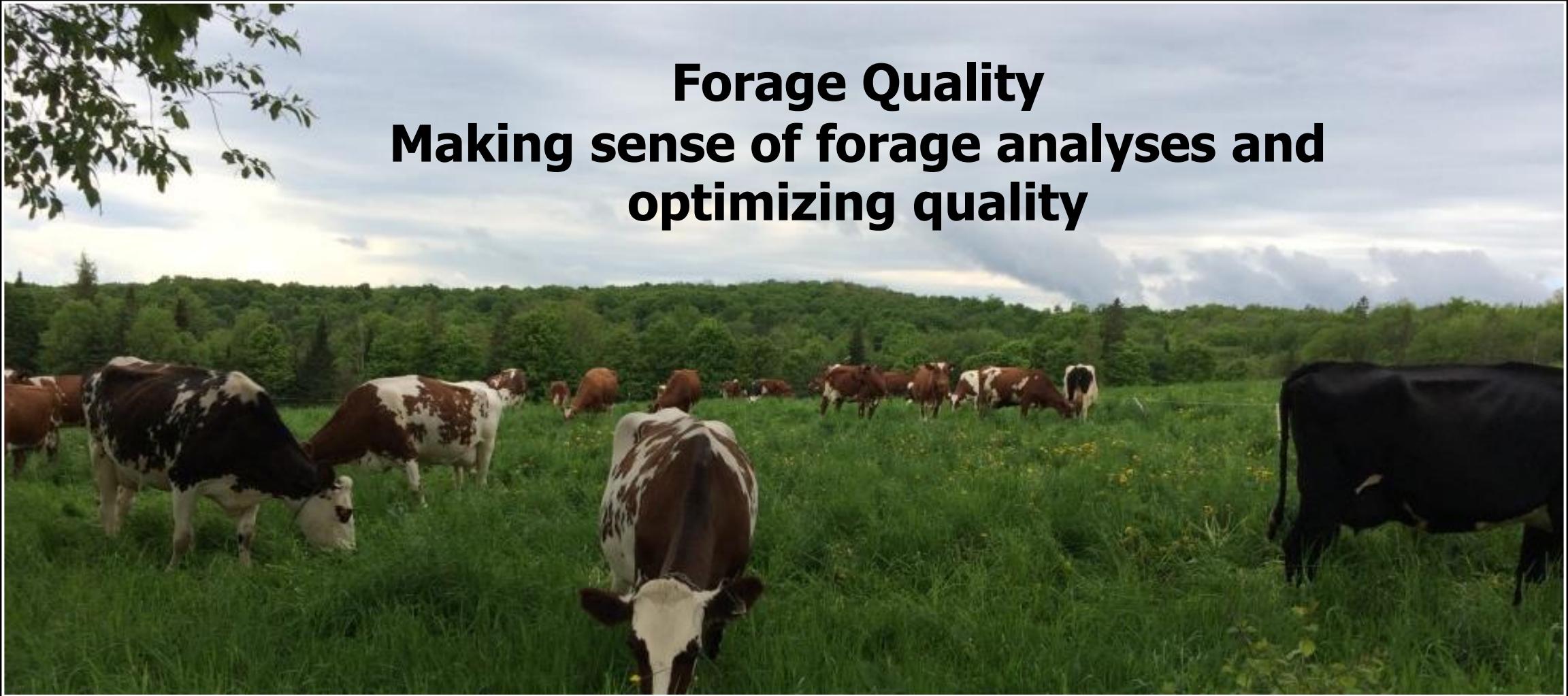




# Organic Dairy Farming

UVM & NOFA series: March 2025



# **Forage Quality**

## **Making sense of forage analyses and optimizing quality**

# Quality Forage

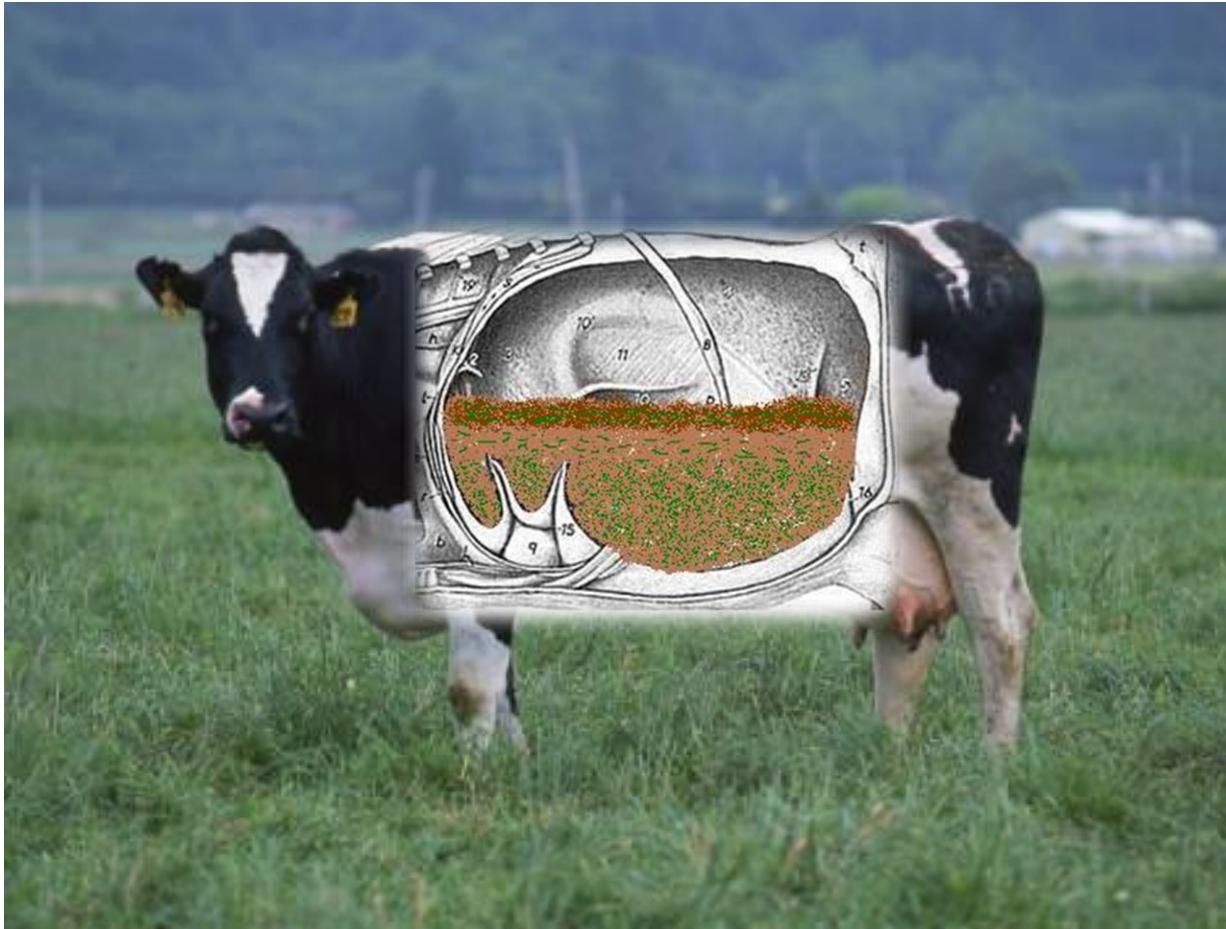


# Forage Quality



Nutrition or Management

# Rumen Fill and Flux





# Rumen Review: Function and Nutrient Fractions

Eating & Rumination

Rumen

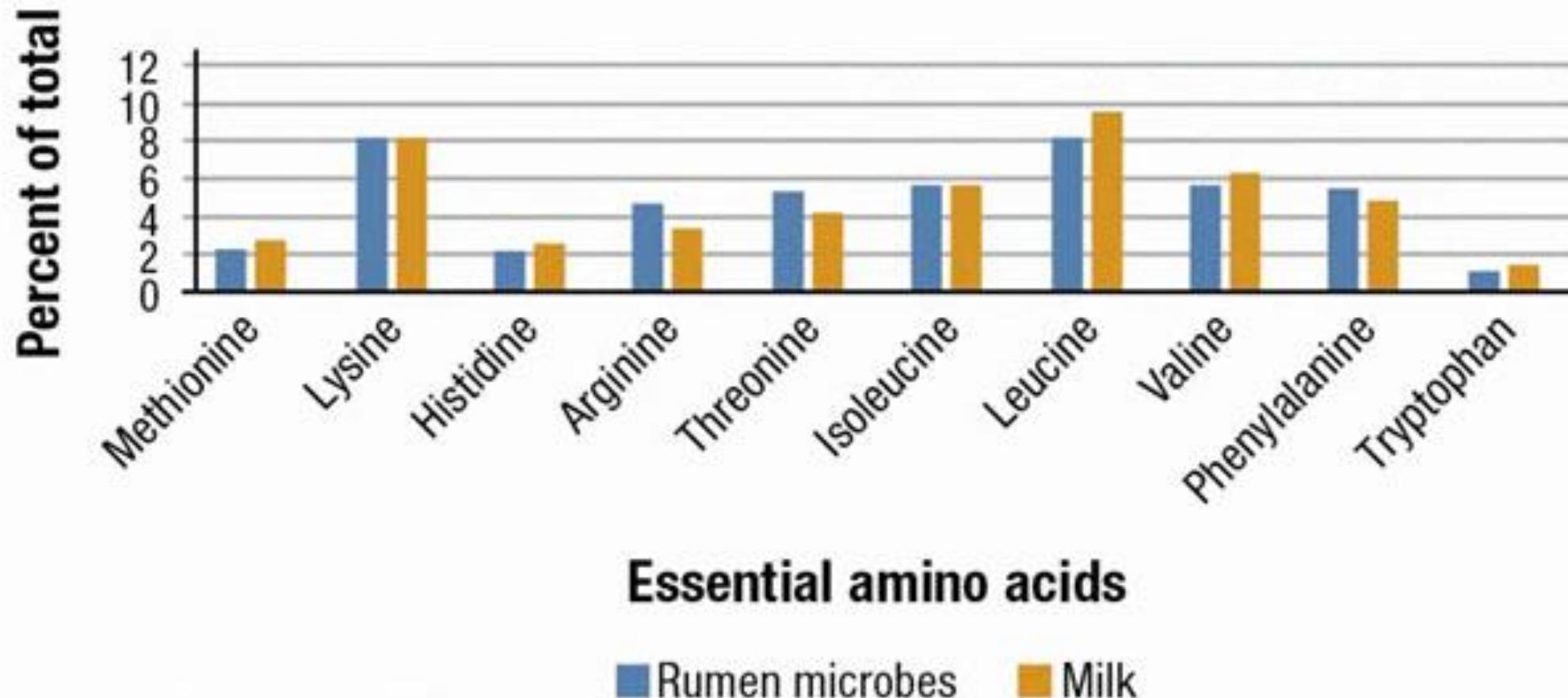
- Microbial growth: Degradation of ingesta
  - VFA production
  - Microbial Protein (Amino acids)

Small Intestine

Hind Gut

**FIGURE 1**

Essential amino acid profile of rumen microbes and milk



## INGREDIENT AND RUMEN MICROBE AMINO ACID COMPOSITION COMPARED TO MILK PROTEIN\*

(The first limiting amino acid in each protein source is highlighted)

	Milk EAA	% of Milk Essential Amino Acids (EAA)						
		Rumen Microbe	Canola Meal	Soybean Meal	Corn Gluten Meal	Cottonseed Meal	Alfalfa	Corn DDGS
<b>Arg</b>	7.2	226	190	239	97	358	145	139
<b>His</b>	5.5	90	87	87	67	97	70	90
<b>Ile</b>	11.4	128	87	100	87	70	78	83
<b>Leu</b>	19.5	<b>84</b>	<b>76</b>	84	179	66	70	130
<b>Lys</b>	16.0	112	77	84	<b>23</b>	58	59	<b>41</b>
<b>Met</b>	5.5	108	80	<b>56</b>	96	<b>56</b>	<b>52</b>	80
<b>Phe</b>	10.0	113	107	109	133	111	91	104
<b>Thr</b>	8.9	140	105	98	83	83	95	93

# Rumen Review: Function and Nutrient Fractions

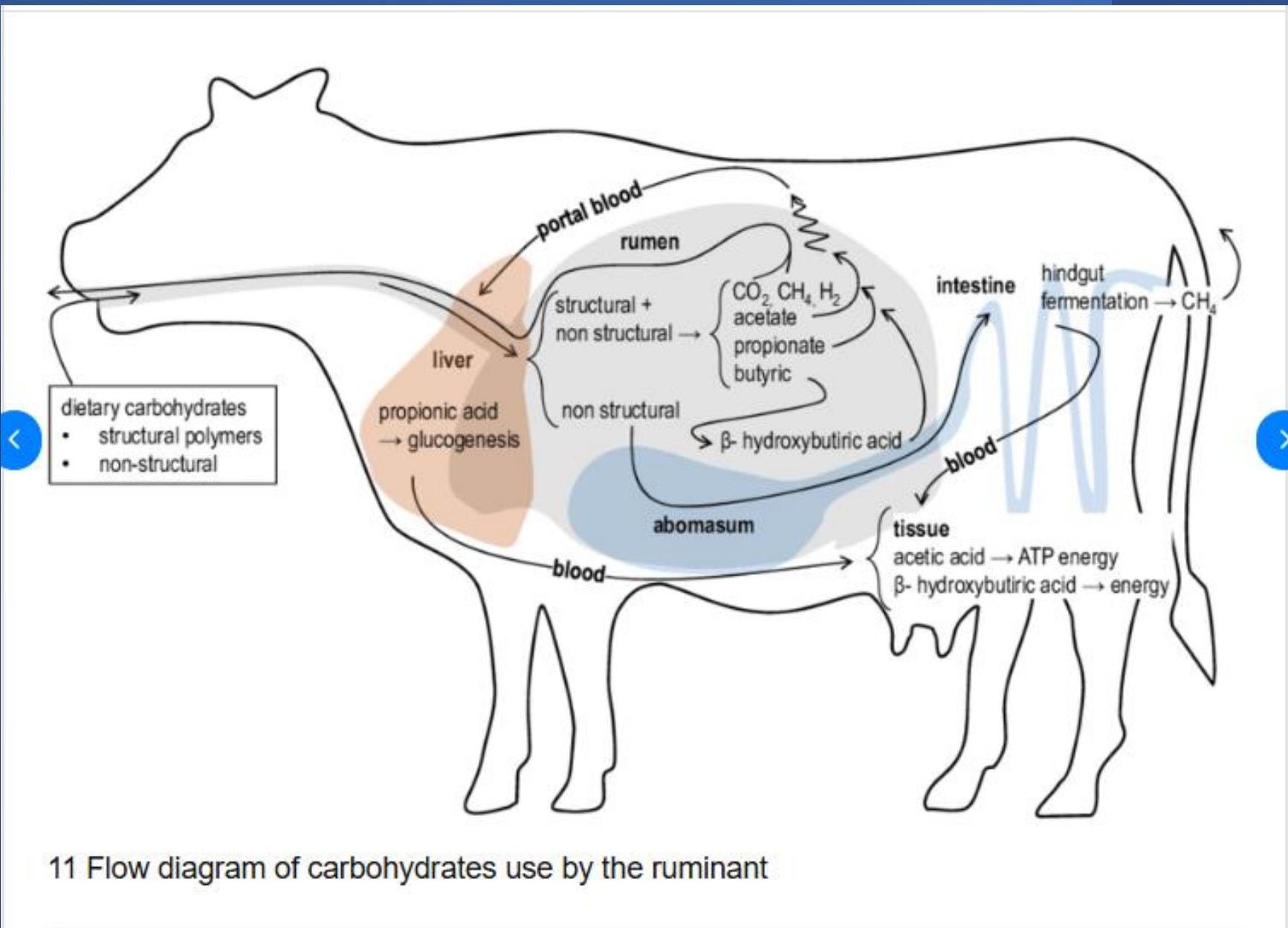
Eating & Rumination

Rumen

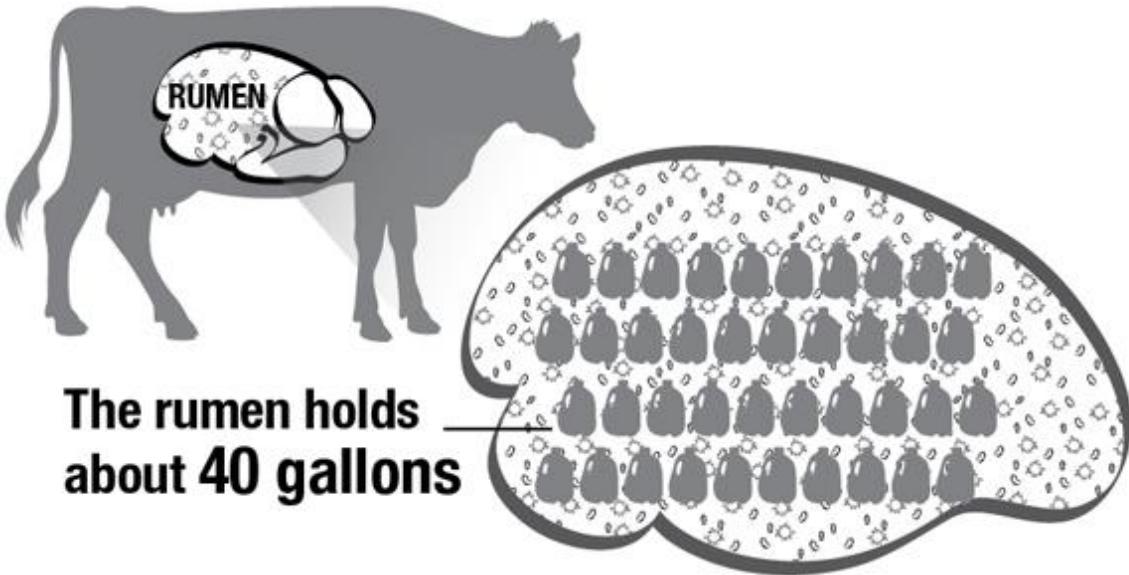
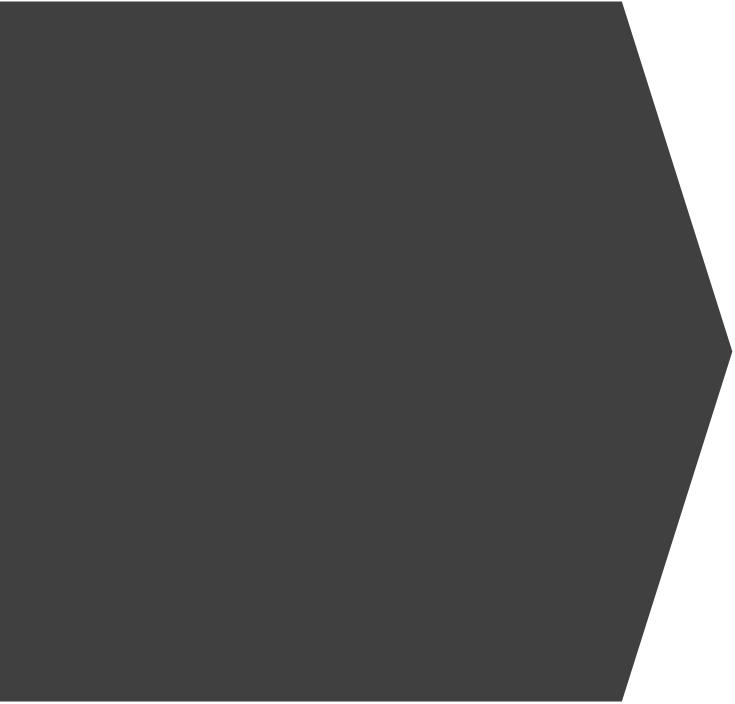
- Microbial growth: Degradation of ingesta
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  - Microbial Protein (Amino acids)

