

Forage Quality and Nutrient Utilization in Ruminants

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 Virginia State Feed Association
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Is all silage created equal?

- Traditional criteria
 - Grain yield
 - Silage yield
 - Appropriate DM at harvest
- Now?
 - Intake potential
 - Milk yield, growth rate



Is all silage created equal?



- Some years they make milk on corn silage . . .

- Some years they don't
- "But the lab says they're the same!!"



Fiber digestibility

The tale of two silages

	Silage 1	Silage 2
Silage NDF, %	42	42
DMI, lb/d (50% silage)	48	48
NDF intake, lb/d	10.1	10.1



Same nutrient intake
 = same milk yield

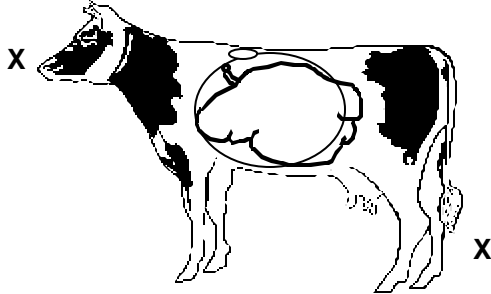
What's the difference??



Fiber digestibility



- Digestibility = $\frac{\text{intake} - \text{excreted}}{\text{intake}}$



Fiber digestibility



The tale of two silages

	Silage 1	Silage 2
Silage NDF, %	42	42
DMI, lb/d (50% silage)	48	48
NDF intake, lb/d	10.1	10.1
Excreted, lb/d	4.7	4.2
Digested, lb/d	5.3	5.9
Digestibility, %	52	58

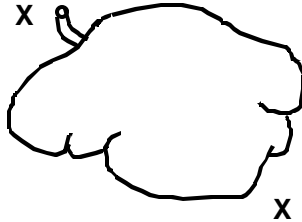


Fiber digestibility



Challenges

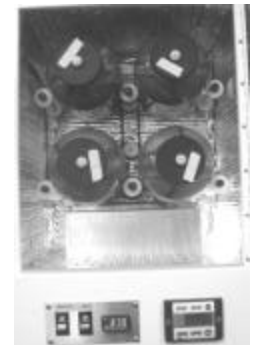
- Total collection studies expensive, time consuming
- Most fiber digestion occurs in rumen
- Can we imitate ruminal fiber digestion in the lab?



How do we measure NDF-D?



- Rumen fluid collected from donor cows
- Samples weighed into small bags, 24 bags put into 2 gal. jars
- Samples incubated 30-48 h
- NDF disappearance measured



Fiber digestibility



Fiber digestibility and energy availability

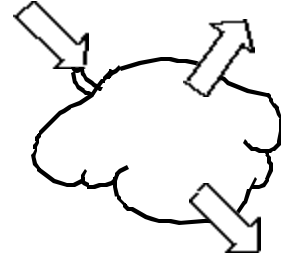
- Fiber (NDF) is 25-35% of dairy ration
- Fiber is least digestible part of ration
- Higher fiber digestibility = higher DM digestibility
= more energy
- 1 unit DM digestibility = 1 unit TDN

Fiber digestibility



Fiber digestibility and feed intake

- Early lactation cows
- Small rumen
- Limited room for feed
- "Gut fill" limits intake

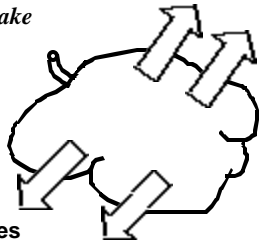


Fiber digestibility



Fiber digestibility and feed intake

- Early lactation cows
- Small rumen
- Limited room for feed
- "Gut fill" limits intake
- More digestible fiber leaves the rumen faster
- Relieves limit on intake



Fiber digestibility



- Varies with
 - management
 - environment



- Repeatable, meaningful differences with genetics?

Is all silage created equal?



Variation in fiber digestibility

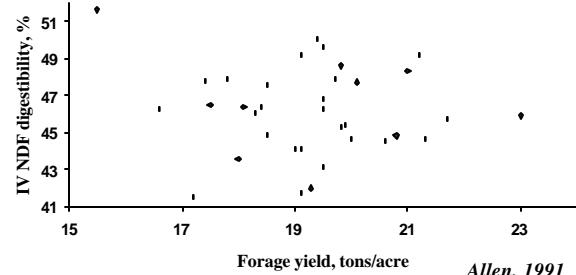
	Mean	Range
% grain	43.9	38 - 51
DM Digestibility	77.1	75 - 80
NDF	41.7	38 - 46
NDF Digestibility	60.4	58 - 63

M. S. Allen, 1991

Fiber digestibility



NDF digestibility vs. forage yield

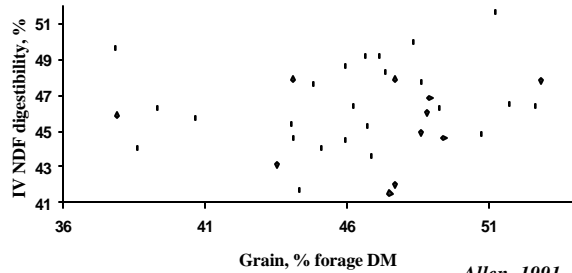


Allen, 1991

Fiber digestibility



NDF digestibility vs. % grain

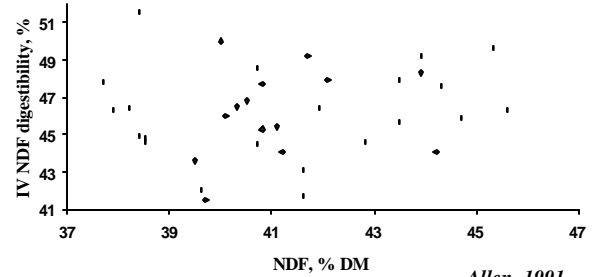


Allen, 1991

Fiber digestibility



NDF digestibility vs. NDF concentration



Allen, 1991

Fiber digestibility



- Variability is repeatable, differences are real
- Fiber digestibility not correlated with grain yield
- Fiber CONTENT not related to fiber DIGESTIBILITY
- We can select hybrids high in fiber digestibility and high in forage yield, but must select for it directly
- Is fiber digestibility economically important?

