Introduction to Dairy Nutrition

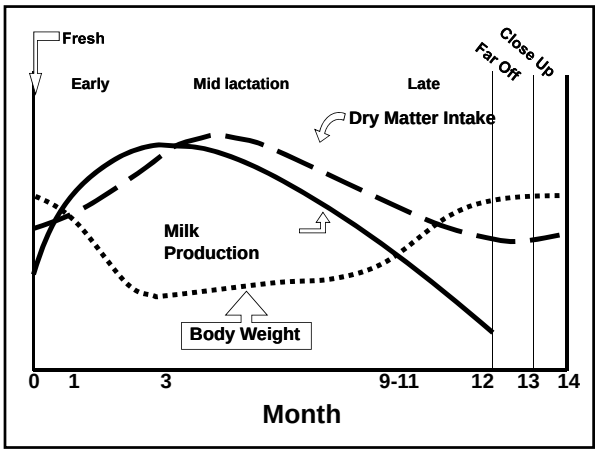
Mark McGuire
AVS Dept.
University of Idaho
Fall 2009

Dairy Nutrition

- Considerations
  - Nutrient requirements
  - Nutrient content of feeds
    - » Sampling for accuracy
  - Processing of feeds
  - Cost of feed
    - » Availability
    - » Contracting
  - Management style
  - Data evaluation

Understanding Dairy Nutrition

- Nutrients
- Dietary formulation
  - Sampling feed ingredients
- Feeding management
- Cow observation



Nutrient Requirements (NRC)

- Nutrient needs of animal
  - Based on body weight, milk production, milk fat content, pregnancy and growth
- Feed tables with "book" values
  - Nutrient content of feeds

http://www.nap.edu/catalog.php?record_id=9825#toc

Milk Rules of Thumb

- Peak
  - 30 to 70 days postpartum
    - » Second month on DHI test
      - Heifers (1st lactation) possibly later
  - Peak times 200 equals lactation total potential
    - » Example: 100 # X 200 = 20,000#
- Persistency
  - 1st lactation cows drop 6% per month after peak
  - Older cows drop 9% per month after peak

Nutrition Based on Dry Matter

Dry matter = as fed x % dry matter

Dry matter % = $\frac{\text{dry matter}}{\text{as fed}}$ x 100%

Dry matter intake is always less than as fed intake!

Dry Matter Intake Guides

Dry Cows: **(B.W. x .0185)**

13 pounds of DM for maintenance

Milk Cows:

(.0185 x B.W.) + (.305 x lb 4% FCM)

4% FCM = (0.4 X lb Milk) + (15 X lb Fat)

1 lb of DM ↑ milk yield 2 - 2.5 lb

NRC Dry Matter Intake

Milk Yield lb (4% FCM)	Body Weight in pounds 880	1,100	1,320	1,540
	lb DMI per day			
44				
66				
88				
110				
132				

Changes in Nutrient Requirements

Body Wt + Milk (3.5%)	NEL (Mcal)	CP (lb)	Ca (lb)
1400 lb BW	10.12	0.932	0.057
1400 lb BW + 60 lb/d	10.12 + 18.6 = **28.72**	0.932 + 5.04 = **5.972**	0.057 + 0.18 = **0.237**
1400 lb BW + 150 lb/d	10.12 + 46.5 = **56.62**	0.932 + 12.6 = **13.532**	0.057 + 0.45 = **0.507**

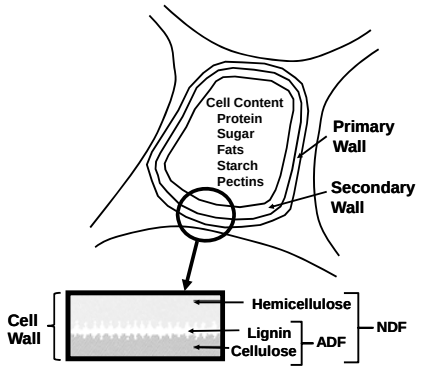
Dilution of Maintenance Costs (% of nutrient for milk)

Body Wt + Milk (3.5%)	NEL (Mcal)	CP (lb)	Ca (lb)
1400 lb BW	10.12	0.932	0.057
1400 lb BW + 60 lb/d	28.72 **(64.8%)**	5.972 **(84.4%)**	0.237 **(75.9%)**
1400 lb BW + 150 lb/d	56.62 **(82.1%)**	13.532 **(93.1%)**	0.507 **(88.8%)**

Energy Sources

- **Carbohydrates (Fermentable)**
  - **Fiber (Cell wall)**
    - **»Cellulose, hemicellulose**
  - **Non-Fiber (Cell contents)**
    - **»Starch, sugars**
- **Fats and Oils (Not fermentable)**