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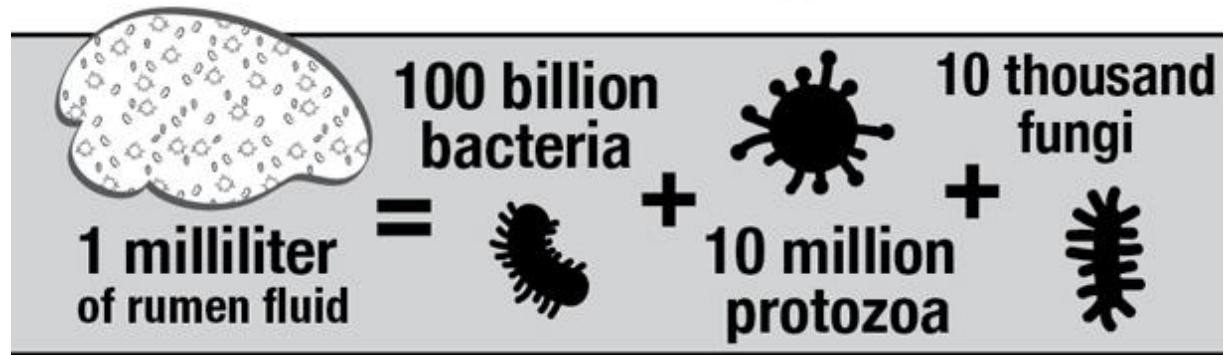
Hind Gut



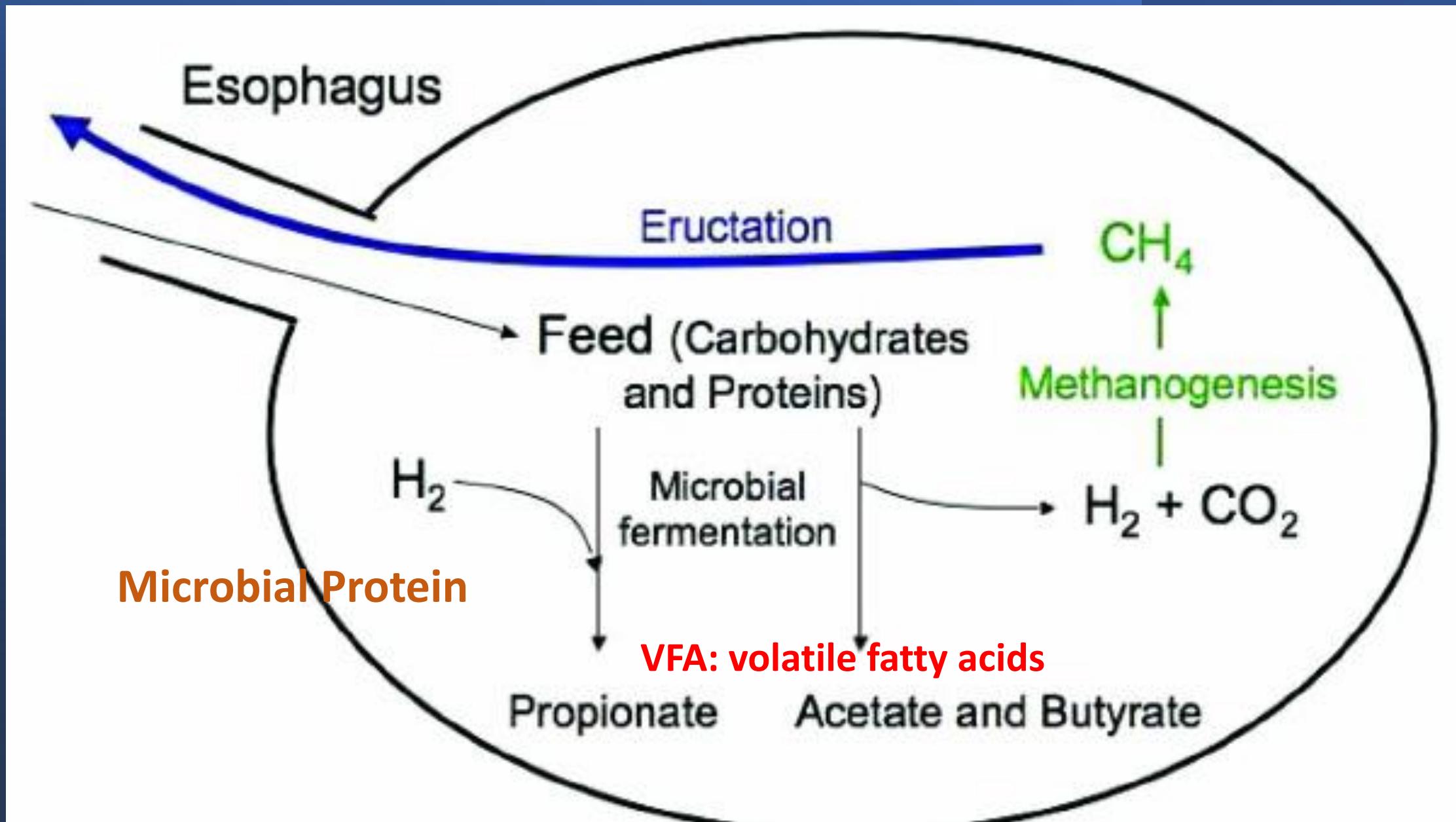
11 Flow diagram of carbohydrates use by the ruminant