Fiber digestibility



- Brown mid rib: high digestibility mutant

Older studies

Stage of lactation	DMI, lbs/d	BW change	Milk yield
14-56 DIM	+ 3.6	+ 31 lbs	No change
42-91 DIM	+ 6.8	+ 94	+1.5 (NS)
Mid lactation	+ .9 (NS)	NA	+ 2.2

Fiber digestibility



- Michigan State study
- Brown midrib corn silage, 45% of diet DM
- 32 Holstein cows (89 DIM)
- Fiber digestibility: + 9.7 units for BMR silage

Fiber digestibility



	Normal	BMR
DMI, lb/d	51.8	56.2
Milk yield, lb/d	85.7	91.6
Milk fat %	3.46	3.43
BW change, lb/d	+ .08	+ .17
BCS change, /28 d	+ .02	+ .11

Oba and Allen, 1997

Fiber digestibility



- Hereford steers (530 lbs, year 1)
- Hereford and Angus heifers (500 lbs, year 2)
- BMR silage vs. normal
- No grain, grain at 1% BW, grain at 2% BW

Keith et al., 1981

Fiber digestibility



	Normal	BMR
Steers		
DMI, lb/d	12.0	13.0
ADG, lb/d	1.81 ^a	1.98 ^b
Feed/gain, lb/lb	6.63	6.57
Heifers		
DMI, lb/d	12.6 ^a	13.6 ^b
ADG, lb/d	1.98 ^a	2.27 ^b
Feed/gain, lb/lb	6.36	5.99

Keith et al., 1981

Fiber digestibility



- In cows, increased DMI and increased milk yield
- More corn silage in ration = greater benefit
- In feedlot cattle, increased feed intake and rate of gain
- Benefit disappeared with grain supplementation

Value of fiber digestibility?



- Early lactation cows
 - + 1 unit NDF digestibility = +.5 lb/d DMI
 - + .53 lb/d milk
 - + .11 lb/d BW
- Mid lactation cows
 - + 1 unit NDF digestibility = Same DMI
 - + .32 lb/d milk

Economic value



Assumptions

- 100 cow herd = 700 tons DM forage/year
- 50% corn silage = 350 tons DM
- Chose hybrid with 6 units higher NDF-D

Economic value



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- 100 cow herd = 700 tons DM forage/year
- 50% corn silage = 350 tons DM
- Chose hybrid with 6 units higher NDF-D

Reduced feed cost (no milk response):

$$+ .06 \text{ units TDN} * 350 \text{ tons DM} = 21 \text{ tons TDN}$$

If corn @ \$3/bushel, TDN is worth 4.5¢ / lb

$$21 \text{ tons TDN} * \$0.045/\text{lb} = \$1,890/\text{yr}$$

Economic value



- Value escalates if milk response
- 6 point increase in digestibility = 2-3 lb/d milk

$$1 \text{ lb/d milk} * 100 \text{ cows} * 365 \text{ days} * \$12/\text{cwt} \\ = \$4,400/\text{yr}$$

$$3 \text{ lb/d milk} * 100 \text{ cows} * 365 \text{ days} * \$12/\text{cwt} \\ = \$13,140/\text{yr}$$

Economic value



Brown Midrib hybrids

- Yields reduced by about 10-15%
- Increased seed cost
- Need increased milk yield of about 1.5 lbs/cow/d to break even.
- Remember: Brown midrib hybrids are not only option to increase digestibility

Virginia Tech project



Began Fall '99

- Rank corn hybrids for fiber digestibility
- Tie in with existing project evaluating hybrids for grain yield, forage yield
- Three locations: Wythe county, Shenendoah Valley, Southern Piedmont AREC
- Three maturity groups
- Virginia Tech analyzes hybrids for forage yield, ADF, CP, NDF, NDF digestibility, & publish results.

Putting it into practice



How should these rankings be used?

- Selecting hybrids for silage
 - Appropriate maturity zone
 - Top 50% in forage yield
 - Slow to medium rate of kernel drying
 - High digestibility hybrids of most value in early lactation, high producing cows.

Hybrid selection



- Little relationship between grain yield and forage quality, or grain yield and forage yield.
- Grain yield NOT a good criteria for selecting silage hybrids.
- Big ears and lots of grain does NOT indicate great silage.
- Height, leafiness, color don't mean much either.

Hybrid selection



- It's digestibility - of DM and fiber.
- Hybrids high in fiber digestibility AND high in forage yield do exist, but we must select for digestibility directly.
- Select silage hybrids for digestibility and forage yield, NOT GRAIN YIELD

Conclusions



- Hybrids with high fiber digestibility have tremendous potential for lactating cows, and for beef cattle on all silage diets
- Fiber digestibility is not correlated with grain yield, forage yield or fiber content.
- For highest digestibility, consider BMR hybrids as they become available for some acreage
- Select hybrids for silage and grain **SEPARATELY**

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