

Evaluating Hay Quality

Daniel Hudson
Sid Bosworth
UVM Agronomists

Forage Quality

- Measure of Nutritional Value
 - Protein
 - Fiber
 - Starch + Sugars + non-fiber carbohydrates
 - Energy
 - Vitamins
 - Minerals
- Measure of potential Intake
- Quality also reflects Palatability

Forage Quality

- Palatability - Relates to forage selection when there is a choice (animal behavior)

Examples:

- Thorny/bitter weeds
- Horsenettle in hay
- Acid preservative treated hay
- Alkaloids in Reed canarygrass



Forage Quality

- Anti-quality factors - Plant chemicals that cause animal disorders

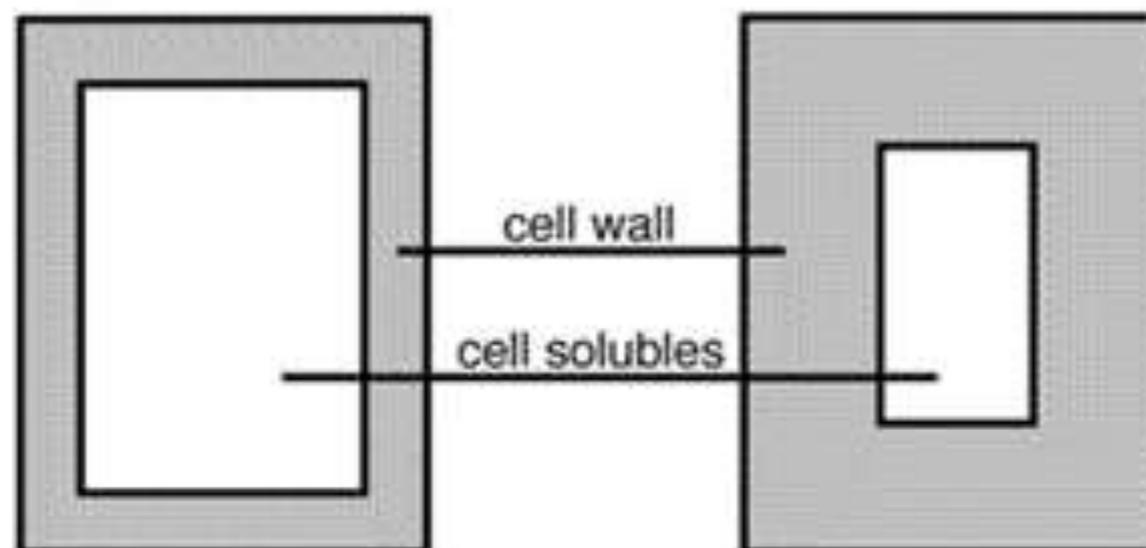
Examples:

- Mycotoxins and molds
- Endophyte in tall fescue
- Poisonous plant contamination
- Red clover slobbers
- Ergot



Early harvested forage

Late harvested forage



Thin cell wall:

low NDF (=high intake)

low ADF (=high energy)

Thick cell wall:

high NDF (=low intake)

high ADF (=low energy)

From: University of Missouri

<http://extension.missouri.edu/publications/DisplayPub.aspx?P=G3161>

Food Pyramid!

- **Same concept for ruminants**
- **Certain dietary requirements for optimal performance**
 - **Vary with species**
 - **Physiological stage: growth, lactation, maintenance, etc**

Algebra!