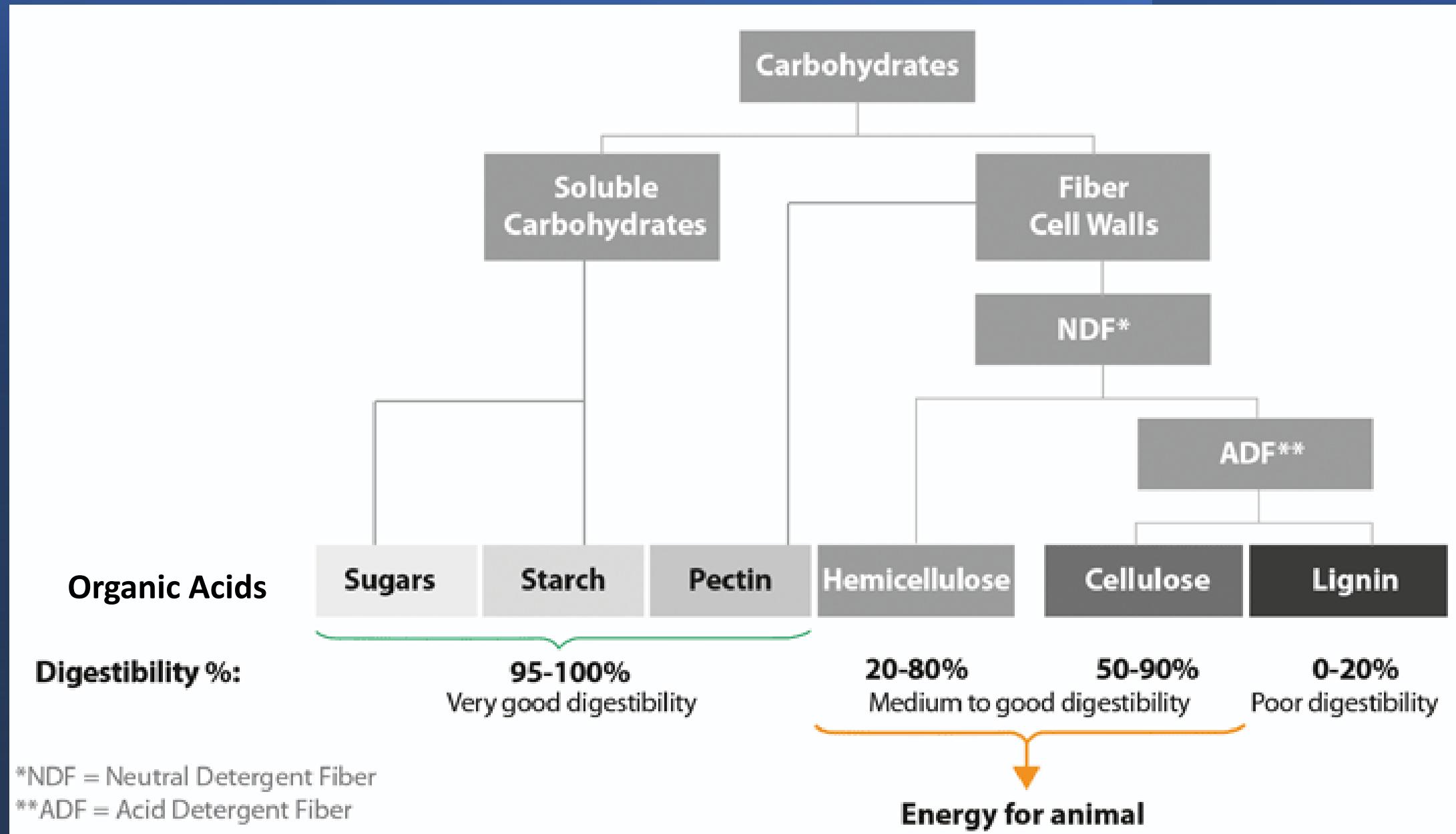


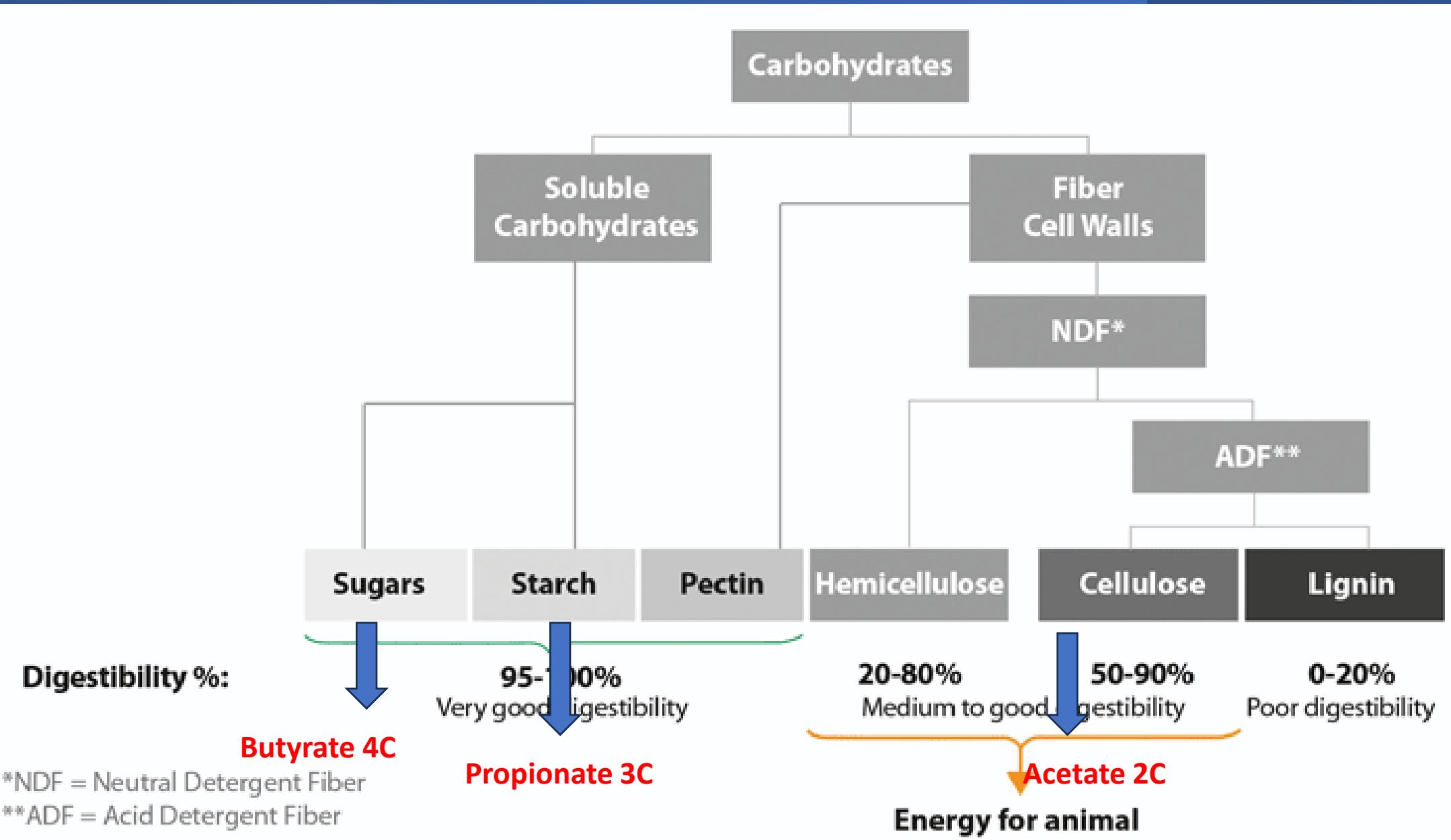
The rumen holds  
about 40 gallons

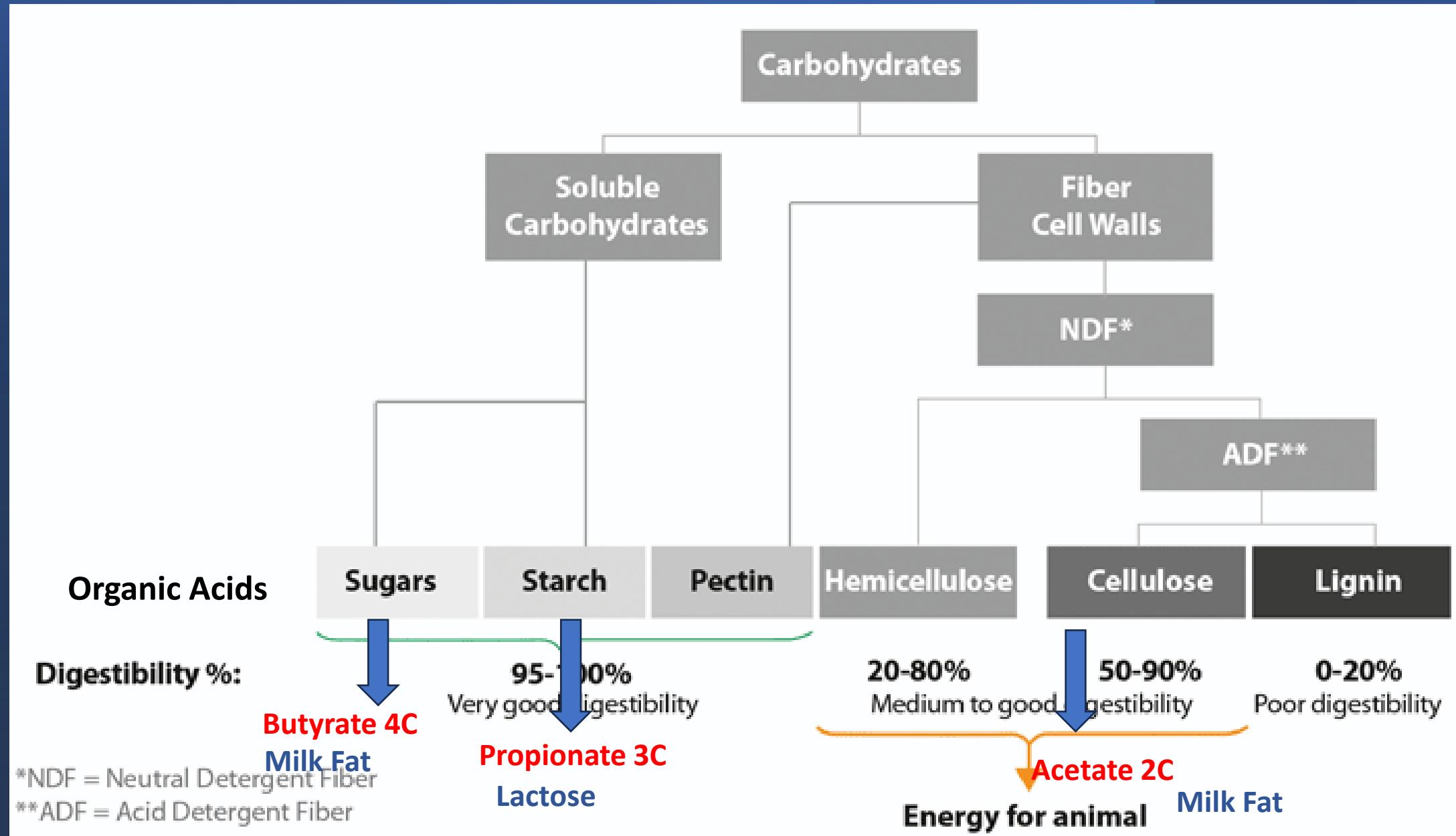


$\geq 1,000,000,000,000,000$   
rumen bugs per cow









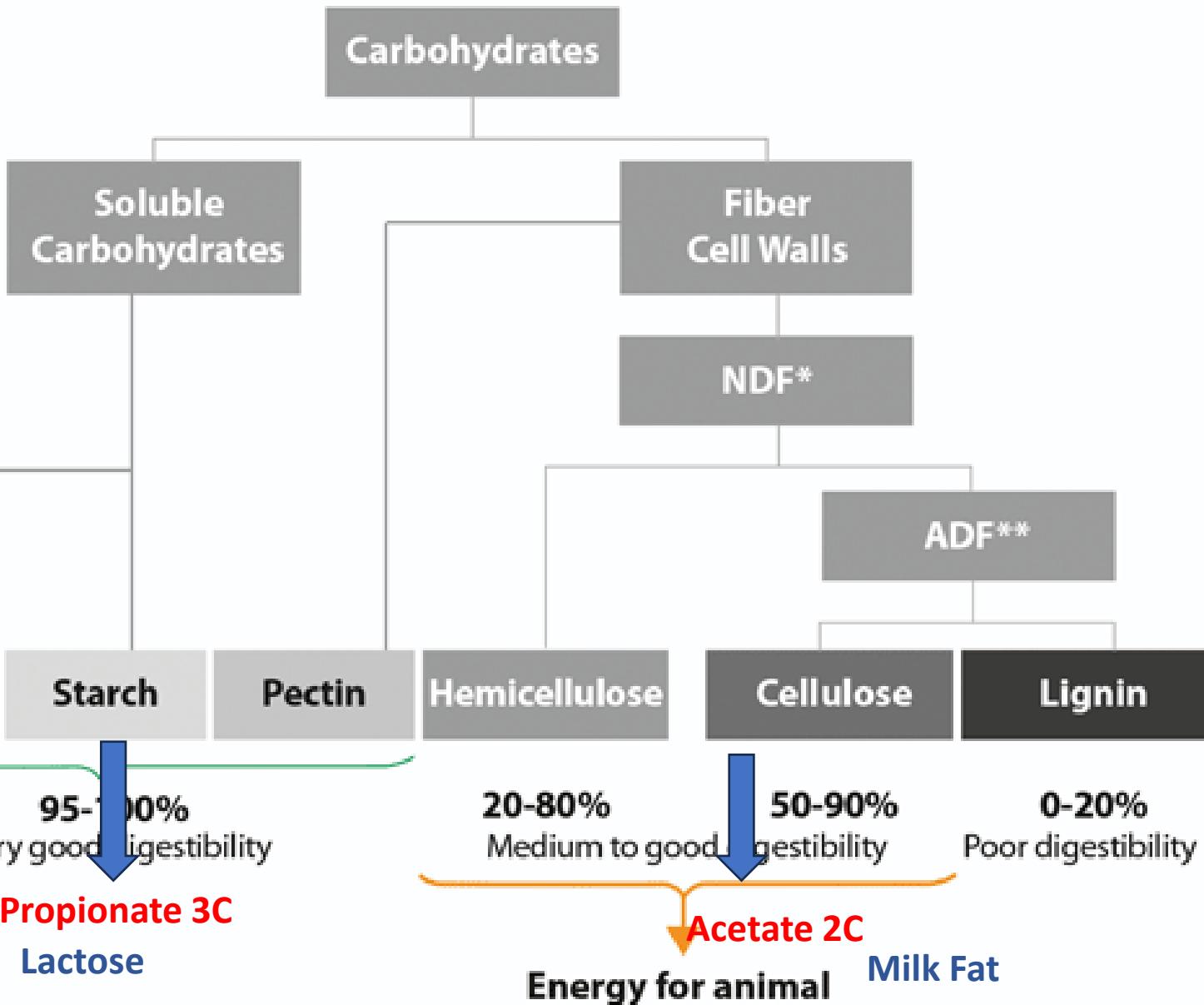
# Microbial Reqs

NPN

Peptides

AA & BCAA

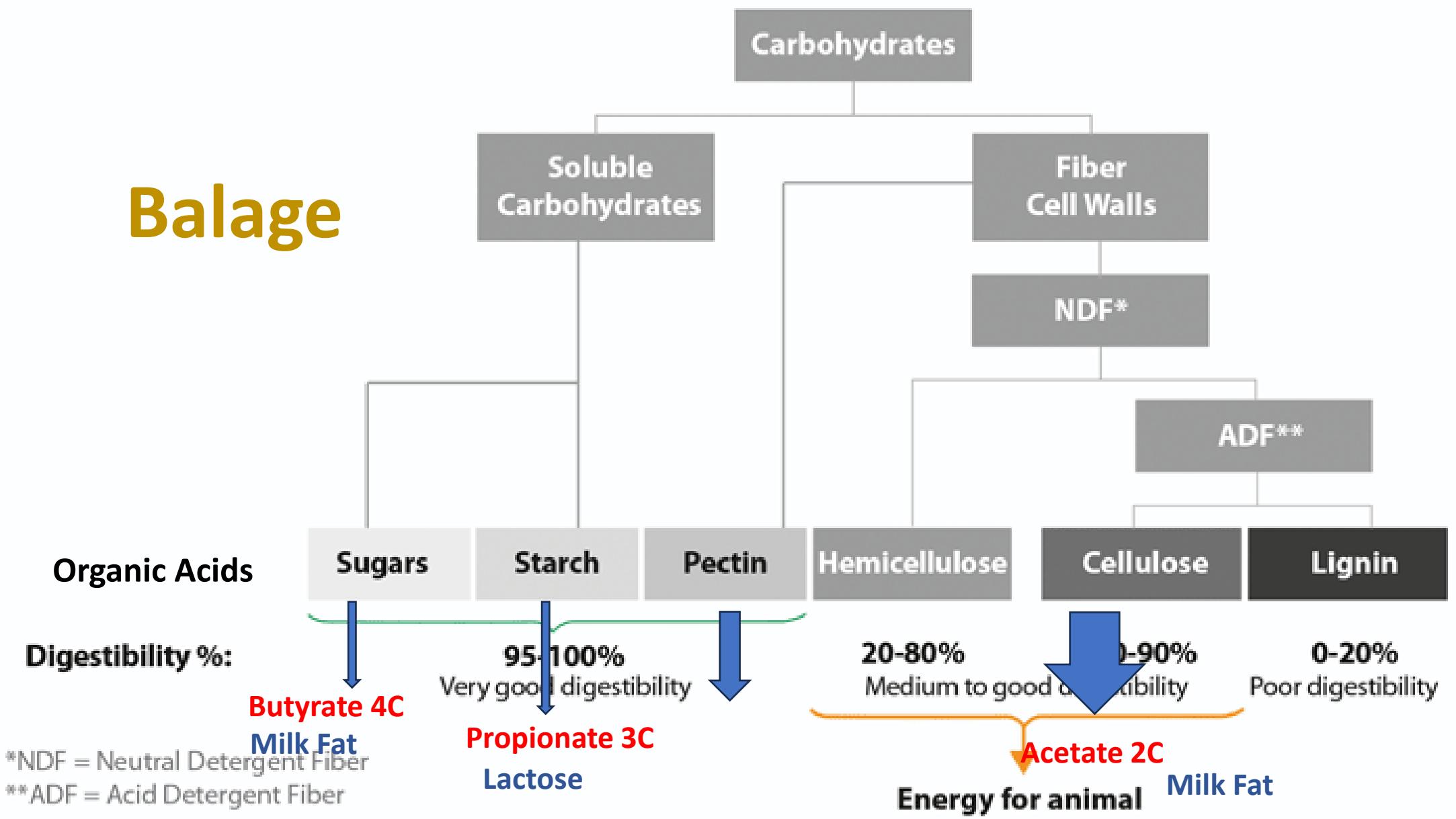
Mins S



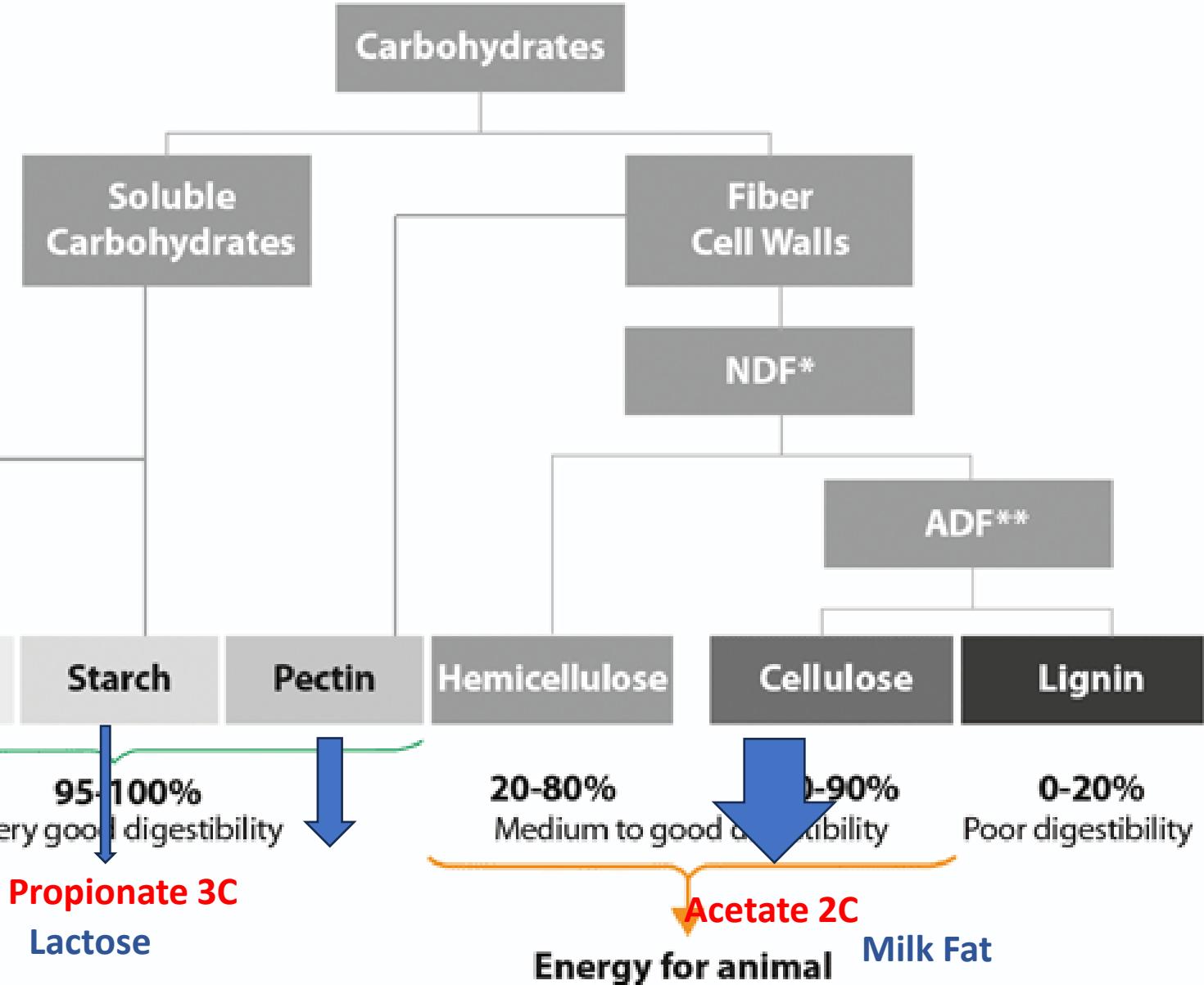
\*NDF = Neutral Detergent Fiber

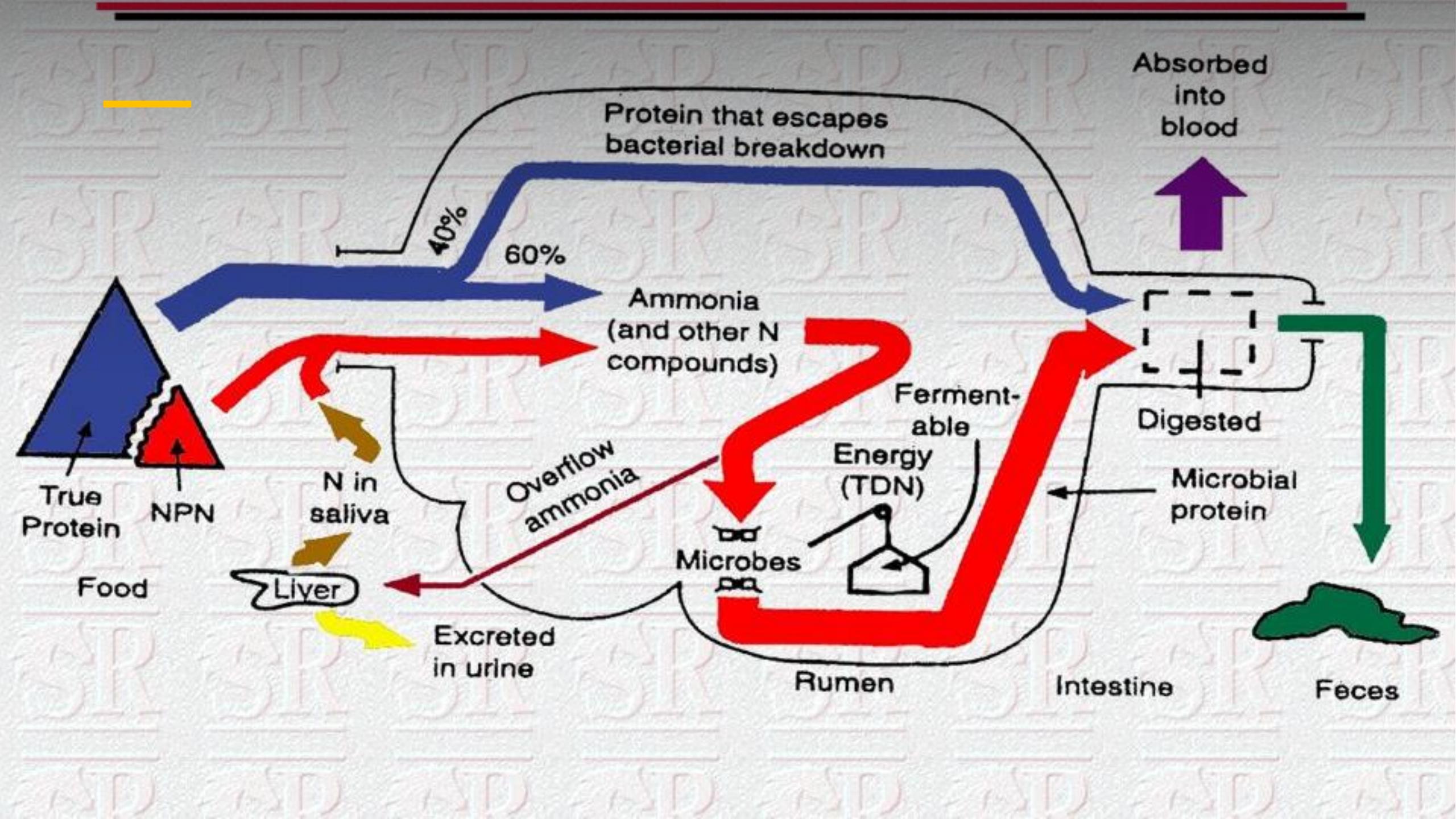
\*\*ADF = Acid Detergent Fiber

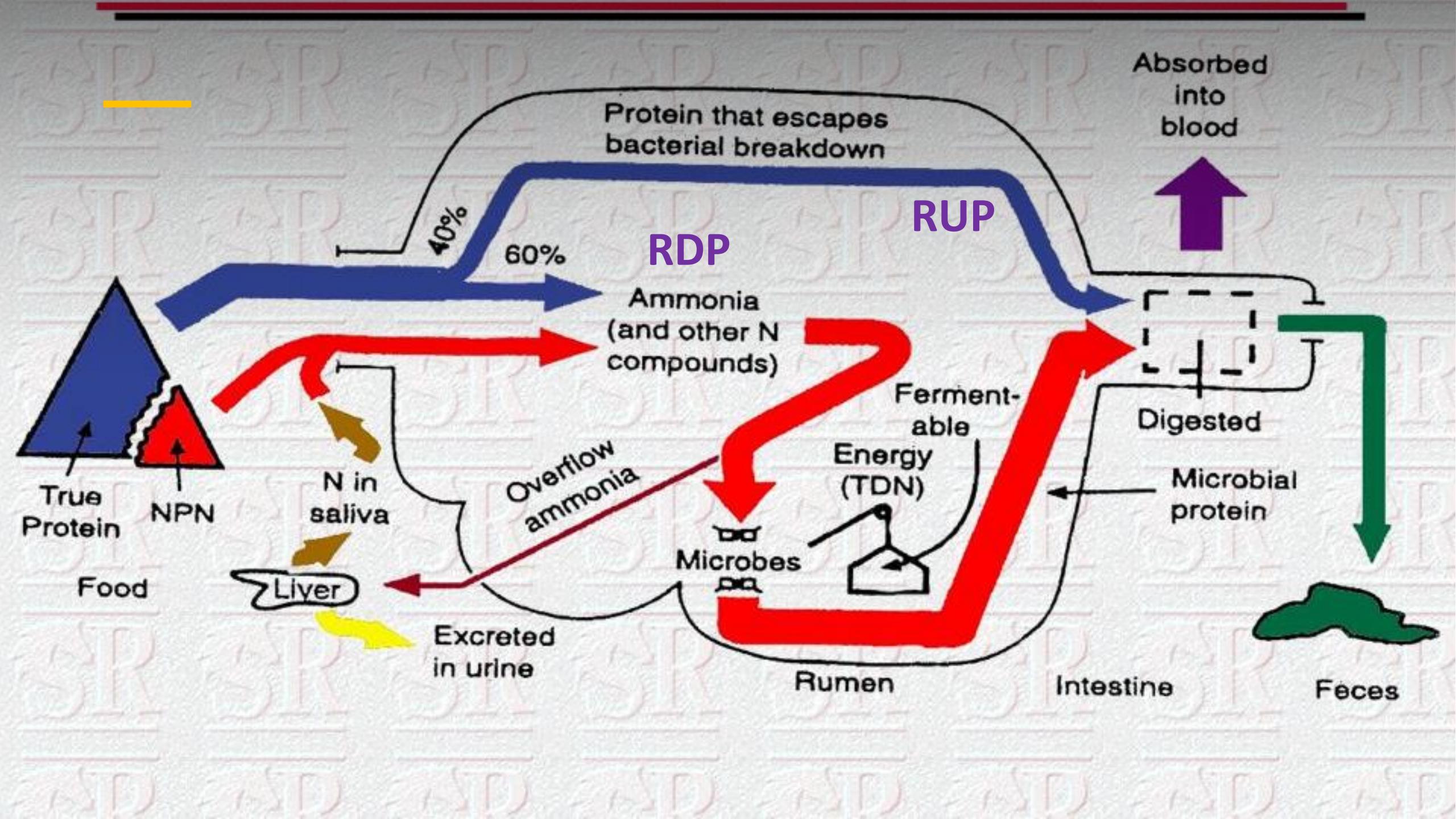
# Balage



# Pasture



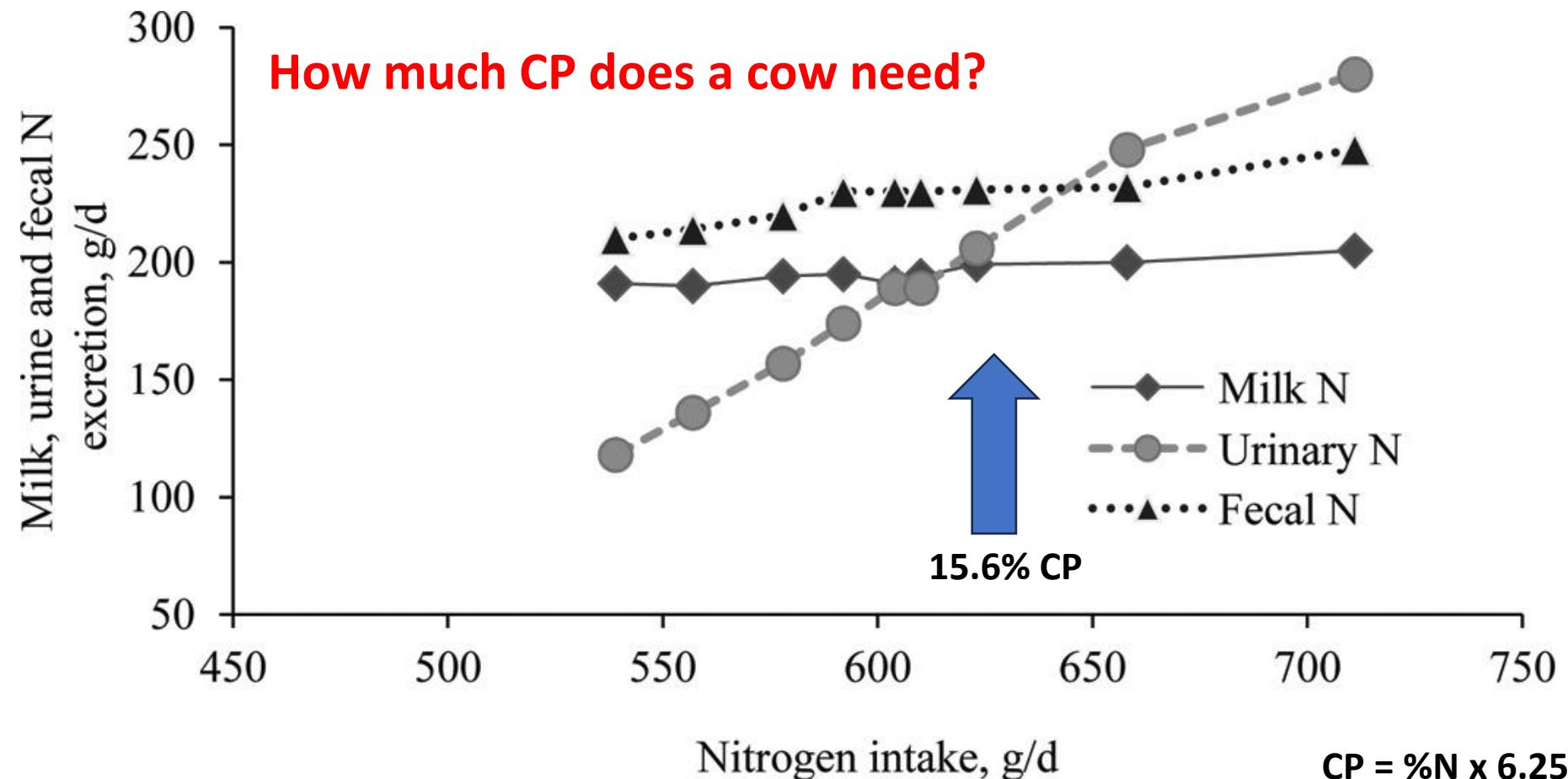




# The Cornell Net Carbohydrate and Protein System: Updates to the model and evaluation of version 6.5

Van Amburgh et al JDS 2015

DMI 25 kg Milk 40kg CP% 14-19%



# Biochemistry: Improved analyses to match improved understanding of metabolism

- Plant Chemistry →→ Ruminant Nutrition: Microbes & Animal

- **Nutrient Pools**

- CHO/Protein/Minerals

- Carbohydrate (CHO) Fractions:

- OA: organic acids
    - Sugars: ESC v WSC
    - Starch
    - Soluble Fiber
    - Fiber: Cellulose v Hemicellulose

