of Forage to Concentrate Ratio on Rumen Volatile Fatty Acid (VFA) Ratios in Cattle

Forage:Concentrate Ratio	Acetate (%)	Propionate (%)	Butyrate (%)
100:0	71.4	16.0	7.9
75:25	68.2	18.1	8.0
50:50	65.3	18.4	10.4
40:60	59.8	25.9	10.2
20:80	53.6	30.6	10.7
Annison and Armstrong, 1970			

VFA Use in Ruminants

Acetate ($CH_3 – COOH$) is primarily used in fatty acid synthesis for subcutaneous and seam fat as well as milk fat.

Propionate ($CH_3 – CH_2$- COOH) is converted to glucose in the liver.

Butyrate ($CH_3 – CH_2$- CH_2 - COOH) is converted to ketones during absorption through the rumen epithelial tissue, then goes to fatty acid synthesis in adipose and mammary gland.

Diet Affects Growth Rate and End Products of Rumen Fermentation

- High-concentrate (grain-based) diets result in increased propionate production relative to acetate.
- Propionate is the only glucogenic fatty acid (The only VFA converted to glucose in the liver).
- Higher levels of glucose production in the liver result in a greater average daily gain, more lean tissue growth per day, and more intramuscular fat (marbling) deposited.

What Happens When Ruminants Have to Drink COLD Water?

Implications

- In winter, or in a drought, the lack of fresh water limits feed intake, because 1 pound of dry matter intake requires 7 pounds of water.
- Cold water can reduce feed intake, and therefore digestible energy, because the rumen functions at 101 to 102 degrees Fahrenheit.
- If the rumen is cold, due to cold water intake, the rate of digestion slows down considerably until the water is warmed to body temperature. When the rate of digestion slows, nutrient absorption is less (with forages), and growth slows.
- When hay is being fed, and the water is cold, there is an additive negative effect of extra time required to warm the rumen contents, and a delay in the time it takes for bacteria to attach to the forage. The result is a decrease in digestible energy.

What Happens in a Drought?

What Happens in a Drought?

- Grasses are often drier than in normal growing conditions.
- Water from ponds, streams, or troughs may be limited.
- Total Dissolved Solids (TDS) in the water can increase to levels that are > 5,000 ppm, and should not be used for pregnant, or lactating animals.
- Feed intake, and then body conditon, will decline, because it takes 7 pounds of water for each pound of dry matter consumed, in the rumen, not including the water lost through evaporative cooling and urination.

When Animals are Grazing, They Choose Short-Length Forage if it is Available

Forage Digestibility

- Ruminant animals in grazing situations need to maximize forage digestion in order to meet their energy and protein requirements.
- Factors that limit the animal's ability to meet their requirements include: forage species, maturity, lignin concentration, and the ruminal ammonia requirements of cellulose digesting bacteria.
- Unlike grain-based diets, there is a time period, referred to as the lag phase, required for cellulose digesting bacteria to attach to forage particles, and the energy available is directly related to surface area.

Feed Can't Exit the Rumen and Reticulum Until it is Less Than ½ inch in Length, with most particles being less than 1/25th of an inch!

Implications

Long-stemmed hay drastically reduces digestible energy intake, and energy available, as the animal expends energy ruminating (regurgitating and re-chewing) feed until it is either digested, or small enough to pass from the reticulo-omasal orifice .

Hay Belly is Just Undigested Feed, and it's Possible for an Animal to Starve With a Fully Belly if the Hay is Poor Quality

Reducing the particle size of many mature forages can reduce maintenance energy expenditures due to a reduction in visceral organ mass, and increase energy and protein intake…CRITICAL WITH MULTIPLE FETUSES

What are the Implications of Increased Forage Digestibility?

More microbial protein supply to the small intestine with increased fiber digestibility.

Reduced need for protein supplementation.

Increased VFA production, leading to increased energy retention by the animal.

Increasing Nutrient Retention with Increased Forage Digestibility Results in:

Reduced feed waste

Reduced manure output

Improved ewe body condition

Reduced need for purchased feed

Forage Digestibility

Digestion normally occurs from the inside of the forage to the outer layers.

The conversion of fibrous forages to meat and milk is not efficient, with only 10 to 35% of the energy intake being captured as net energy to the animal, because **20 to 70% of the cellulose may not be digested** (Varga and Kolver, 1997).