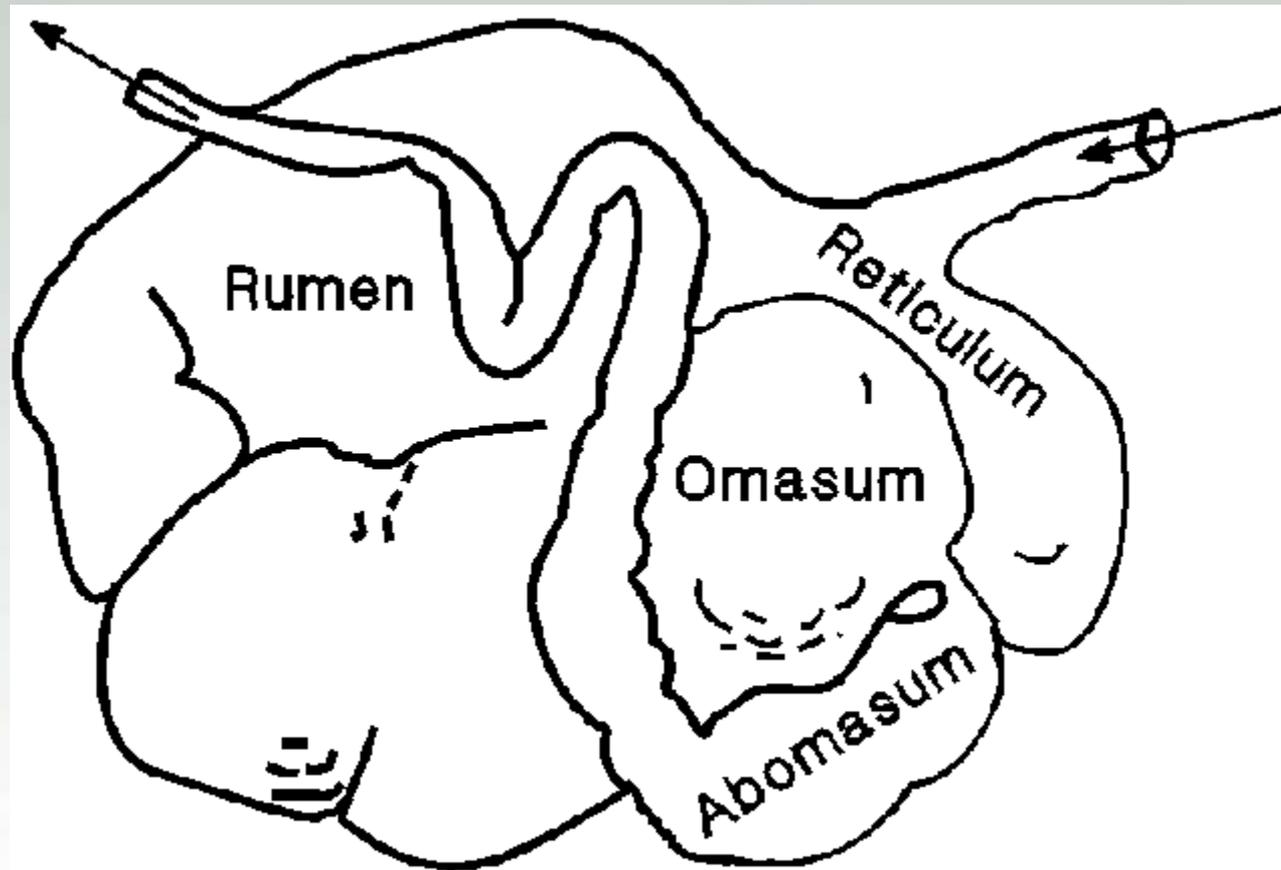
- **Forage + Concentrate = ration**
 - **Do I need to supplement or not?**
 - **Testing is the only way to know**

Practically Speaking

- **Serious livestock producers should feed hay that has been tested.**
- **Many/most small scale producers do not test it . . .**
“Why would I? I sell it all anyway!”
- **The only possible reasons not to test:**
 - **Perceived benefit**
 - **What I don’t know must not matter**
 - **Ignorance is bliss [but it can be expensive]**

What should I test for?

- **Crude Protein (CP)**
- **Acid Detergent Fiber (ADF)**
 - Used to calculate total digestible nutrients (TDN)
 - Low levels indicate high digestibility
- **Neutral Detergent Fiber (NDF)**
 - Can be used to predict intake
 - Needed to help determine concentrate requirements to meet goals
- **Other parameters should also be considered**