- Protein (Pro) Fractions

- CP/Soluble/RDP/RUP
    - NPN/Amino acids/Peptides (BCAA Leu, Isoleucine, Valine)
    - MP: Metabolizable Protein

- Minerals

	<b>Pool Size Amount</b>	<b>Digestibility &amp; Rates</b>
• CHO/Protein/Minerals		Very Fast
• Carbohydrate (CHO) Fractions:		Fast
• Protein (Pro) Fractions		Moderate
• Minerals		Moderate
		Variable

# Biochemistry: Improved analyses to match improved understanding of metabolism

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    - MP: Metabolizable Protein

- **Minerals**

Pool Size	Amount	Digestibility & Rates
Large	Small	Very Fast
Medium	Medium	Fast
Medium	Large	Moderate
Small	Large	Moderate
Large	Variable	Variable

NIR vs Wet Chem

# Excellent Forage Analyses

Farm: ESH, AMOS Copies to: COTANCH, KURT (GMAIL)  
 Desc: GRASS LEGUMES BROUILLETTE, SUSAN  
 Submitter: DARBY, HEATHER MCGRATH, TOM  
 Account: UNIV. OF VT - EXTENSION Lab ID: 36115 392  
 Sampled: 10/02/2024  
 Arrived: 10/09/2024  
 Completed: 10/09/2024  
 Reported: 10/09/2024

## GRASS LEGUMES

SAMPLE INFORMATION				MINERALS			
Lab ID:	36115 392	Version:	1.0	Ash (%DM)	13.8		
Crop Year:	2024	Series:		Calcium (%DM)	0.73		
Feed Type:	GRASS FORAGE	Cutting #:	2	Phosphorus (%DM)	0.40		
Package:	BASIC NIR			Magnesium (%DM)	0.26		
				Potassium (%DM)	3.37		
				Sulfur (%DM)	0.33		
				Sodium (%DM)			
				Chloride (%DM)			
				Iron (PPM)			
				Manganese (PPM)			
				Zinc (PPM)			
				Copper (PPM)			
				Molybdenum (PPM)			
NIR ANALYSIS RESULTS				QUALITATIVE			
Moisture				pH	4.98		
Dry Matter				Total VFA (%DM)	5.16		
Crude Protein				Lactic Acid (%DM)	4.11		
Adjusted Protein				Lactic as % of Total VFA	80		
Soluble Protein				Acetic Acid (%DM)	0.73		
Ammonia (CPE)	17.6			Butyric Acid (%DM)	0.32		
ADF Protein (ADICP)				1, 2 Propanediol (%DM)			
NDF Protein (NDRCP)				Nitrate Ion (%DM)			
Rumen Degr. Protein				Nitrate-Nitrogen, ppm			
Amino Acid Protein, Total	61.2						
FIBER				Soil Contamination Probability	Probable moderate contamination		
ADF				NIR Statistical Confidence	Excellent prediction potential		
aNDF		45.8					
NDF (NDF w/o sulfite)				ENERGY & INDEX CALCULATIONS			
Crude Fiber				TDN (%DM)	58.1		
Lignin				Net Energy Lactation (Mcal/lb)	0.59		
NDF Digestibility (12 hr)	56.0	25.7	48.7	Net Energy Maintenance (Mcal/lb)	0.58		
NDF Digestibility (24 hr)				Net Energy Gain (Mcal/lb)	0.32		
NDF Digestibility (30 hr)	71.1	32.5	61.7	ME (Mcal/lb)	0.97		
NDF Digestibility (72 hr)				AA Protein as % of Total Protein	61.2		
NDF Digestibility (120 hr)	82.4	37.7	71.7	NDF Dig. Rate (Kd, %HR, Van Amburgh, Lignin*2.4)	4.82		
NDF Digestibility (240 hr)	85.9	39.3	74.8	NDF Dig. Rate (Kd, %HR, uNDF)	4.9		
uNDF (12 hr)	44.0	20.2		Starch Dig. Rate (Kd, %HR, Mertens)			
uNDF (30 hr)	29.0	13.3	38.3	Relative Feed Value (RFV)	109		
uNDF (120 hr)	17.6	8.1	28.3	Relative Forage Quality (RFQ)	106		
uNDF (240 hr)	14.1	6.5	25.2	Milk per Ton (lbs/ton)	2887		
CARBOHYDRATES				Beef per Ton (lbs/ton)			
Silage Acids				Dig. Organic Matter Index (lbs/ton)	656		
Ethanol Soluble CHO (ESC-Sugar)				ROM (Residual Organic Matter)	15.87		
Water Soluble CHO (WSC-Sugar)				NFC (Non-Fiber Carbohydrates)(%DM)	13.4		
Starch				NSC (Non-Structural Carbohydrates) ESC (%DM)	2.6		
Soluble Starch				NSC (Non-Structural Carbohydrates) WSC (%DM)	5.8		
Soluble Fiber	46.7		6.24	DCAD (meq/100gdm)			
Starch Dig. (7 hr, 4 mm)				Summative Index % (Mass Balance)	97.7		
Crude Fat							
Fatty Acids, Total							
C16:0							
C18:0							
C18:1							
C18:2							
C18:3							
Unsaturated Fatty Acids (RUFA)							
Fatty Acids (%Fat)							

Values in bold were analyzed by wet chemistry methods.

Additional sample information, submitted documents and lab pictures linked to QR code



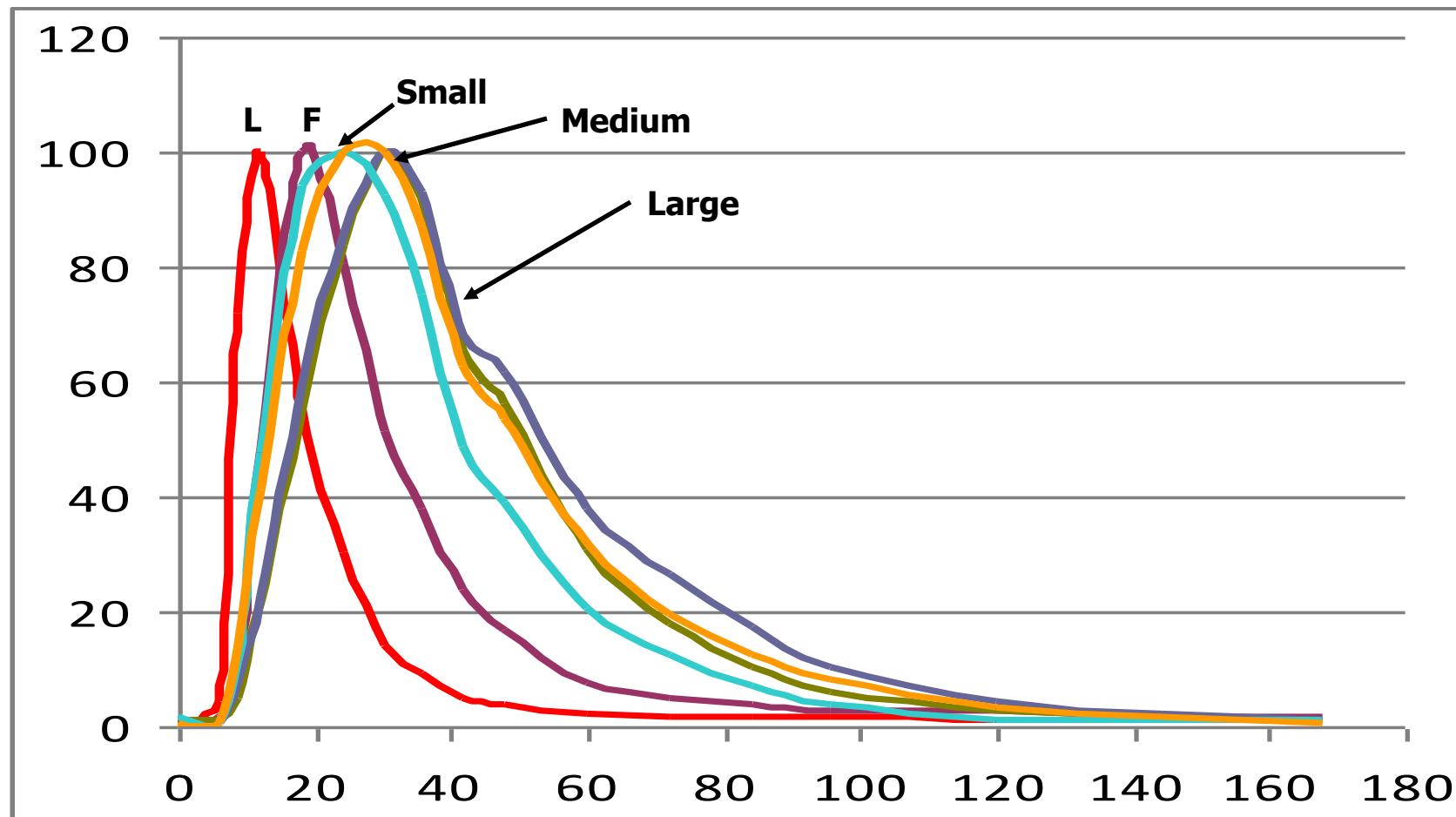
# Rumen Degradation Math

- kd: rate of degradation
- kp: rate of passage; rumen retention time
- Extent of degradation:  $kd/(kd + kp) \times$  pool size
  - How much Energy & Microbial protein obtained:
    - VFAs & Microbial mass

# Ingredient and Nutrient Composition of Diets

Feed ingredient (% of DM)	Lower forage		Higher forage	
	Conv	BMR	Conv	BMR
CS BMR	---	36.1	---	50.2
CS Conv	39.3	---	55.0	---
Haycrop silage	13.4	13.3	13.4	13.3
Corn meal	17.3	20.4	1.6	6.3
Concentrate	30.0	30.2	30.0	30.2
TMR NDF, %	29.1	30.0	33.7	34.5
%NDF from CS	50.8	49.0	61.6	59.0
peNDF, %	17.3	18.5	23.1	22.0
Starch, %	28.0	27.8	21.2	22.3

# Measuring multiple passage rates: marker excretion curves



# Dry matter intake

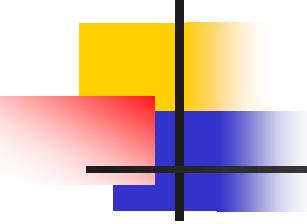
Item	Low CS	High CS	Low BMR	High BMR	SEM	P
<b>DMI, kg/d</b>	<b>29.0<sup>a</sup></b>	<b>26.5<sup>b</sup></b>	<b>29.4<sup>a</sup></b>	<b>29.2<sup>a</sup></b>	<b>0.7</b>	<b>0.001</b>
<b>DMI, % of BW</b>	<b>4.31<sup>a</sup></b>	<b>3.96<sup>b</sup></b>	<b>4.37<sup>a</sup></b>	<b>4.36<sup>a</sup></b>	<b>0.12</b>	<b>&lt;0.001</b>
<b>NDF intake , kg/d</b>	<b>9.36<sup>b</sup></b>	<b>9.47<sup>b</sup></b>	<b>9.32<sup>b</sup></b>	<b>10.25<sup>a</sup></b>	<b>0.22</b>	<b>&lt;0.01</b>
<b>NDF intake, % of BW</b>	<b>1.39<sup>b</sup></b>	<b>1.41<sup>b</sup></b>	<b>1.39<sup>b</sup></b>	<b>1.53<sup>a</sup></b>	<b>0.04</b>	<b>&lt;0.01</b>

a,b  $P \leq 0.05$

# Milk Yield, Milk Composition, and Efficiency

Item	Low CS	High CS	Low BMR	High BMR	SEM	P
Milk, kg/d	47.0 <sup>a</sup>	43.1 <sup>b</sup>	48.6 <sup>a</sup>	47.2 <sup>a</sup>	1.6	<0.01
SCM, kg/d	45.2 <sup>a</sup>	41.8 <sup>b</sup>	46.4 <sup>a</sup>	45.7 <sup>a</sup>	1.2	0.02
Milk/DMI, kg/kg	1.62	1.62	1.66	1.62	0.04	0.46

a,b  $P \leq 0.05$



# Chewing Activity

Item	Low CS	High CS	Low BMR	High BMR	P
<b>Eating, min/kg NDF</b>	<b>29.3<sup>ab</sup></b>	<b>31.7<sup>a</sup></b>	<b>27.3<sup>b</sup></b>	<b>27.1<sup>b</sup></b>	<b>&lt;0.01</b>
<b>Ruminating, min/kg NDF</b>	<b>55.3<sup>xy</sup></b>	<b>57.0<sup>x</sup></b>	<b>50.6<sup>y</sup></b>	<b>53.4<sup>xy</sup></b>	<b>0.09</b>
<b>Total chewing, min/kg NDF</b>	<b>84.6<sup>ab</sup></b>	<b>88.7<sup>a</sup></b>	<b>77.9<sup>b</sup></b>	<b>80.5<sup>b</sup></b>	<b>&lt;0.01</b>

<sup>abc</sup> Least squares means within a row without a common superscript differ ( $P \leq 0.05$ ).

<sup>xy</sup> Least squares means within a row without a common superscript differ ( $P \leq 0.10$ ).

# Typical forage analysis report

## CVAS and Dairy One

**POULIN GRAIN**

**Green Mountain Feed Testing Laboratory**  
An Affiliate of Cumberland Valley Analytical Services

Farm: MINER INSTITUTE	Copies to: WHITTAKER, ERIK	Lab ID: 21448 027
Desc: CSLG		Sampled: 02/01/2017
Submitter: GREEN MOUNTAIN FEED TESTING LAB, RENEE		Arrived: 02/02/2017
Account: GREEN MOUNTAIN FEED TESTING LAB		Completed: 02/02/2017
		Reported: 02/02/2017
<b>Miner Institute CSLG</b>		
Moisture: 59.1		
Dry Matter: 40.9		
<b>PROTEINS</b>		
Crude Protein: 7.8	% SP: 4.4	% CP: 7.8
Soluble Protein:	Zinc (PPM):	
Adjusted Protein:	Copper (PPM):	
Ammonium (CPE): 23.9	Manganese (PPM):	
ADF Protein (ADICP): 8.5	Iron (PPM):	
NDF Protein (NDICP): 9.4	Molybdenum (PPM):	
NDR Protein (NDRCP):	Selenium (PPM):	
Rumen Deg. Protein: 78.5	Lactate Ion (%DM):	
Rumen Deg. CP (Strep.G):	Chloride (%DM):	
<b>NIR ANALYSIS RESULTS</b>		
Moisture: 59.1	Ash (%DM): 3.30	
Dry Matter: 40.9	Calcium (%DM): 0.17	
Phosphorus (%DM): 0.23		
Magnesium (%DM): 0.11		
Potassium (%DM): 1.15		
Sulfur (%DM): 0.11		
Sodium (%DM):		
Chloride (%DM):		
Iron (PPM):		
Manganese (PPM):		
Zinc (PPM):		
Copper (PPM):		
Molybdenum (PPM):		
Selenium (PPM):		
Lactate Ion (%DM):		
Chloride (%DM):		
Molybdenum (PPM):		
<b>QUALITATIVE</b>		
Total VFA (%DM): 6.17		
Lactic Acid (%DM): 4.67		
Lactate as % of Total VFA: 79		
NDF (%DM): 1.50		
Rumen Deg. Protein: 78.5		
Rumen Deg. CP (Strep.G):		
<b>FIBER</b>		
%NDFom: 33.7	% NDF: 60.4	% DM: 20.8
%ADF: 27.2	% ADF: 34.4	
%aNDF: 27.2	% NDF w/o sulfite: 34.4	
%pNDF:		
<b>ENERGY &amp; INDEX CALCULATIONS</b>		
ADF: 7.7	pH: 3.90	
NDF Digestibility (12 hr): 2.50	TDN (%DM): 75.7	
NDF Digestibility (24 hr): 2.72	Net Energy Lactation (mcal/lb):	
NDF Digestibility (30 hr): 55.8	Schwab/Shaver NEL (Unprocessed): 0.73	
NDF Digestibility (48 hr): 68.8	Net Energy Maintenance (mcal/lb): 0.65	
NDF Digestibility (120 hr): 65.6	Net Energy Gain (mcal/lb): 0.81	
NDF Digestibility (240 hr): 68.8	Net Energy Gain (mcal/lb): 0.53	
uNDF (30 hr): 44.2	NDF Dg. Rate (Kid, WHT, Van Amburgh, Lignin*.24): 3.42	
uNDF (120 hr): 34.4	NDF Dg. Rate (Kid, WHT, UNDF): 5.25	
uNDF (240 hr): 31.2	Relative Feed Value (RFV): 20.7	
<b>CARBOHYDRATES</b>		
% Starch: 11.8	% NFC: 6.2	% DM: 11.8
Starch Acid: 0.5	Relative Feed Quality (RFQ):	
Water Soluble CHO (Sugar): 0.5	Milk per Ton (lbs/ton): 3079	
Starch: 77.7	Dig. Organic Matter Index (lbs/ton):	
Soluble Fiber: 9.2	Non Fiber Carbohydrates (%DM): 52.3	
Starch Dig. (7 hr, 4 mm): 74.5	Neutral Detergent Carbohydrates (%DM): 40.9	
Fatty Acids, Total: 2.51	DCAD (meq/lb):	
Unsaturated Fatty Acids (RUFA): 1.88	CNCPS / GPM Lignin Factor: 4.7	
Saturated Fatty Acids: 0.63	RFC - Fill Index: 3.81	
Crude Fat: 2.99	Summative Index % (Mass Balance): 98.9	
Additional sample information, source and lab pictures		
<small>Values in bold were analyzed by wet chemistry methods. Definitions and explanation of report terms</small>		
Powered by Cumberland Valley Analytical Services 145-15 Industry Drive, Hagerstown, MD 21742 www.foragelab.com   mail@foragelab.com   301-790-1980   800-CVAS-LAB		

**Dairy One** 2016 Certified by NELA

**FORAGE TESTING LABORATORY**  
DAIRY ONE, INC.  
730 WARREN ROAD  
ITHACA, NEW YORK 14850  
607-257-1272 (fax 607-257-1350) 18402 CS

Sample Description	Farm/Code/ Sample #	
CORN SILAGE	323   23450210	
<b>Analysis Results</b>		
Sampled   Recvd   Printed   ST(CO)	01/20/17   01/23/17	
Components	As Fed   DM	
18402 CS	% Dry Matter   39.5	
Miner Institute	% NDF   16.2	
Attn: Acet Payables	% NDF   41.1	
PO Box 90	% Crude Protein   8.2	
Chazy, NY 12921	% Crude Fat   3.4	
	% Ash   3.2	
	% Soluble Protein & CP   55	
	% NDICP & CP   12.4	
	% ADICP & CP   6.2	
	Meal/Lb Meal/Kg	
	% Calcium   .06	.16
	% Phosphorus   .09	.23
	% Magnesium   .04	.11
	% Chloride Ion   .15	.38
	% Potassium   .42	1.05
	% Sulfur   .04	.11
	% ADF   9.7	24.4
	% ADICP   .2	.5
	% NDICP   .4	1.1
	% Lignin   1.3	3.4
	% NFC   17.2	43.6
	% TDN   28	72
<b>COMMENTS:</b>		
1. * SCHWAB - SHEAVER (SS)		
ADJUSTMENTS FOR STARCH DIGESTIBILITY.		
NEL, Meal/Lb	.30	.75
NEM, Meal/Lb	.30	.76
NEG, Meal/Lb	.19	.48
% Moisture	60.5	
% Available Protein	3.2	8.2
% Adjusted Crude Protein	3.4	8.7
(Degradable Protein)CP		76
% Starch	13.7	34.7
% WSC (Water Sol. Carbs.)	.8	2.0
% ESC (Simple Sugars)	.8	1.9
*SS NEL, Meal/Lb		.71
*SS Proc. NEL, Meal/Lb		.74
% Lysine	.09	.22
% Methionine	.05	.13

Page 1

Run: 1/23/2017 12:04:53PM Report 1C Page 1

# Forage Quality Evaluation: What values to focus on?

- Primary
  - DM
  - aNDFom
  - NDFD30h
  - VFA
  - Ash
  - Starch (CS)
- Lesser Concern
  - Energy Values (**Dynamic**)
  - CP
  - Minerals
  - Fat