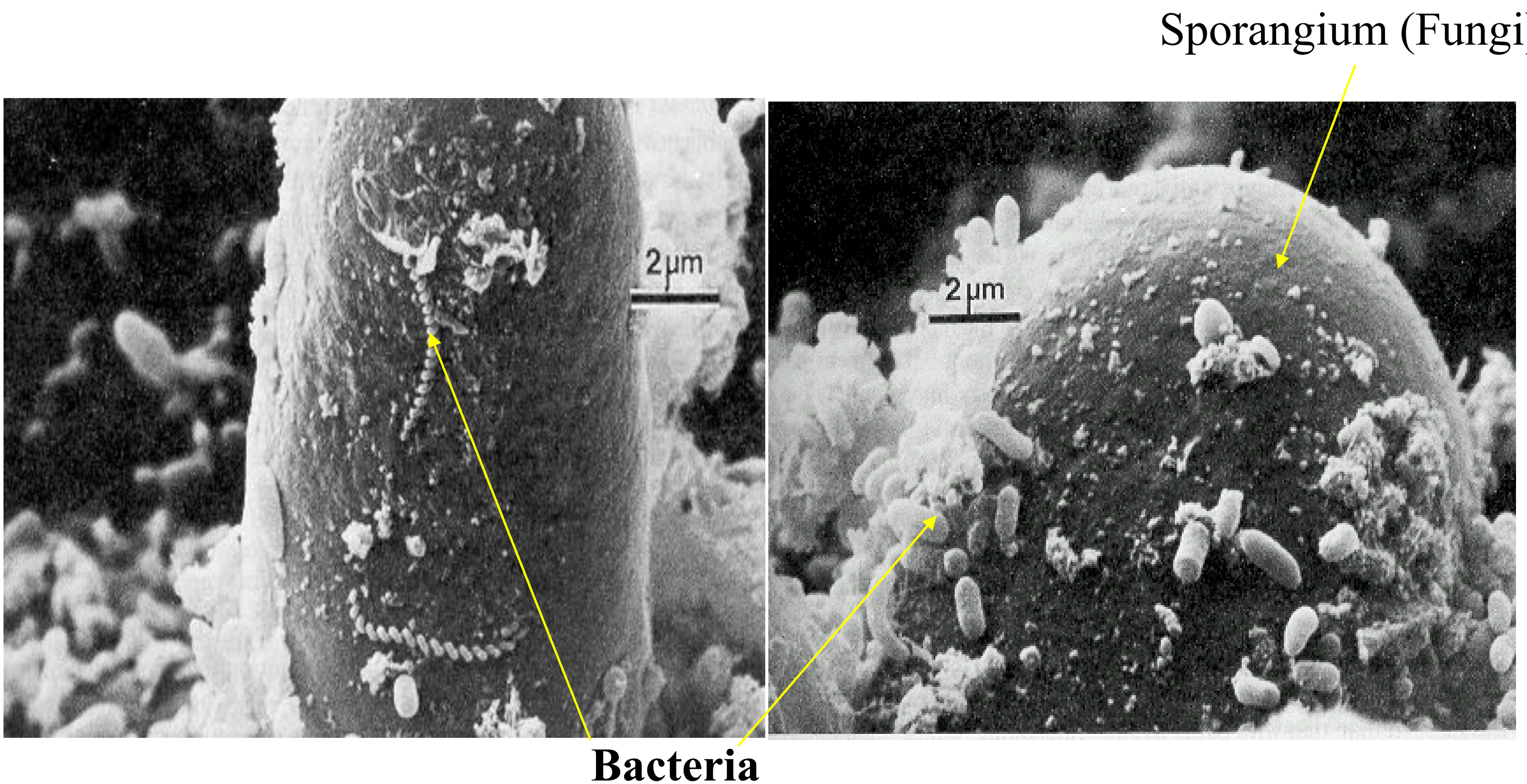
Limitations to the speed at which this occurs include the physical and chemical properties of the forage, the moisture level of the forage, time for penetration of the waxes and cuticle layer, and the extent of lignification (Varga and Kolver, 1997).

Example of the Effects of Forage Length on the Average Daily Gain of Weaned Calves

Round Baled Grass Hay supplemented with 5 lbs. of Whole-Shelled Corn	Chopped Hay (the same hay as in the Round Bales) supplemented with 5 lbs. of Whole-Shelled Corn
1.4 lb/day	2.6 lb/day 86% increase

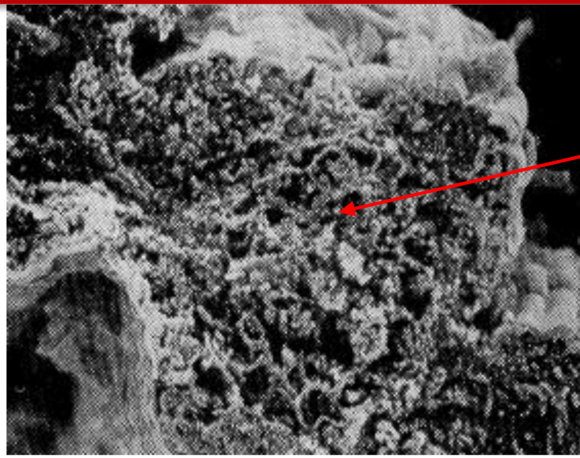
(Source: http://beef.osu.edu/library/AltFeedSuplong.pdf).