From: Kansas State University

www.ksu.edu/~pds/agron.ksu.edu/ig3.html

NDF

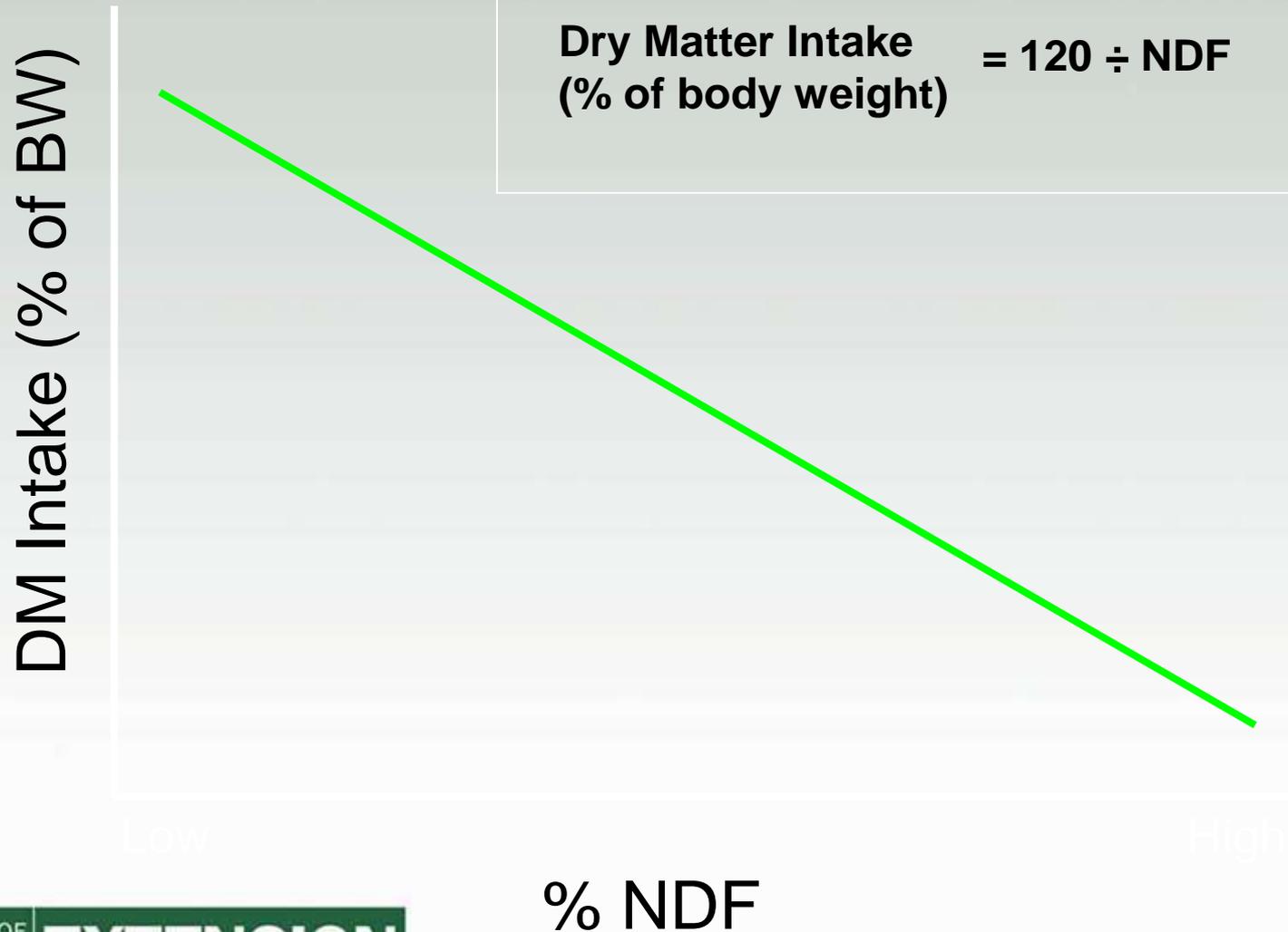
- **They can only fit so much in their rumen at one time**
- **NDF indicates how bulky the forage is**
- **Generally, they can fit about 1.2% of their body weight in their rumen as NDF**

Components of NDF

- **Cell wall constituents**
 - **Cellulose**
 - **Hemicellulose**
 - **Lignin**

- **Higher NDF → Lower intake**

Neutral Detergent Fiber



ADF

- **Cell wall constituents**
 - Cellulose
 - Lignin
- **A predictor of energy intake**
- **High ADF → lower intake of energy**

An example follows:

For legumes:

$$\text{NEL} = 1.037 - 0.0124 \times \text{ADF}$$

$$\text{NEM} = 1.037 - 0.0124 \times \text{ADF}$$

$$\text{NEG} = [2.54 - (2.42/(\text{NEM} \times 2.2))]/2.2$$

$$\text{TDN} = 8 + 86 \times \text{NEL}$$

For alfalfa with 34% ADF:

$$\text{NEL} = 0.62$$

$$\text{NEM} = 0.62$$

$$\text{NEG} = 0.35$$

$$\text{TDN} = 61$$

From University of Missouri:

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What is Your Target Quality?