# Forage Quality Evaluation: What values to focus on?

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Anti nutritional:  
Yeast & molds  
Toxins  
Protein end products

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- Lessor Concern

- Energy Values (Dynamic)
- CP
- Minerals

Fat

Anti nutritional:  
Yeast & molds  
Toxins  
Protein end products

Depressed:  
DMI

Extent of Degradation: VFA & Microbial mass

# 2 Qualities of grass silage

## Rumen incubation of 0, 24, 48 and 120h

A



B



# Forage Digestible NDF and Performance

(Oba and Allen, 1999)

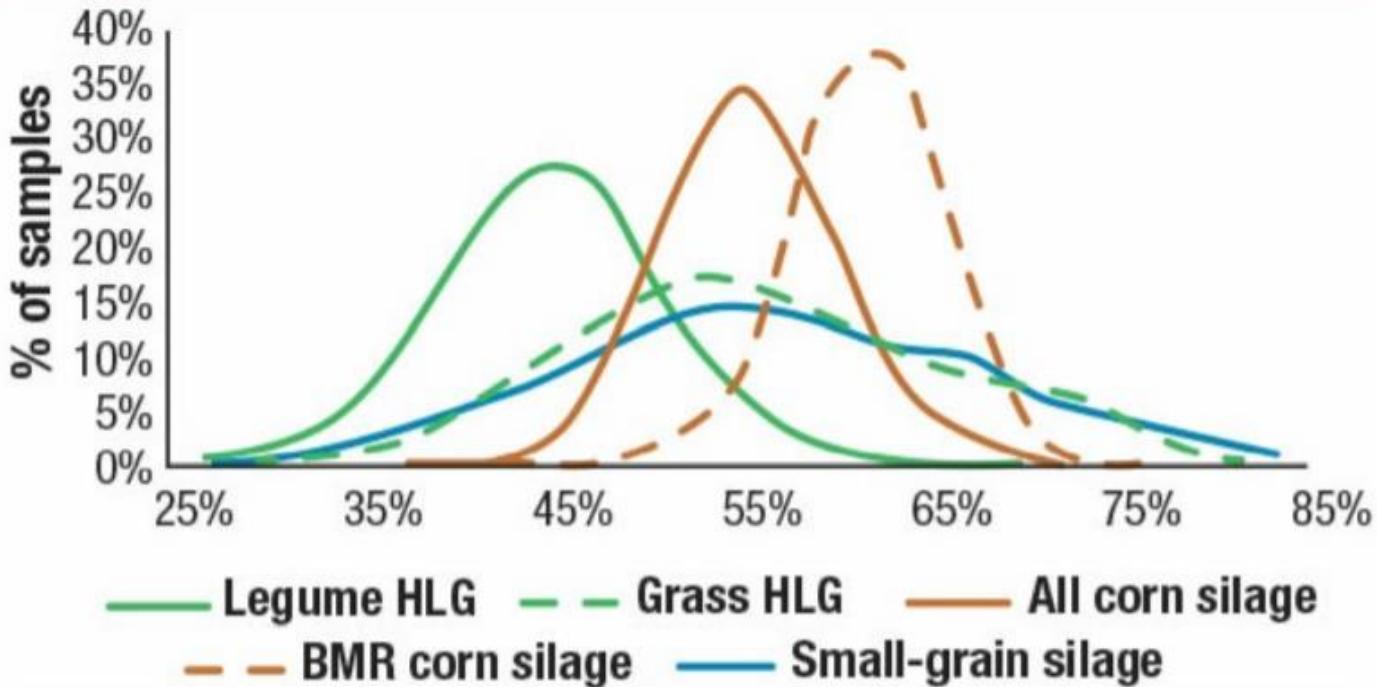
For every 1  
percentage-unit  
increase in NDF  
digestibility

- +0.40 lb/d DMI
- +0.53 lb/d milk
- +0.55 lb/d 4%FCM

>40% corn  
silage in diet

- +0.26 lb/d DMI
- +0.31 lb/d 3.5%FCM (Jung et al., 2010)

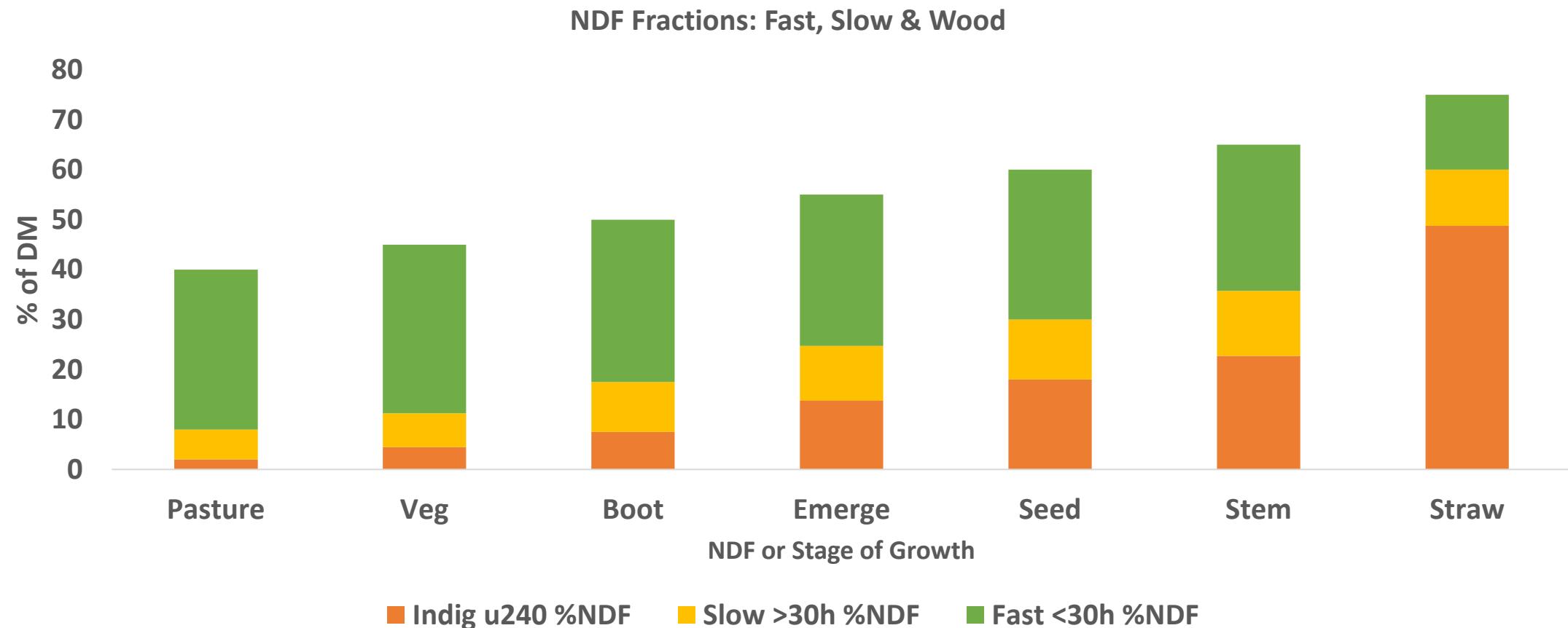
**FIGURE 1** NDFD30 across five forages



140,964 samples – 2016 crop year.

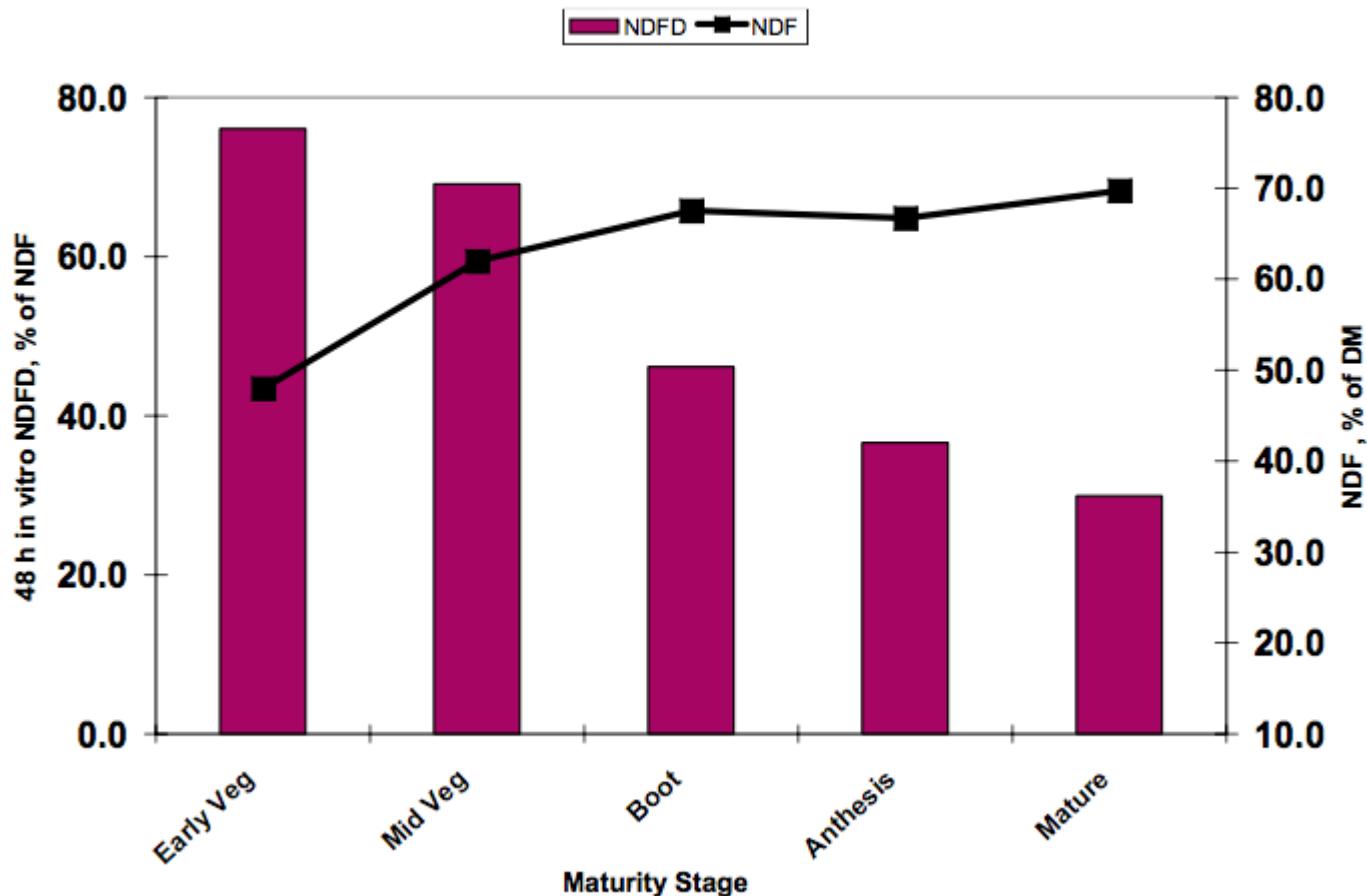
Legume haylages, also known as alfalfa haylages, had an average digestibility around 45 percent. All corn silages, with brown midrib (BMR) included, averaged around 55 percent. Furthermore, grass haylages averaged around 54 percent digestibility along with cereal grain silages averaging around 56 percent.

# NDF Fractions by stage of growth



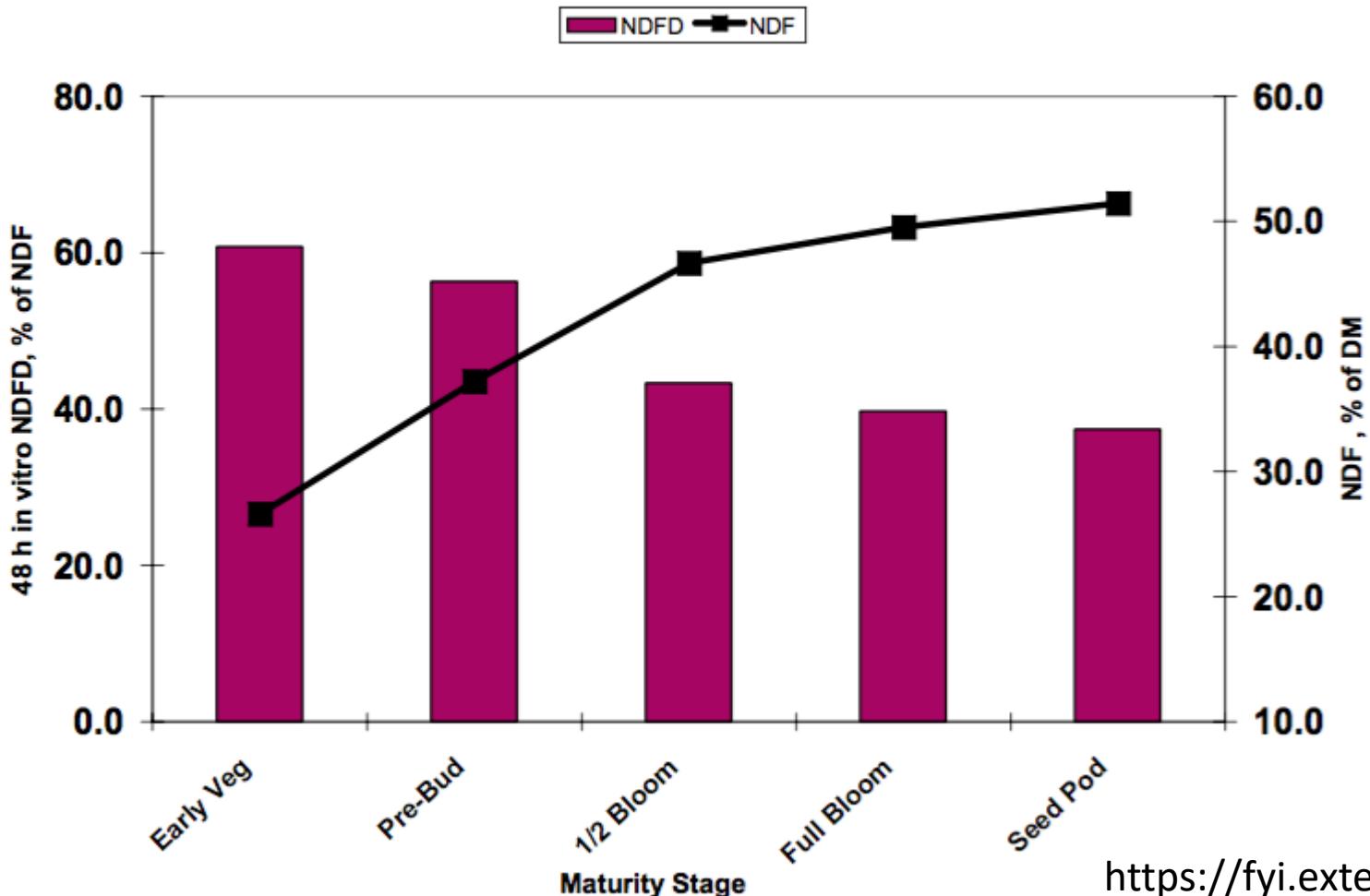
# Digestible Fiber x Maturity: Grass

Figure 1. Effect of maturity stage on 48 h NDF digestibility of grass hay and silage.



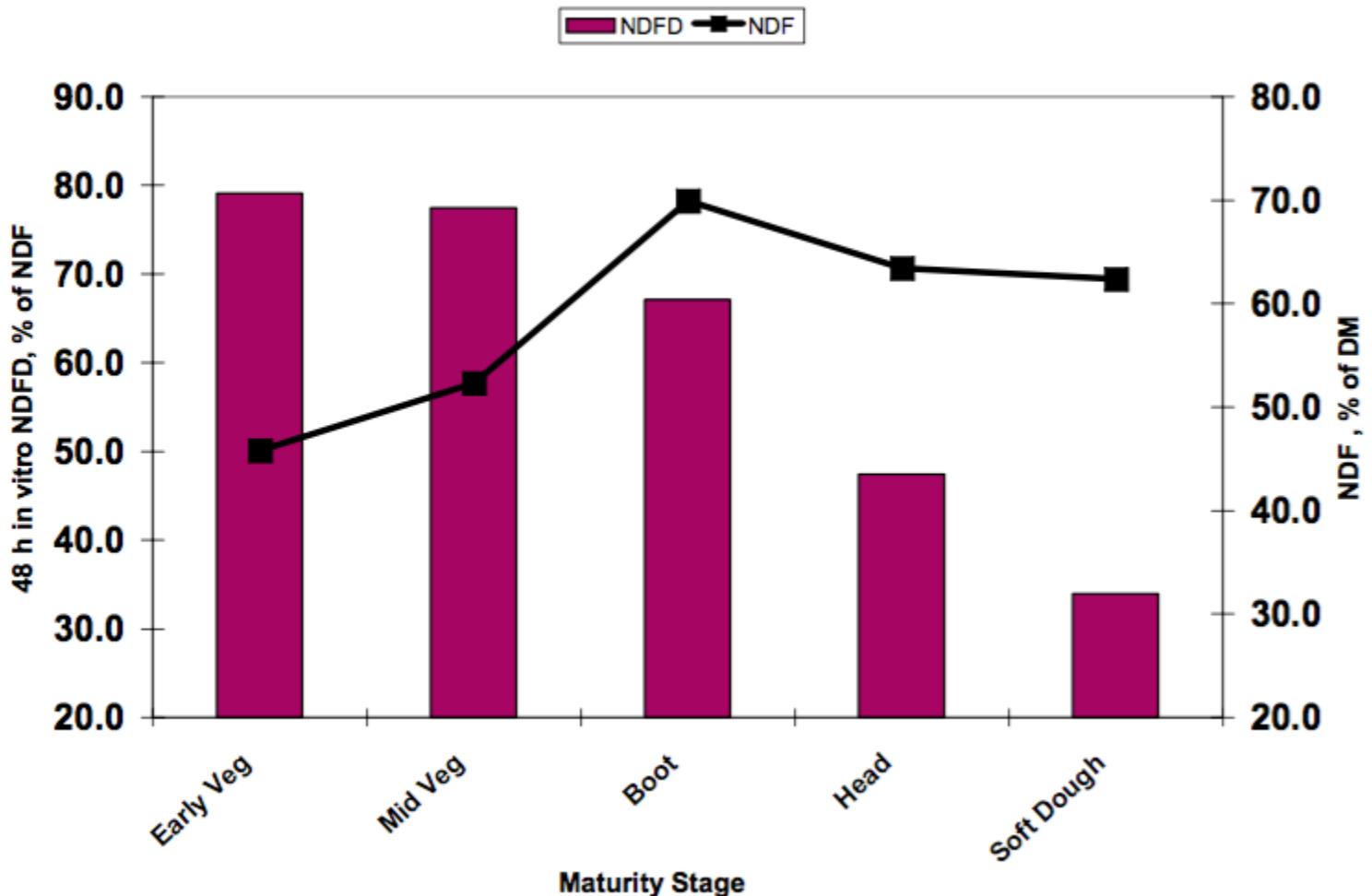
# Digestible Fiber x Maturity: Legume

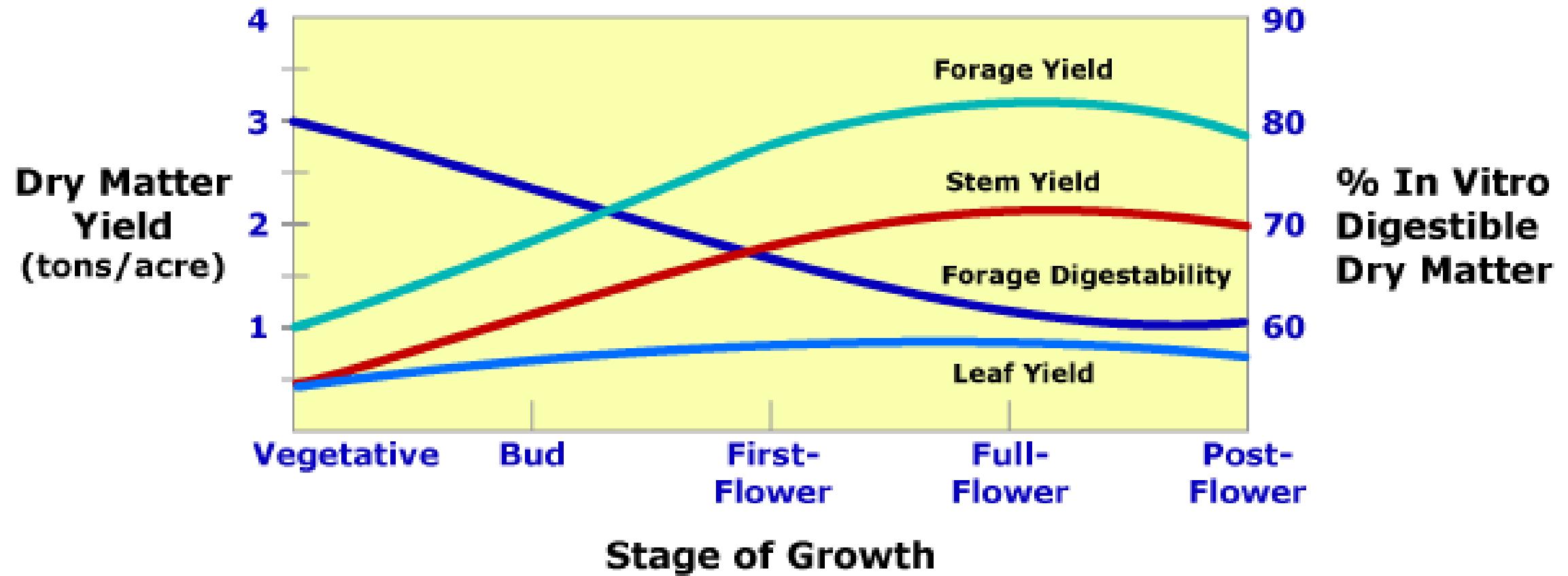
Figure 2. Effect of maturity stage on 48 h NDF digestibility of legume hay and silage.