Bacterial Association with Fungi



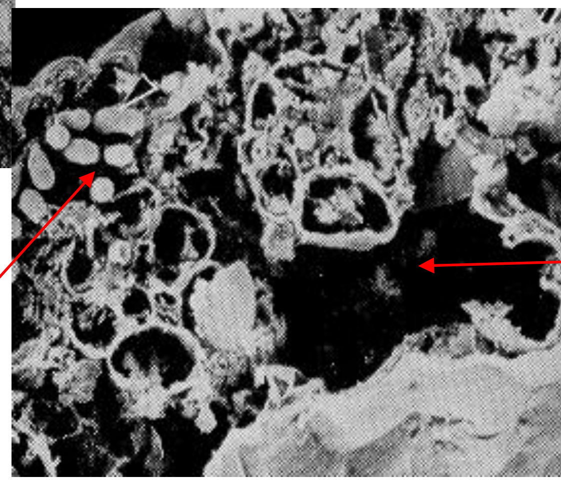
Source: Akin, et al. 1993

Digestion of Forage by Bacteria



Digestible Cellulose and Hemicellulose

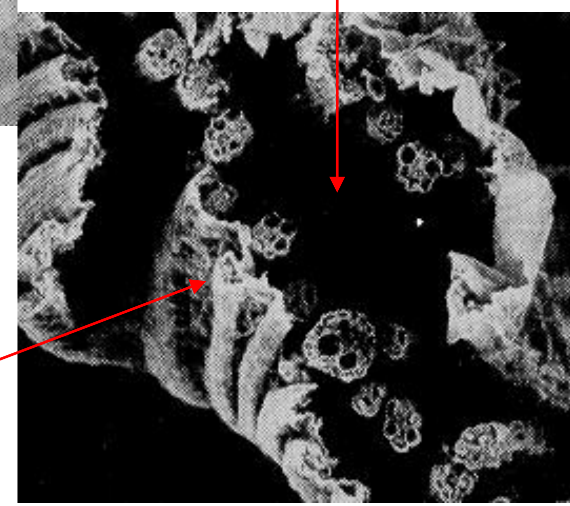
T=0 hrs



Fungal invasion

Digestible Material is Gone

T=6 hrs



Undigested Material: Mostly Lignin and Cellulose

T=20 hrs

Source: Akin, et al. 1993

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Methods to Increase Forage Digestion

- Grinding forage during harvest, using a chop-cut baler, or post-harvest, by grinding increases digestibility by 30 to 35%, can increase gains on grass hay by 50% to 100%, and is the best way to access the energy and bound protein in a grass-based forage, because rumen bacteria digest forage from the inside first, and work toward the outside due to the waxy cuticle layer.
- Several feed additives aid microbial enzyme production and digestion of forage (Amaferm®, Levucell®), or energy (VFA) production from forages (Bovatec®, Amaferm®, Levucell®) and several others with varying degrees of research behind them…. Be open to new options in the future.

Rumen Fungi/Amaferm® Effects

Control

Amaferm™

Enhanced growth rate and budding of mycelia = MORE FIBER DIGESTION

Harper et al., 1996

To Supply Newborn Lambs With More Energy, Increase Acetate Production

Through Improved Forage Digestion

- Acetate production, from increased fiber digestion, in the rumen goes primarily to milk fat and intermuscular fat production. With newborn calves, supplementing the cow with grain will increase propionate, not acetate. This will result in an increase in milk production, but not milk fat concentration. A newborn lamb probably can't drink more milk than the ewe is already producing, so more milk is not needed.
- The best way to increase energy to the newborn lamb is to increase forage digestibility.

Flushing

- Flushing consists of increasing the dietary energy, so that animals are gaining weight, and are increasing their energy intake prior to breeding.
- Research has shown that increased energy will improve body condition, increase ovulation rates, and result in increased lambing percentages.
- Generally, 2 to prior to the breeding season, continuing through 4 weeks of breeding is sufficient.
- My flushing supplement is 23% corn, 15% DDGS, 50% Soyhulls, 8% Soybean meal, 3% fat, .5% urea, and .5% feed-grade limestone, and 16% CP.

In Summary:

The ewe lamb's nutrition plays a huge role in reproductive success, or failure.

Managing replacement ewes separate from mature ewes allows for greater nutritional management.

Improved forage digestibility and having ewes in proper body condition is critical to maximizing reproduction.


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