Diagram of a plant cell showing cell wall structure



ADF

(Acid Detergent Fiber)

* Lignin and cellulose
* Cell wall of the plant
* Digestibility is lower
* Increases as plant matures
* Predicts energy level

NDF

(Neutral Detergent Fiber)

* Total cell wall
* ADF + hemicellulose
* Modest digestibility
* Dry matter intake control
* Increases as plant matures

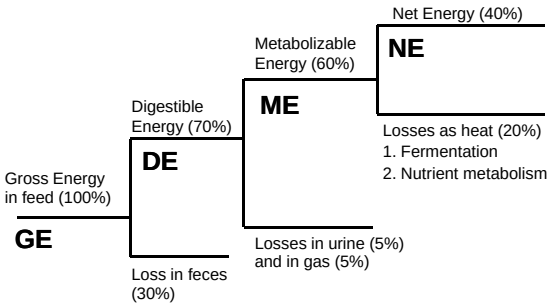
Total Digestible Nutrients (TDN)
Expressed as % or lb

- Older system; moving to each “nutrient” needs
- Digestible Protein (70%)
- Digestible Crude Fiber (30 - 40%)
- Digestible Nitrogen Free Extract (80%)
- Digestible Ether Extract (60 - 80%) X 2.25

Net Energy Basis
Expressed as Mcal/lb

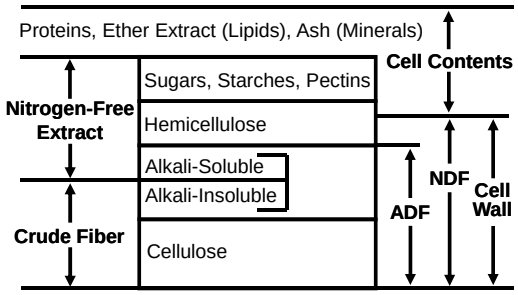
- Net Energy Maintenance NE_M
- Net Energy Lactation NE_L
- Net Energy Growth NE_G

Partitioning of ration (60% Alfalfa & 40% Corn) energy and losses in a lactating cow



Net energy system

Forage Analysis



Forage analysis showing Crude Fiber (Green) versus Van Soest (Yellow)

Protein

Total Crude Protein

- CP = Nitrogen (N) x 6.25
- 100 lb CP = 16 lb N
- 100 / 16 = 6.25
- Example: Alfalfa hay =
  3% N x 6.25 = 18.75% CP

Available Protein

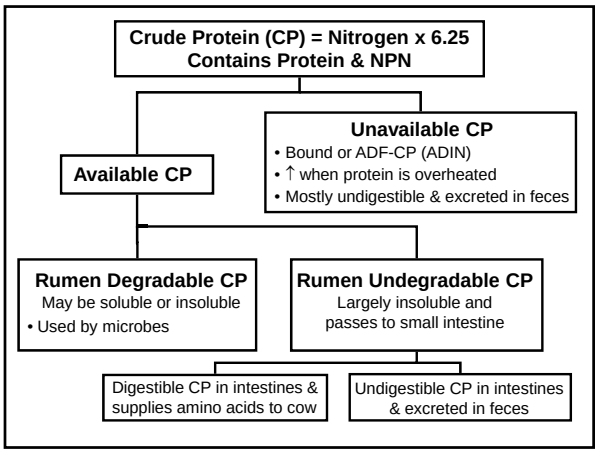
- Protein available for digestion
- Should be 90% or more of CP
- Less than 90% CP available indicates:
  - Heat damage
  - Excessive maturity at harvest

Unavailable Protein

- Protein unavailable for digestion
- Should be less than 10% of CP
- If greater than 10% of CP indicates:
  - Heat damage
    - » Malliard Reaction
    - » Carmelized protein
      - Pay attention to distillers grains and other heated protein sources
  - Bound protein
  - ADF-N (ADIN)

Avoid Heating & Carmelization in Silages

- Proper stage of maturity
- Correct moisture content
  - Oxygen-limiting (45 - 50%)
  - Conventional (55 - 60%)
  - Bunkers & bags (65 - 70%)
- Length of chop
- A tight silo or pack well
- Fill rapidly
- Seal if needed



Nonprotein Nitrogen (NPN)

- N not in a protein
- True protein is N in a long chain of amino acids
- NPN must be incorporated into microbial protein to be beneficial
- Examples of NPN
  - Urea
  - Monoammonium phosphate
  - Free amino acids

Sources

- Some slides adapted from Dairy Nutrition & Management (ANSCI 200/492), University of Illinois at Urbana-Champaign, Dr. Mike Hutjens