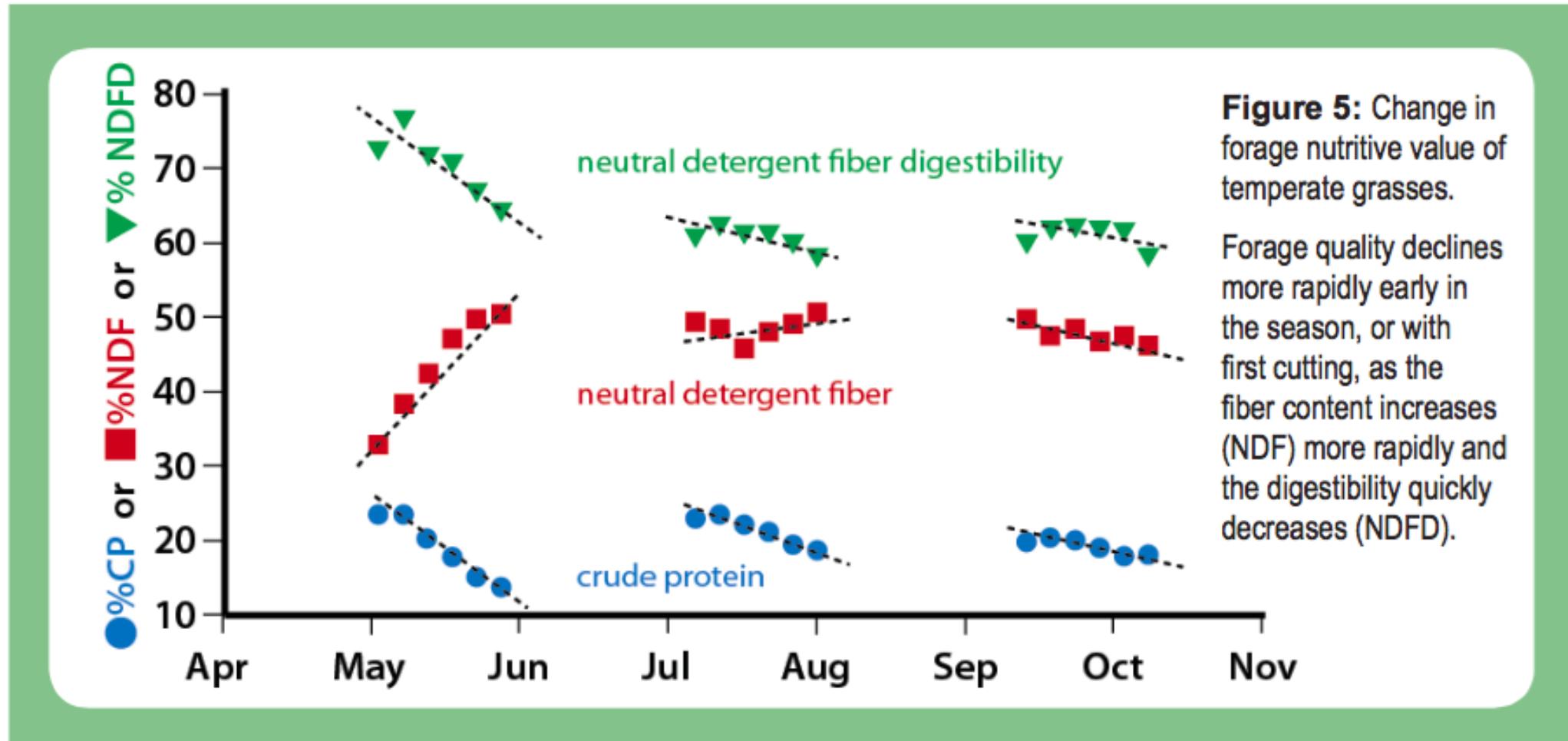
# Digestible Fiber x Maturity: SGS

Figure 4. Effect of maturity stage on 48 h NDF digestibility of small grain silage.



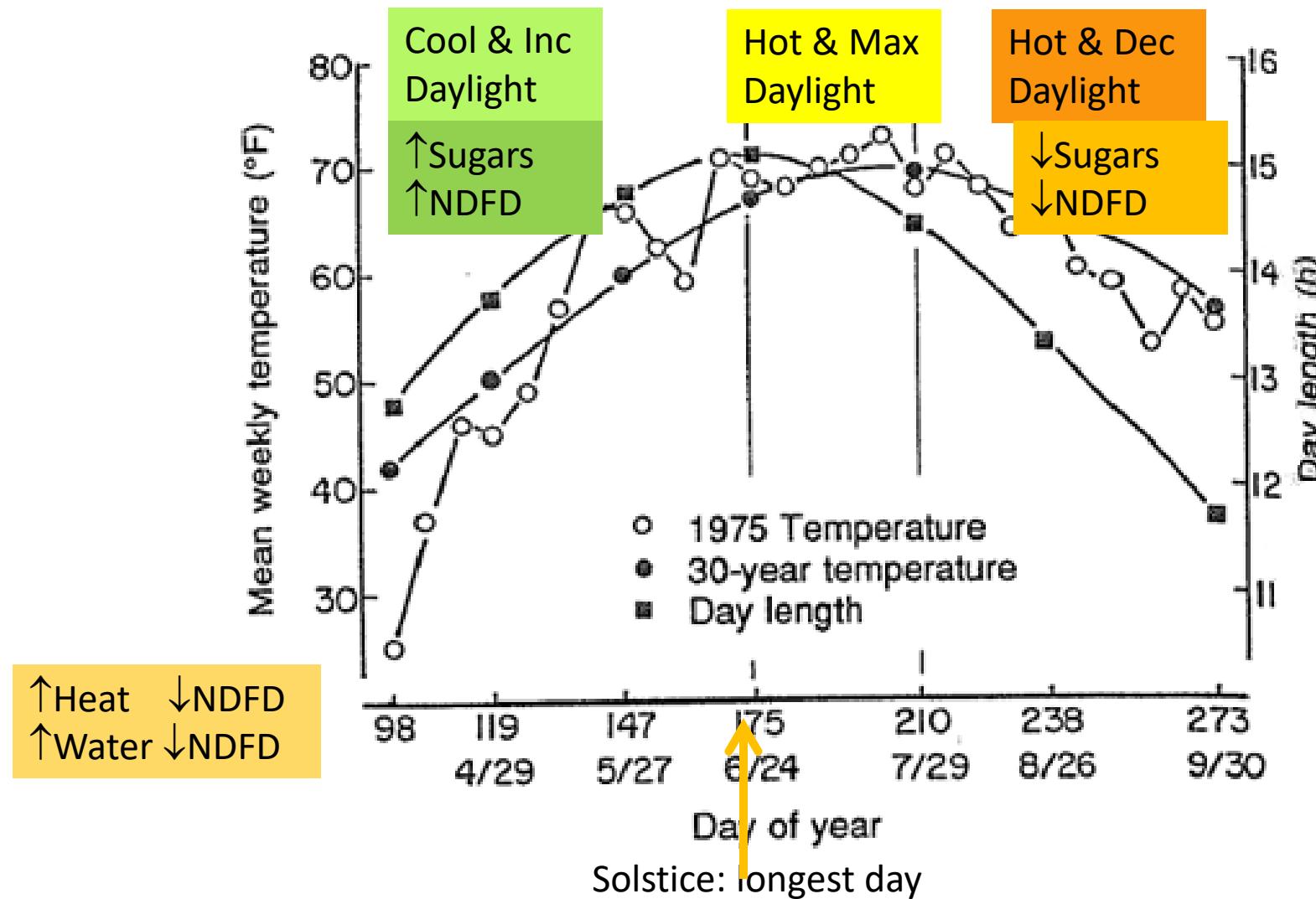


[https://courses.ecampus.oregonstate.edu/ans312/four/legumes\\_trans.htm](https://courses.ecampus.oregonstate.edu/ans312/four/legumes_trans.htm)



# Seasonality and Cutting

# Seasons



# Fiber and digestibility (undigestibility): uNDF

1<sup>st</sup> cut

FIBER	% NDFom	NDFom %DM	% NDF	% DM
ADF			64.9	36.7
aNDF		55.7		56.5
NDR (NDF w/o sulfite)				
Crude Fiber				
Lignin			10.8	6.08
NDF Digestibility (12 hr)	44.1	24.6	43.9	25.1
NDF Digestibility (24 hr)				
NDF Digestibility (30 hr)	55.2	30.8	54.9	31.0
NDF Digestibility (72 hr)				
NDF Digestibility (120 hr)	67.8	37.8	67.2	38.0
NDF Digestibility (240 hr)	70.7	39.4	70.1	39.6
uNDF (12 hr)	55.9	31.1		
uNDF (30 hr)	44.8	24.9	45.1	25.5
uNDF (120 hr)	32.2	17.9	32.8	18.5
uNDF (240 hr)	29.3	16.3	29.9	16.9

2<sup>nd</sup> cut

FIBER	% NDFom	NDFom %DM	% NDF	% DM
ADF				62.4
aNDF				34.1
NDR (NDF w/o sulfite)		53.6		54.6
Crude Fiber				
Lignin				13.6
NDF Digestibility (12 hr)				7.44
NDF Digestibility (24 hr)				
NDF Digestibility (30 hr)		51.7	27.7	50.6
NDF Digestibility (72 hr)				27.6
NDF Digestibility (120 hr)		60.6	32.5	59.3
NDF Digestibility (240 hr)		63.2	33.9	61.9
uNDF (12 hr)				32.4
uNDF (30 hr)		48.3	25.9	49.4
uNDF (120 hr)		39.4	21.1	40.7
uNDF (240 hr)		36.8	19.7	38.1

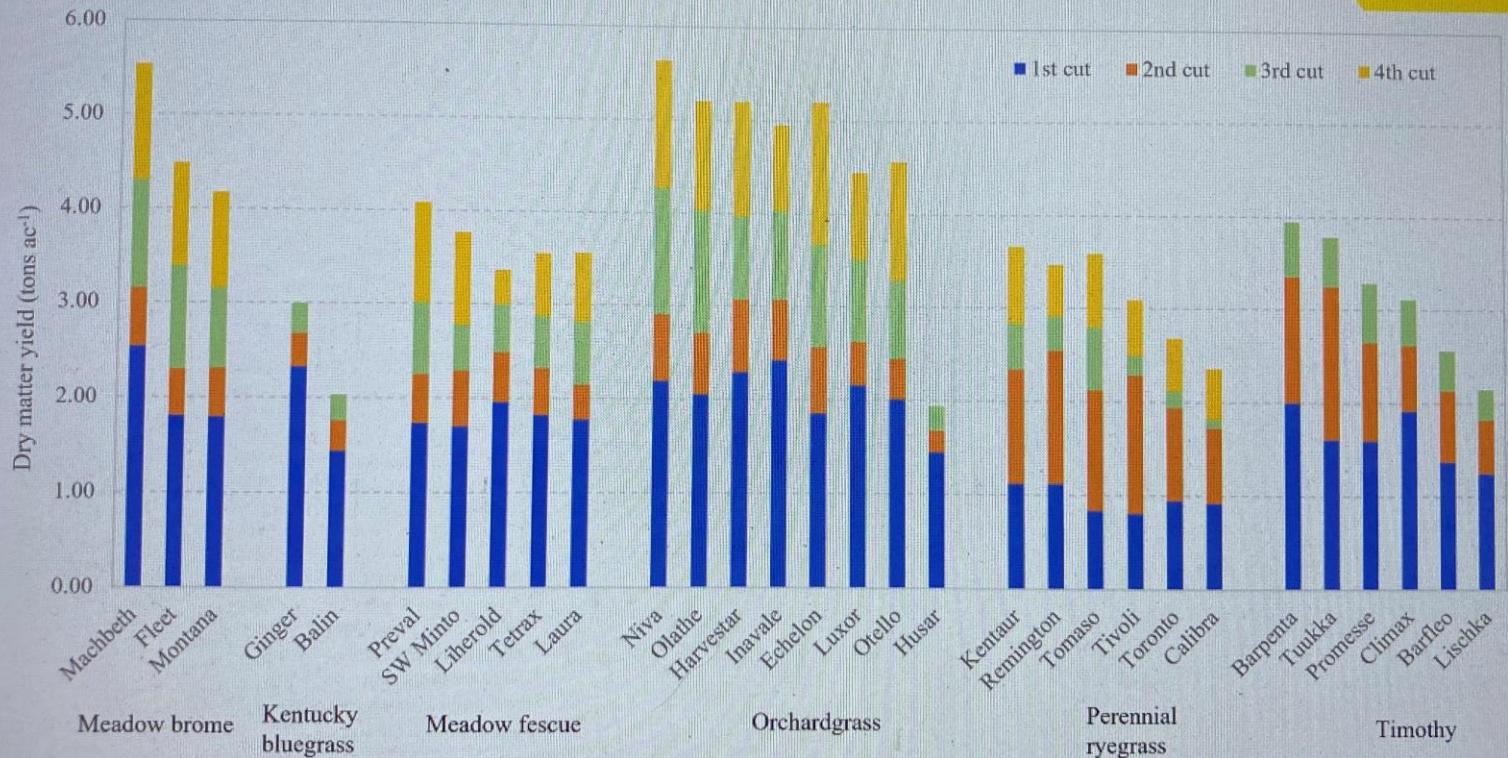


# Darby Grass Trial

- Variety
- Yields
- Graze v Bale

# New Seeding Grass Varieties

Perennial Grass Species Yields- 2020 & 2021



# Yield and Quality, 2020

	DM Yield	Crude protein	WSC	Digestible NDF (48-hrs)
tons ac <sup>-1</sup>				
Fleet	4.16	0.914	0.448	1.86
Macbeth	6.67	1.48	0.675	3.01
Montana	4.56	1.07	0.501	1.91
<b>Brome</b>	<b>5.13</b>	<b>1.16</b>	<b>0.541</b>	<b>2.26</b>
Laura	3.75	0.857	0.483	1.64
Liherold	4.11	0.915	0.554	1.81
Preval	4.48	1.02	0.545	1.99
SW Minto	4.99	1.15	0.573	2.14
TetraX	4.58	1.07	0.636	1.93
<b>Meadow Fescue</b>	<b>4.38</b>	<b>1.00</b>	<b>0.558</b>	<b>1.90</b>
Echelon	6.25	1.39	0.510	3.04
Harvestar	6.36	1.38	0.531	2.71
Inavale	5.36	1.21	0.527	2.48
Luxor	5.37	1.15	0.605	2.59
Niva	<b>6.69</b>	<b>1.52</b>	<b>0.549</b>	<b>3.14</b>
Olathe	6.58	1.46	0.546	3.08
Otello	5.58	1.22	0.475	2.67
<b>Orchardgrass</b>	<b>6.03</b>	<b>1.33</b>	<b>0.535</b>	<b>2.81</b>
Calibra	3.24	0.643	0.536	1.41
Kentaur	5.97	1.15	<b>0.859</b>	2.56
Remington	6.08	1.20	0.834	2.68
Tivoli	4.97	0.973	0.717	2.20
Tomaso	5.03	0.987	0.728	2.16
Toronto	3.94	0.804	0.595	1.73
<b>Perennial Ryegrass</b>	<b>4.87</b>	<b>0.960</b>	<b>0.711</b>	<b>2.12</b>

Species	Season yield	CP	aNDF	WSC	TDN	NEL	48-hr NDFD
	DM tons ac <sup>-1</sup>	% of DM			Mcal lb <sup>-1</sup>	% of NDF	
Meadow brome	5.13ab†	<b>22.3a</b>	53.2b	10.4b	59.0b	0.578b	81.8b
Meadow fescue	4.38b	22.1a	<b>49.4a</b>	12.2ab	<b>60.7a</b>	<b>0.613a</b>	<b>86.1a</b>
Orchardgrass	<b>6.03a</b>	21.7a	57.0c	8.18c	57.5c	0.548c	83.3ab
Perennial ryegrass	4.87b	18.9b	53.7b	<b>13.4a</b>	58.6bc	0.571b	82.7b
Level of significance	*	**	**	**	**	**	*
Trial mean	5.18	21.1	53.7	10.9	58.8	0.574	83.6



THE UNIVERSITY OF VERMONT  
EXTENSION

# Nutrient Yields

Species	Season yield	CP	aNDF	WSC	TDN	NEL	48-hr NDFD
	DM tons ac <sup>-1</sup>	% of DM			Mcal lb <sup>-1</sup>	% of NDF	
Meadow brome	5.13ab†	<b>22.3a</b>	53.2b	10.4b	59.0b	0.578b	81.8b
Meadow fescue	4.38b	22.1a	<b>49.4a</b>	12.2ab	<b>60.7a</b>	<b>0.613a</b>	<b>86.1a</b>
Orchardgrass	<b>6.03a</b>	21.7a	57.0c	8.18c	57.5c	0.548c	83.3ab
Perennial ryegrass	4.87b	18.9b	53.7b	<b>13.4a</b>	58.6bc	0.571b	82.7b
Level of significance	*	**	**	**	**	**	*
Trial mean	5.18	21.1	53.7	10.9	58.8	0.574	83.6

- Yield of **Highly Digestible NDF**

- M Brome = **2.23 T**
- M Fescue = **1.86 T**
- Orchard = **2.86 T**
- P Rye = **2.16 T**

- Yield of CP

- M Brome = **1.14 T**
- M Fescue = **0.97 T**
- Orchard = **1.31 T**
- P Rye = **0.92 T**

# **Greater Yields of Highly Digestible Forages**

A green tractor with a mower attachment is cutting a grassy field. The field has several parallel tracks from previous mowings. In the background, there are trees, a red barn, and a blue sky with white clouds.