- **Early harvest → higher “quality,” lower yield**
 - High CP, low ADF and NDF
- **Later harvest → lower quality, higher yield**
 - Lower CP, higher ADF and NDF
- **Different classes of livestock have different requirements**

Typical Forage Quality*

Crop	% C.P.	NE_L	%ADF	%NDF
	%	kcal/lb	%	%
Corn Silage	7.9	0.72	27.5	45.0
Legume Haylage	19.5	0.59	37.0	48.1
Legume Hay	19.3	0.62	34.5	41.3
Grass Haylage	14.4	0.52	37.5	59.1
Grass Hay	12.2	0.51	38.3	58.5
Mixed Haylage	17.0	0.56	37.0	53.8
Mixed Hay	14.7	0.56	37.0	52.7
Pasture	21.3	0.63	29.4	48.4

Factors affecting hay quality

- **Stage of plant development**
- **Legume, weed, ash content**
- **Species and variety**
- **Seasonal growth conditions (heat, moisture)**
- **Length of dry-down and exposure to sun**
- **Handling (excessive tedding/raking)**
- **Exposure to moisture**
- **Moisture at harvest**

Staging Grasses



Vegetative



Elongating



Boot



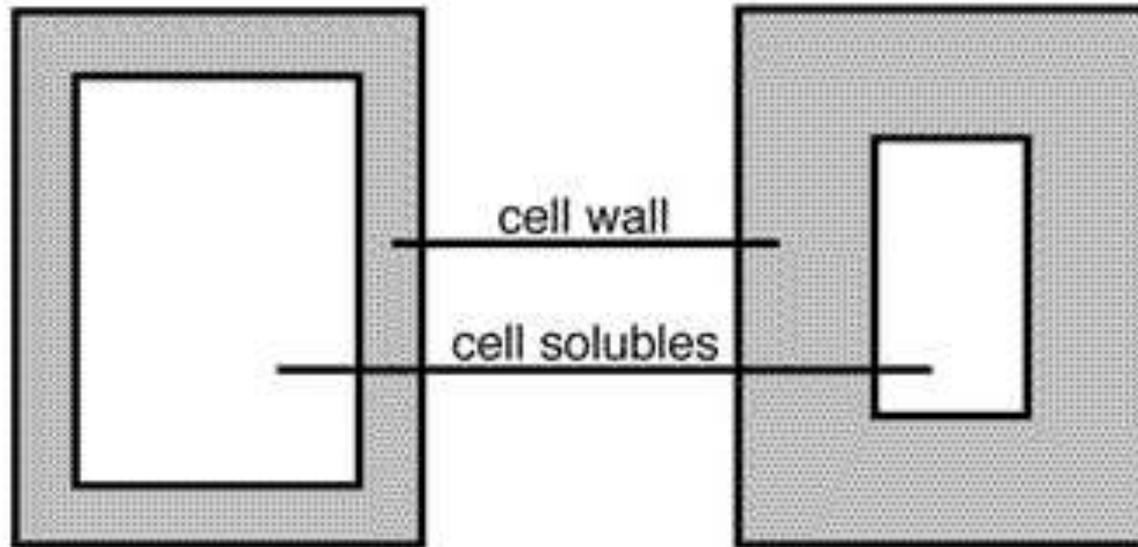
Heading

Hay Quality Depends Which Cut and Stage at Cut



Early harvested forage

Late harvested forage



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Table 2
Relationships between energy values for alfalfa

Term	ADF (percent)	
	30.00	40.00
NEL (Mcal/lb)	0.66	0.54
NEM (Mcal/lb)	0.66	0.54
NEG (Mcal/lb)	0.40	0.23
TDN (%)	65	55