**And How to Preserve Quality**



## Harvesting Quality Mowing

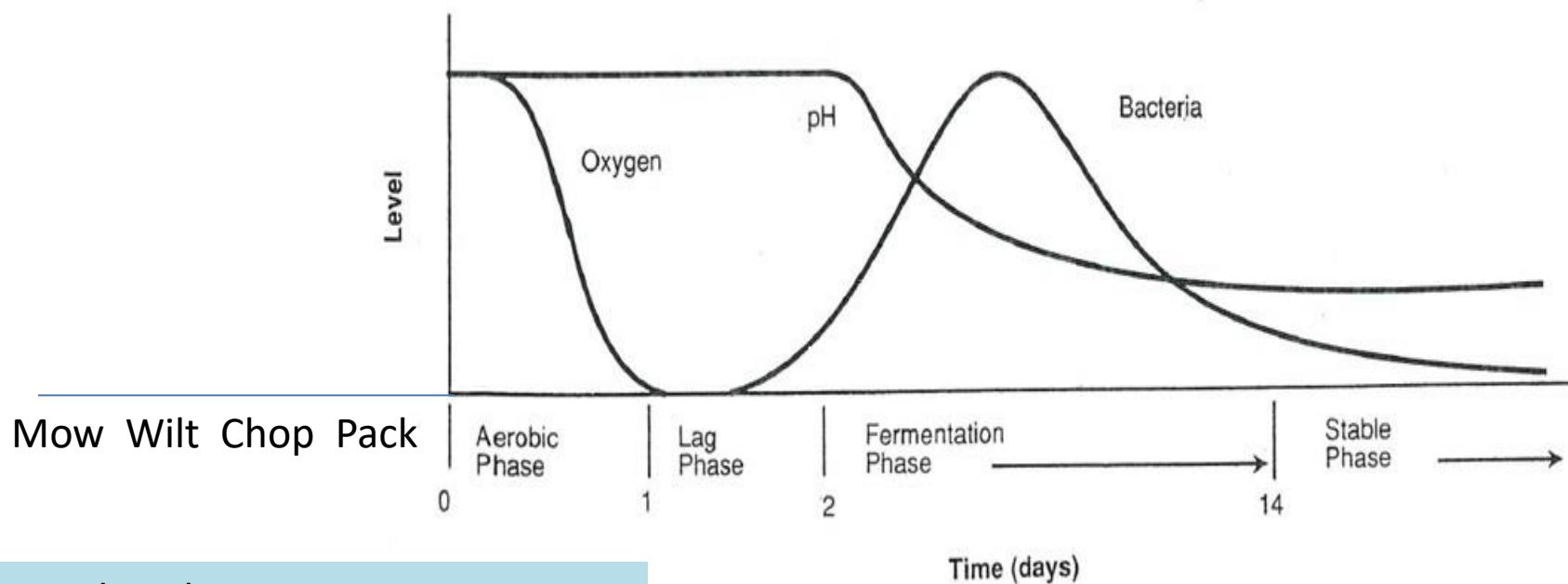
- Cut Ht: 4" Yellow v Brown
- Stubble Ht
- Air Flow
- Drying Capacity Windrow
- Wilting and Respiration



# Preserving Forage Quality

## Managing Forage Inventory

# Phases of forage preservation



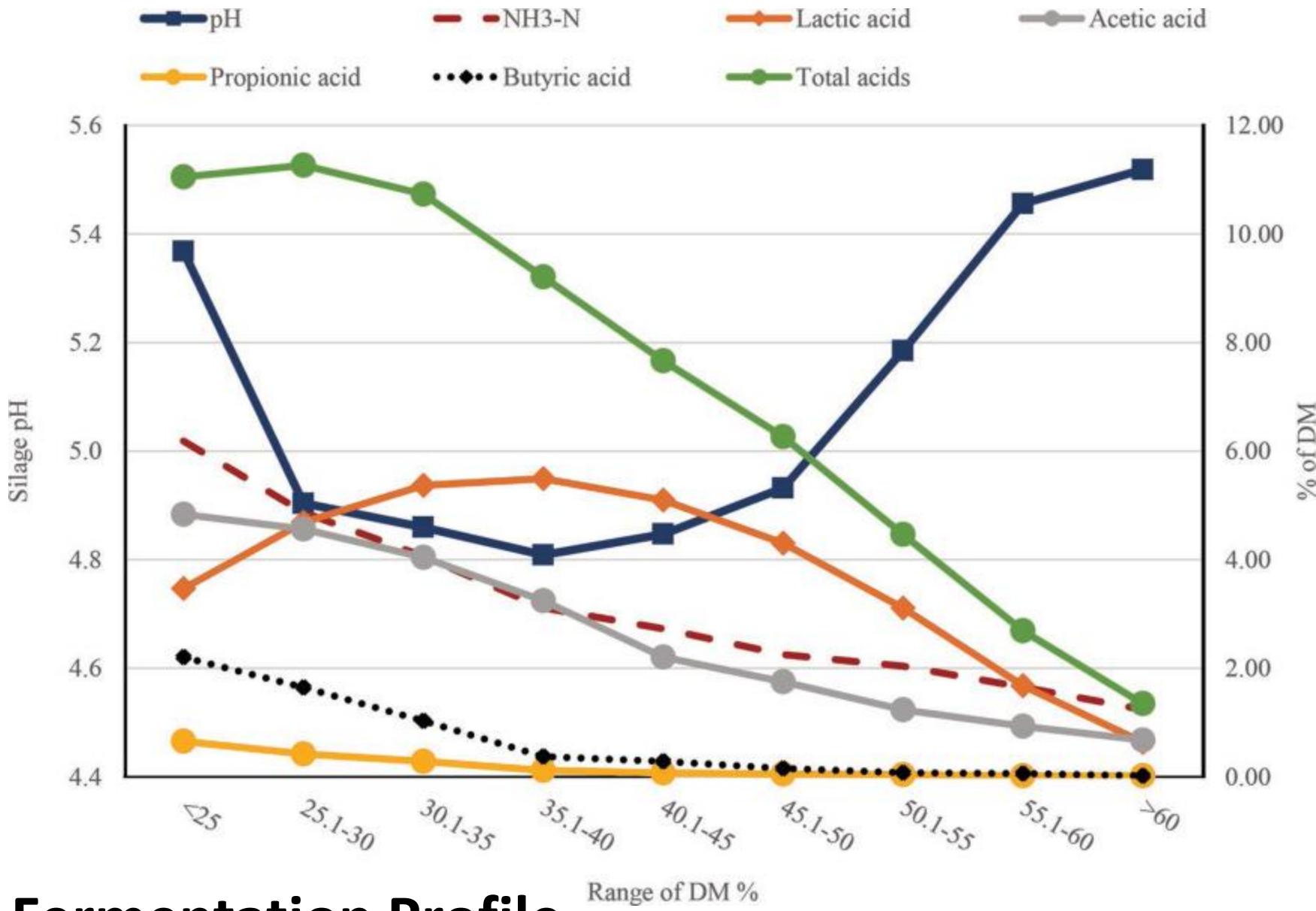
Aerobic Phase:



**SAVE THE SUGAR!** Sugar fuels fermentation

Hay or Silage

Dry quickly or Omit O<sub>2</sub> ASAP. Stop cellular respiration and aerobic bacteria



# Good silage fermentation

Measurement	Legume/grass	Corn silage	H.M. corn
Dry matter (%)	35 to 50	30 to 35	70 to 75
pH	4.3 to 4.7	3.8 to 4.2	4.0 to 4.5
Lactic acid (%)	4.0 to 6.0	5.0 to 10.0	1.0 to 2.0
Acetic acid (%)	0.5 to 2.5	1.0 to 3.0	<0.5
Propionic acid (%)	<0.25	<0.10	<0.10
Butyric acid (%)	<0.25	<0.10	<0.10
Ethanol (%DM)	<1.0	<3.0	<2.0
Ammonia (%CP)	<12.0	<8.0	<10.0
Lactic/Acetate	>2.5	>3.0	>3.0
Lactic (% total)	>70	>70	>70

Source: Pioneer-ISU Collaborative Field Study

## Summary of Fermentations by Dry Matter Range in Small Grain Silage

(CVAS, Crop years 2018 - 2020, Chemistry Data)

**NOT Just for SGS**

Dry Matter %, Range	Average Dry Matter %	CP %DM	ADICP %DM	Ammonia (CPE) %DM	Ammonia (CPE) % CP	Fermentation Failure Rate <sup>1</sup>	Lactic % Total VFA
10 to 20	18.8	13.1	1.23	6.10	46.7	<b>67%</b>	22.6
20 to 25	23.9	14.5	1.02	5.18	35.7	<b>64%</b>	41.4
25 to 30	28.7	13.3	0.97	3.01	22.6	<b>40%</b>	55.8
30 to 35	33.6	13.1	0.93	2.38	18.2	<b>27%</b>	62.3
35 to 40	38.8	11.7	0.92	1.71	14.5	<b>12%</b>	65.2
40 to 45	43.4	11.6	0.92	1.36	11.7	<b>2%</b>	66.7
45 to 50	47.9	10.6	0.90	1.17	11.0	<b>0%</b>	56.3

<sup>1</sup> Fermentation failure rate = % of samples where ammonia (CPE) as %CP is > 20%



Farm: JM  
 Desc: BALAGE RANK  
 Submitter: DARBY, HEATHER  
 Account: UNIV. OF VT - EXTENSION

## BALAGE RANK

## SAMPLE INFORMATION

Lab ID: 36031 295 Version: 1.0  
 Crop Year: 2024 Series:  
 Feed Type: MMG FORAGE Cutting#:  
 Package: BASIC NIR

## NIR ANALYSIS RESULTS

Moisture	69.2
Dry Matter	30.8
<b>PROTEINS</b>	% SP % CP % DM
Crude Protein	21.9
Adjusted Protein	21.9
Soluble Protein	66.3 14.5
<b>Ammonia (CPE)</b>	<b>36.5 24.2 5.29</b>
ADF Protein (ADICP)	5.9 1.30
NDF Protein (NDICP)	10.9 2.38
NDR Protein (NDRCP)	
Rumen Degr. Protein	83.2 18.2
Amino Acid Protein, Total	55.7 12.19

<b>FIBER</b>	% NDFom NDFom % DM
ADF	63.2 33.9
aNDF	49.9 53.6
NDR (NDF w/o sulfite)	
Crude Fiber	

Lignin	7.87 4.22
NDF Digestibility (12 hr)	59.6 29.7
NDF Digestibility (24 hr)	55.5 30.2
NDF Digestibility (30 hr)	75.5 37.7
NDF Digestibility (72 hr)	70.1 37.6

NDF Digestibility (120 hr)	88.3 44.1
NDF Digestibility (240 hr)	92.1 46.0
uNDF (12 hr)	40.4 20.2
uNDF (30 hr)	24.6 12.3
uNDF (120 hr)	11.7 5.9
uNDF (240 hr)	7.9 4.0

<b>CARBOHYDRATES</b>	% Starch % NFC % DM
Silage Acids	103.8 7.9
Ethanol Soluble CHO (ESC-Sugar)	31.1 2.4
Water Soluble CHO (WSC-Sugar)	1.2 3.4
Starch	

Soluble Starch	
Soluble Fiber	48.6 3.69
Starch Dig. (7 hr, 4 mm)	
Crude Fat	5.14
Fatty Acids, Total	2.53
C16:0	0.44
C18:0	0.04
C18:1	0.06
C18:2	0.37
C18:3	0.37
Unsaturated Fatty Acids (RUFAL)	1.21 1.64
Fatty Acids (%Fat)	49.2

Values in bold were analyzed by wet chemistry methods.

Copies to: COTANCH, KURT (GMAIL)  
 BROUILLETTE, SUSAN

Lab ID: 36031 295  
 Sampled: 09/19/2024  
 Arrived: 09/27/2024  
 Completed: 10/01/2024  
 Reported: 10/01/2024

## JM

Desc: BALAGE SWEET  
 Submitter: DARBY, HEATHER  
 Account: UNIV. OF VT - EXTENSION

Copies to: COTANCH, KURT (GMAIL)  
 BROUILLETTE, SUSAN

Lab ID: 36031 296  
 Sampled: 09/19/2024  
 Arrived: 09/27/2024  
 Completed: 10/01/2024  
 Reported: 10/01/2024

## MINERALS

Ash (%DM)	14.2
Calcium (%DM)	0.92
Phosphorus (%DM)	0.37
Magnesium (%DM)	0.34
Potassium (%DM)	2.49
Sulfur (%DM)	0.39
Sodium (%DM)	
Chloride (%DM)	
Iron (PPM)	
Manganese (PPM)	
Zinc (PPM)	
Copper (PPM)	
Molybdenum (PPM)	

## QUALITATIVE

pH	5.66
<b>Total VFA (%DM)</b>	<b>8.49</b>
Lactic Acid (%DM)	1.50
Lactic as % of Total VFA	18
Acetic Acid (%DM)	0.93
Butyric Acid (%DM)	5.50
1, 2 Propanediol (%DM)	
Nitrate Ion (%DM)	
Nitrate-Nitrogen, ppm	

## ENERGY &amp; INDEX CALCULATIONS

TDN (%DM)	58.7
Net Energy Lactation (Mcal/lb)	0.60
Net Energy Maintenance (Mcal/lb)	0.59
Net Energy Gain (Mcal/lb)	0.33
ME (Mcal/lb)	0.98
AA Protein as % of Total Protein	55.7
NDF Dig. Rate (Kd, %HR, Van Amburgh, Lignin*2.4)	5.77
NDF Dig. Rate (Kd, %HR, uNDF)	5.0
Starch Dig. Rate (Kd, %HR, Mertens)	
Relative Feed Value (RFV)	108
Relative Forage Quality (RFQ)	101
Milk per Ton (lbs/ton)	2805
Beef per Ton (lbs/ton)	
Dig. Organic Matter Index (lbs/ton)	453
NFC (Non-Fiber Carbohydrates) (%DM)	7.6
NSC (Non-Structural Carbohydrates), ESC (%DM)	
NSC (Non-Structural Carbohydrates), WSC (%DM)	
DCAD (meg/100gdm)	
Summative Index % (Mass Balance)	102.8

Additional sample information, submitted documents and lab pictures linked to QR code.



## BALAGE SWEET

## SAMPLE INFORMATION

Lab ID: 36031 296 Version: 1.0  
 Crop Year: 2024 Series:  
 Feed Type: MMG FORAGE Cutting#:  
 Package: BASIC NIR

## NIR ANALYSIS RESULTS

Moisture	54.0
Dry Matter	46.0
<b>PROTEINS</b>	% SP % CP % DM
Crude Protein	16.9
Adjusted Protein	16.9
Soluble Protein	65.4 11.1
<b>Ammonia (CPE)</b>	<b>16.4 10.7 1.81</b>
ADF Protein (ADICP)	7.3 1.23
NDF Protein (NDICP)	12.9 2.19
NDR Protein (NDRCP)	
Rumen Degr. Protein	82.7 14.0
Amino Acid Protein, Total	56.5 9.56

<b>FIBER</b>	% NDFom NDFom % DM
ADF	61.0 33.4
aNDF	50.7 54.7
NDR (NDF w/o sulfite)	
Crude Fiber	

Lignin	6.53 3.57
NDF Digestibility (12 hr)	66.8 33.9
NDF Digestibility (24 hr)	62.0 34.4
NDF Digestibility (30 hr)	80.1 40.6
NDF Digestibility (72 hr)	78.6 43.0
NDF Digestibility (120 hr)	84.5 42.8
NDF Digestibility (240 hr)	88.0 44.6
uNDF (12 hr)	33.2 16.8
uNDF (30 hr)	19.9 10.1
uNDF (120 hr)	15.5 7.9
uNDF (240 hr)	12.0 6.1

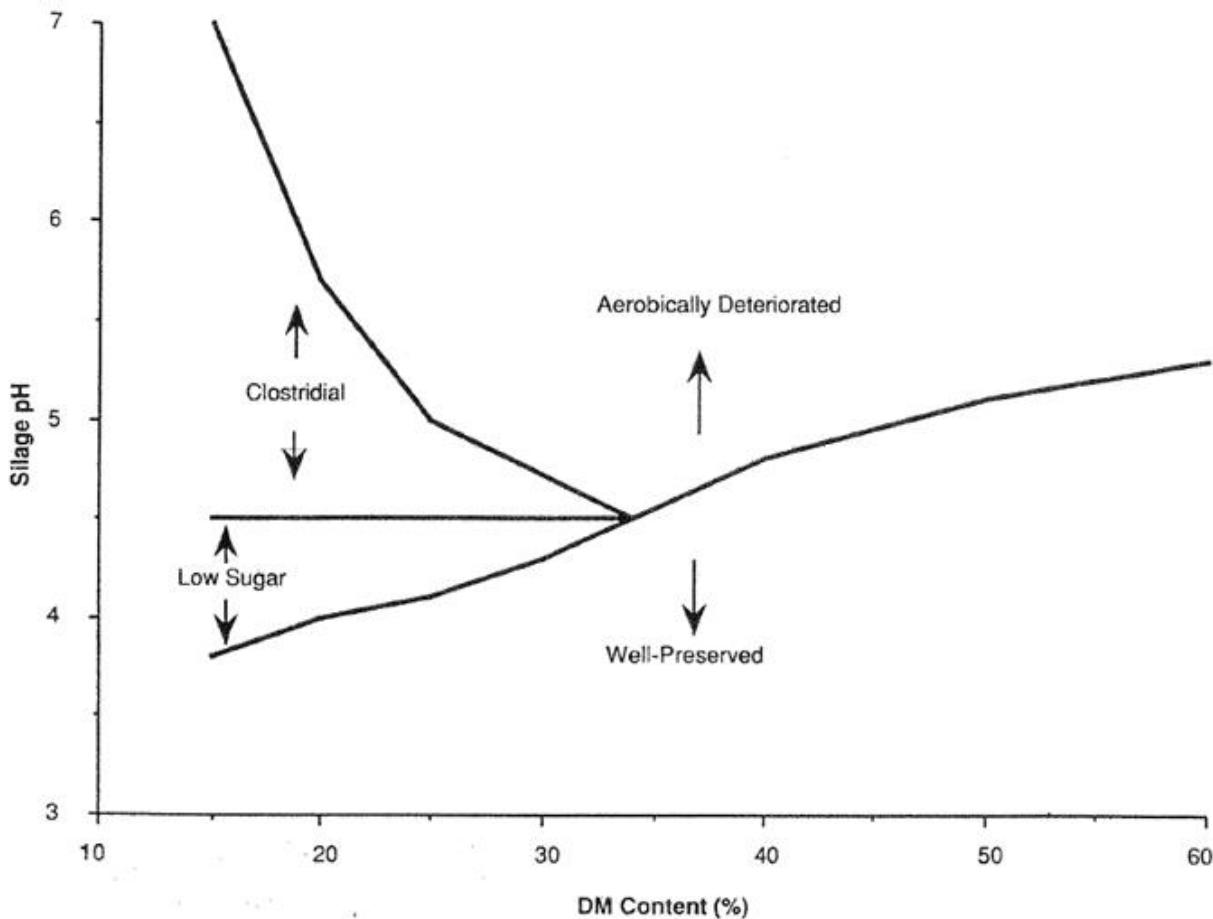
Soil Contamination Probability	Probable low to none
NIR Statistical Confidence	Excellent prediction potential
<b>ENERGY &amp; INDEX CALCULATIONS</b>	
TDN (%DM)	63.3
Net Energy Lactation (Mcal/lb)	0.65
Net Energy Maintenance (Mcal/lb)	0.68
Net Energy Gain (Mcal/lb)	0.41
ME (Mcal/lb)	1.07
AA Protein as % of Total Protein	56.5
NDF Dig. Rate (Kd, %HR, Van Amburgh, Lignin*2.4)	6.13
NDF Dig. Rate (Kd, %HR, uNDF)	6.3
Starch Dig. Rate (Kd, %HR, Mertens)	
Relative Feed Value (RFV)	107
Relative Forage Quality (RFQ)	162
Milk per Ton (lbs/ton)	3212
Beef per Ton (lbs/ton)	
Dig. Organic Matter Index (lbs/ton)	743
ROM (Residual Organic Matter)	19.43
NFC (Non-Fiber Carbohydrates) (%DM)	17.1
NSC (Non-Structural Carbohydrates), ESC (%DM)	7.7
NSC (Non-Structural Carbohydrates), WSC (%DM)	9.8
DCAD (meg/100gdm)	
Summative Index % (Mass Balance)	100.0

<b>CARBOHYDRATES</b>	% Starch % NFC % DM
Silage Acids	12.3 2.1
Ethanol Soluble CHO (ESC-Sugar)	40.9 7.0
Water Soluble CHO (WSC-Sugar)	9.1
Starch	4.2 0.7
Soluble Starch	
Soluble Fiber	52.1 8.92
Starch Dig. (7 hr, 4 mm)	
Crude Fat	4.29
Fatty Acids, Total	1.82
C16:0	0.33
C18:0	0.03
C18:1	0.06
C18:2	0.35
C18:3	0.84
Unsaturated Fatty Acids (RUFAL)	1.25
Fatty Acids (%Fat)	42.4

Values in bold were analyzed by wet chemistry methods.