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Species and Forage Quality

Forage Crop Species

- Legumes versus Grasses



Species and Forage Quality

Legumes Verses Grasses

- Legumes have higher CP and lower NDF content

<u>Forage</u>	<u>Stage</u>	<u>CP</u> %	<u>DE</u> Mcal/kg	<u>NDF</u> %
Alfalfa	First Flower	18	2.42	45
Timothy	Boot	12	2.20	55
Timothy	Head	9	1.98	>60

Species and Forage Quality

Legumes Verses Grasses

- Legumes have higher Ca content

<u>Forage</u>	<u>Stage</u>	<u>Ca</u> %	<u>P</u> %
Alfalfa	First Flower	1.75	0.28
Timothy	Boot	0.50	0.25
Timothy	Head	0.41	0.19

Pests and Forage Quality

Weeds

- Weeds can have similar forage quality to forage plants
- Their quality response to maturity is similar
- Weeds tend to mature quicker than most crops



Pests and Forage Quality

Weeds

- Broadleaf weeds may slow down drying



Garbage in, garbage out!

- Representing **TONS** of hay with a **teaspoon-sized sample**..... protocol is important!
- **Core sampling probe**
- **Powerful drill**



Quality test of single bales of alfalfa hay.

<u>Bale No.</u>	<u>DM%</u>	<u>CP%</u>	<u>ADF%</u>	<u>NDF%</u>	<u>RFV</u>
1	87.9	18.2	35.3	44.6	128
2	86.7	18.4	35.8	48.7	117
3	86.6	18.4	36.1	44.3	128
4	87.3	18.9	32.5	39.0	152
5	88.4	19.8	31.4	38.3	156
6	87.1	19.8	32.7	41.5	142
7	85.9	20.3	32.7	40.0	148
8	88.0	20.3	31.5	38.5	156
9	85.6	20.3	36.9	54.1	103
10	85.5	20.4	32.1	40.6	146
11	87.4	20.5	32.0	39.2	152
12	86.9	20.5	32.5	39.1	151
13	86.4	20.8	31.5	41.2	145
14	86.2	20.8	33.4	42.0	139
15	88.0	21.2	30.3	35.7	170
16	84.7	21.3	31.4	38.5	156
17	86.8	21.4	29.3	33.9	181
18	89.9	21.5	28.6	33.7	184
19	85.2	21.8	32.1	40.3	148
20	87.8	22.4	29.4	37.0	166
Minimum	84.7	18.2	28.6	33.7	103
Maximum	89.9	22.4	36.9	54.1	184
Average	86.9	20.4	32.4	40.5	148
Composite	88.1	20.7	31.5	40.7	147

Source: Dairy One, Ithaca, NY

How many, which way?

- **20 random bales from the lot**
- **Squares: test from the end of the bale across flakes**
- **Round: across the layers, not from the end**
- **Combine the cores**
- **Submit a sub-sample for testing**
 - **Beware of settling**

What if I Won't Test?

- Recognize visual attributes of quality hay
- Smell is also important
- “How to Judge Hay Quality Visually”
 - <http://www-agecon.ag.ohio-state.edu/programs/FarmManagement/Budgets/crops-2008/index.htm>

High vs Low Quality Characteristics

- **Leafy (in tact)**
- **Fine-stemmed**
- **Few seed heads or blossoms**
- **Green**
- **Good smell**
- **Few weeds**
- **No foreign material**
- **Few leaves**
- **Shattered leaves**
- **Coarse**
- **Stemmy**
- **Full of seed heads or blossoms**
- **Musty smell**
- **Bleached or brown**
- **Soil or foreign material**
- **Noxious weeds**

How can you tell?

- **Buyers: ask the seller to break a bale**
 - Offer to pay for it
- **If they won't, don't buy it**
- **No forage quality test, no inspection**
 - Why would you buy it??

- **Producers: educate your customers**

Pay!

- **Generally, you get what you pay for**
- **You can pay now or pay later, but you will always pay**
 - **Pay for quality hay, testing, etc**
 - **Paying for excessive “quality”**
 - **Pay for lost production/animal performance**



Let the Buyers and Sellers Beware!

- Lots of hay scams out there
- Especially when there is a shortage and livestock owners are desperate
- <http://www.haybarn.com/main/scams.asp>
- There will be new scams!

Questions?

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