# Silage pH and DM as indicator of quality of preservation



A photograph showing a large stack of white hay bales piled high in a field. The bales are cylindrical and made of compressed straw. They are stacked in several rows, with some bales leaning against each other. The background shows a clear blue sky.

# Inventory: What Quality and How Many...?

Is it milker quality...?

Good  
Bad  
Average



Farm:	LAPIERRE FARM	Copies to:	Lab ID:	35819 154
Desc:	GRASS WRAPPED ROUND		Sampled:	08/14/2024
Submitter:	LAPIERRE, ANDY		Arrived:	08/16/2024
Account:	LAPIERRE FARM LLC		Completed:	08/16/2024
Reported:	08/16/2024			
<b>GRASS WRAPPED ROUND</b>				
<b>SAMPLE INFORMATION</b>				
Lab ID:	35819 154	Version:	1.0	
Crop Year:	2024	Series:		
Feed Type:	GRASS FORAGE	Cutting#:	2	
Package:	BASIC NIR			
<b>NIR ANALYSIS RESULTS</b>				
Moisture			15.3	
Dry Matter			84.7	
<b>PROTEINS</b>				
Crude Protein			13.7	
Adjusted Protein			13.7	
Soluble Protein		31.3	4.3	
Ammonia (CPE)	29.0	9.1	1.24	
ADF Protein (ADICP)		9.1	1.25	
NDF Protein (NDICP)		34.1	4.66	
NDR Protein (NDRCP)				
Rumen Degr. Protein		65.7	9.0	
Amino Acid Protein, Total				
<b>FIBER</b>				
ADF			61.7	33.4
aNDF		51.3		54.1
NDR (NDF w/o sulfite)				
Crude Fiber				
Lignin			8.58	4.64
NDF Digestibility (12 hr)				
NDF Digestibility (24 hr)				
NDF Digestibility (30 hr)	63.6	32.6	60.4	32.7
NDF Digestibility (72 hr)	74.5	38.2	70.8	38.3
NDF Digestibility (120 hr)	77.6	39.8	73.8	39.9
uNDF (12 hr)				
uNDF (30 hr)	36.4	18.7	39.6	21.4
uNDF (120 hr)	25.5	13.1	29.2	15.8
uNDF (240 hr)	22.4	11.5	26.2	14.2
<b>CARBOHYDRATES</b>				
Silage Acids				
Ethanol Soluble CHO (ESC-Sugar)		47.6	12.7	
Water Soluble CHO (WSC-Sugar)			14.6	
Starch		7.1	1.9	
Soluble Starch				
Soluble Fiber		21.8	5.84	
Starch Dig. (7 hr, 4 mm)				
Crude Fat			3.14	
Fatty Acids, Total			1.55	
C16:0			0.30	
C18:0			0.03	
C18:1			0.06	
C18:2			0.31	
C18:3			0.74	
Unsaturated Fatty Acids (RUFAL)			1.11	
Fatty Acids (%Fat)			49.4	
<b>MINERALS</b>				
Ash (%DM)				6.95
Calcium (%DM)				0.53
Phosphorus (%DM)				0.27
Magnesium (%DM)				0.26
Potassium (%DM)				1.50
Sulfur (%DM)				0.26
Sodium (%DM)				
Chloride (%DM)				
Iron (PPM)				
Manganese (PPM)				
Zinc (PPM)				
Copper (PPM)				
Molybdenum (PPM)				
<b>QUALITATIVE</b>				
pH				
Total VFA (%DM)				
Lactic Acid (%DM)				
Lactic as % of Total VFA				
Acetic Acid (%DM)				
Butyric Acid (%DM)				
1, 2 Propanediol (%DM)				
Nitrate Ion (%DM)				
Nitrate-Nitrogen, ppm				
Soil Contamination Probability				Probable low to none
NIR Statistical Confidence				Excellent prediction potential
<b>ENERGY &amp; INDEX CALCULATIONS</b>				
TDN (%DM)				63.0
Net Energy Lactation (Mcal/lb)				0.65
Net Energy Maintenance (Mcal/lb)				0.67
Net Energy Gain (Mcal/lb)				0.40
ME (Mcal/lb)				1.07
AA Protein as % of Total Protein				
NDF Dig. Rate (Kd, %HR, Van Amburgh, Lignin*2.4)				4.38
NDF Dig. Rate (Kd, %HR, uNDF)				4.8
Starch Dig. Rate (Kd, %HR, Mertens)				
Relative Feed Value (RFV)				108
Relative Forage Quality (RFQ)				153
Milk per Ton (lbs/ton)				3229
Beef per Ton (lbs/ton)				
Dig. Organic Matter Index (lbs/ton)				1260
ROM (Residual Organic Matter)				23.80
NFC (Non-Fiber Carbohydrates)(%DM)				26.8
NSC (Non-Structural Carbohydrates) ESC (%DM)				14.6
NSC (Non-Structural Carbohydrates) WSC (%DM)				16.5
DCAD (meq/100gdm)				
Summative Index % (Mass Balance)				95.8
Additional sample information, submitted documents and lab pictures linked to QR code				

Values in bold were analyzed by wet chemistry methods.



**GRASS WRAPPED ROUND**

SAMPLE INFORMATION				MINERALS			
Lab ID:	35819 154	Version:	1.0	Ash (%DM)	6.95		
Crop Year:	2024	Series:		Calcium (%DM)	0.53		
Feed Type:	GRASS FORAGE	Cutting #:	2	Phosphorus (%DM)	0.27		
Package:	BASIC NIR			Magnesium (%DM)	0.26		
NIR ANALYSIS RESULTS				Potassium (%DM)	1.50		
Moisture			15.3	Sulfur (%DM)	0.26		
Dry Matter			84.7	Sodium (%DM)			
PROTEINS				Chloride (%DM)			
Crude Protein			13.7	Iron (PPM)			
Adjusted Protein			13.7	Manganese (PPM)			
Soluble Protein		31.3	4.3	Zinc (PPM)			
Ammonia (CPE)	29.0	9.1	1.24	Copper (PPM)			
ADF Protein (ADICP)		9.1	1.25	Molybdenum (PPM)			
NDF Protein (NDICP)		34.1	4.66	QUALITATIVE			
NDR Protein (NDRCP)				pH			
Rumen Degr. Protein		65.7	9.0	Total VFA (%DM)			
Amino Acid Protein, Total				Lactic Acid (%DM)			
FIBER				Lactic as % of Total VFA			
ADF			61.7	Acetic Acid (%DM)			
aNDF		51.3	33.4	Butyric Acid (%DM)			
NDF (NDF w/o sulfite)			54.1	1, 2 Propanediol (%DM)			
Crude Fiber				Nitrate Ion (%DM)			
Lignin		8.58	4.64	Nitrate-Nitrogen, ppm			
NDF Digestibility (12 hr)				Soil Contamination Probability			
NDF Digestibility (24 hr)				NIR Statistical Confidence	Probable low to none		
NDF Digestibility (30 hr)	63.6	32.6	60.4		Excellent prediction potential		
NDF Digestibility (72 hr)				ENERGY & INDEX CALCULATIONS			
NDF Digestibility (120 hr)	74.5	38.2	70.8	TDN (%DM)	63.0		
NDF Digestibility (240 hr)	77.6	39.8	73.8	Net Energy Lactation (Mcal/lb)	0.65		
uNDF (12 hr)				Net Energy Maintenance (Mcal/lb)	0.67		
uNDF (30 hr)	36.4	18.7	39.6	Net Energy Gain (Mcal/lb)	0.40		
uNDF (120 hr)	25.5	13.1	29.2	ME (Mcal/lb)	1.07		
uNDF (240 hr)	22.4	11.5	26.2	AA Protein as % of Total Protein			
CARBOHYDRATES				NDF Dig. Rate (Kd, %HR, Van Amburgh, Lignin*2.4)	4.38		
Silage Acids				NDF Dig. Rate (Kd, %HR, uNDF)	4.8		
Ethanol Soluble CHO (ESC-Sugar)		47.6	12.7	Starch Dig. Rate (Kd, %HR, Mertens)			
Water Soluble CHO (WSC-Sugar)			14.6	Relative Feed Value (RFV)	108		
Starch		7.1	1.9	Relative Forage Quality (RFQ)	153		
Soluble Starch				Milk per Ton (lbs/ton)	3229		
Soluble Fiber		21.8	5.84	Beef per Ton (lbs/ton)			
Starch Dig. (7 hr, 4 mm)				Dig. Organic Matter Index (lbs/ton)	1260		
Crude Fat		3.14		ROM (Residual Organic Matter)	23.80		
Fatty Acids, Total		1.55		NFC (Non-Fiber Carbohydrates)(%DM)	26.8		
C16:0		0.30		NSC (Non-Structural Carbohydrates) ESC (%DM)	14.6		
C18:0		0.03		NSC (Non-Structural Carbohydrates) WSC (%DM)	16.5		
C18:1		0.06		DCAD (meq/100gdm)			
C18:2		0.31		Summative Index % (Mass Balance)	95.8		
C18:3		0.74					
Unsaturated Fatty Acids (RUFAA)		1.11					

Additional sample information submitted



Dry Cow

Dry Cow



# Energy Value across Forage Quality

Table 2 Approximate NDF digestibility, and energy values across grass maturity: NDS/CNCPS 6.55								
Forage Quality		Typical Analyses						
Plant Stage	Example	Expected	Est	Est	NRC	Comments		
		NDF	NDFd30h	NEI3x	TDN	Mcal/lb DM		
Early Veg	Pasture	35-45	>70	0.80	78	1.26	Milking and Young	Low Rumen Fill, High Energy, Fast Passage
Late Veg/Boot	Balage Good	45-55	65	0.66	67	1.07	Close up Dry Cows, Growing and Preg Hfr	Medium Rumen Fill & Energy
Emerge/Seed Head	Balage Avg	55-65	55	0.60	62	0.97	Far Dry Cows and Preg Hfr	High Rumen Fill and will Limit DMI
Late Stem	"Heifer Hay"	65-75	45	0.45	53	0.77	Nobody	

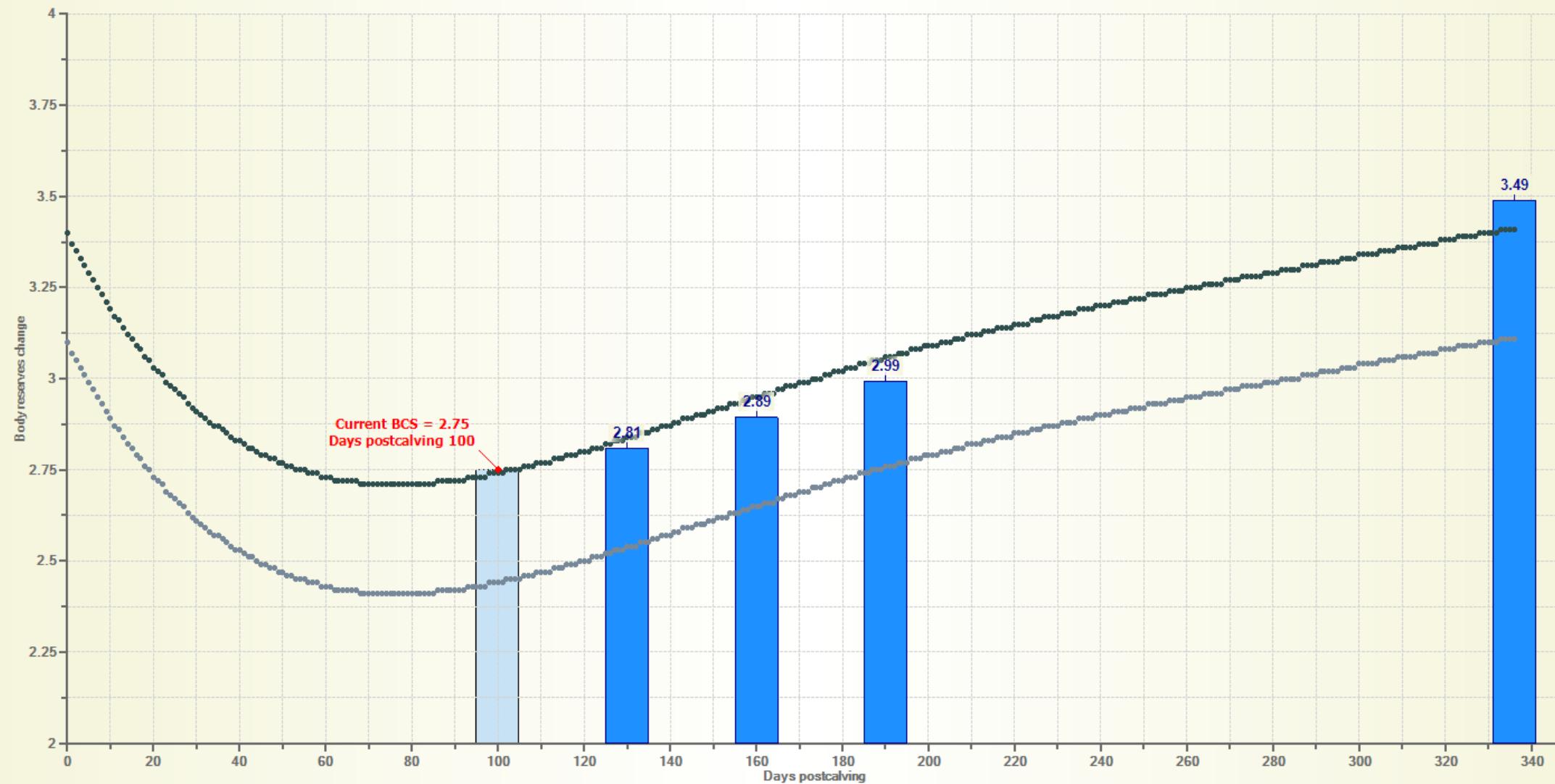
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Late Veg/Boot	Balage Good	45-55	65	0.66	67	1.07	Close up Dry Cows, Growing and Preg H	Medium Rumen Fill & Energy
Emerge/Seed Head	Balage Avg	55-65	55	0.60	62	0.97	Far Dry Cows and Preg Hfr	High Rumen Fill and will Limit DMI
Late Stem	"Heifer Hay"	65-75	45	0.45	53	0.77	Nobody	

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Late Stem	"Heifer Hay"	65-75	45	0.45	53	0.77	Nobody	

Inventory: Do You Have Enough High Quality Forage?



● Upperrange

● Lowerrange

■ BCS Projections according to NDS

# Economics of Forage Scenarios

Organic Dairy 2025						
Assumptions						
1	<b>1200 lb mature Jersey 5.3% Milkfat, 3.7% Protein</b>					
2	<b>Costs = \$/T As Fed</b>					
3	<b>DMI held constant at 43lb, except where NDF limits or allows different DMI</b>					
4	<b>ME Milk: Estimated milk production based on Metabolizable Energy</b>					
5	<b>Rumen Fill limits DMI: 1200 lb cow = 4-5lb of uNDF30</b>					
6	<b>Avg NDFd30 as % of NDF: needs to be &gt;64% (65%) to be able to estimate IOFC &gt;\$10</b>					

					Pasture	Pasture	Pasture	Winter	Winter	Ideal
		As Fed			Good Blg	Poor Blg	Poor Bale	Good	Poor	
	NDFd 30h	\$/ T	% DM		A	B	C	D	E	F
<b>Pasture</b>	<b>70</b>	<b>36</b>	<b>18</b>	<b>18</b>						
Balage 1	65	130	66							
Balage 2	60	130	66	10						
Balage 3	50	68	34							
Corn Meal		400	88	5						
Pro Mix 16%		650	89	10						
DMI lbs				43						
Forage %				65						
CP %				18						
ME Milk lbs				54						
Rumen Fill	lbs			4.25						
	% of DM			9.9						
Milk \$				19.96						
Cost \$/hd	\$/hd			7.60						
	\$/lb DM			0.18						
	\$/lb Milk			0.16						
<b>IOFC</b>				<b>12.36</b>						
Grain lbs				15						
Milk: Grain	Lb/lb			3.6						
Avg NDFd30	% of NDF			66						

				Pasture	Pasture	Pasture	Winter	Winter	Ideal
		As Fed		Good Blg	Poor Blg	Poor Bale	Good	Poor	
	NDFd 30h	\$/ T	% DM	A	B	C	D	E	F
<b>Pasture</b>	<b>70</b>	<b>36</b>	<b>18</b>	<b>18</b>	<b>18</b>				
Balage 1	65	130	66						
Balage 2	60	130	66	10					
Balage 3	50	68	34		10				
Corn Meal		400	88	5		5			
Pro Mix 16%		650	89	10	10				
DMI lbs				43	43				
Forage %				65	65				
CP %				18	17				
ME Milk lbs				54	50				
Rumen Fill	lbs			4.25	5.30				
	% of DM			9.9	12.3				
Milk \$				19.96					
Cost \$/hd	\$/hd			7.60					
	\$/lb DM			0.18					
	\$/lb Milk			0.16					
IOFC				12.36					
Grain lbs				15	15				
Milk: Grain	Lb/lb			3.6	3.3				
Avg NDFd30	% of NDF			66	63				

				Pasture	Pasture	Pasture	Winter	Winter	Ideal
		As Fed		Good Blg	Poor Blg	Poor Bale	Good	Poor	
	NDFd 30h	\$ / T	% DM	A	B	C	D	E	F
<b>Pasture</b>	<b>70</b>	<b>36</b>	<b>18</b>	<b>18</b>	<b>18</b>	<b>18</b>			
Balage 1	65	130	66						
Balage 2	60	130	66	10					
Balage 3	50	68	34		10	7			
Corn Meal		400	88	5	5	8			
Pro Mix 16%		650	89	10	10	10			
DMI lbs				43	43	43			
Forage %				65	65	58			
CP %				18	17	17			
ME Milk lbs				54	50	54			
Rumen Fill	lbs			4.25	5.30	4.30			
	% of DM			9.9	12.3	10.0			
Milk \$				19.96		20.21			
Cost \$/hd	\$/hd			7.60		7.99			
	\$/lb DM			0.18		0.19			
	\$/lb Milk			0.16		0.17			
<b>IOFC</b>				<b>12.36</b>		<b>12.22</b>			
Grain lbs				15	15	18			
Milk: Grain	Lb/lb			3.6	3.3	3.0			
Avg NDFd30	% of NDF			66	63	64			

				Pasture	Pasture	Pasture	Winter	Winter	Ideal
		As Fed		Good Blg	Poor Blg	Poor Bale	Good	Poor	
	NDFd 30h	\$ / T	% DM	A	B	C	D	E	F
<b>Pasture</b>	<b>70</b>	<b>36</b>	<b>18</b>	<b>18</b>	<b>18</b>	<b>18</b>			
Balage 1	65	130	66				11.5		
Balage 2	60	130	66	10			11.5		
Balage 3	50	68	34		10	7			
Corn Meal		400	88	5	5	8	5		
Pro Mix 16%		650	89	10	10	10	15		
DMI lbs				43	43	43	43		
Forage %				65	65	58	54		
CP %				18	17	17	15		
ME Milk lbs				54	50	54	51		
Rumen Fill	lbs			4.25	5.30	4.30	4.54		
	% of DM			9.9	12.3	10.0	10.6		
Milk \$				19.96		20.21	17.18		
Cost \$/hd	\$/hd			7.60		7.99	8.93		
	\$/lb DM			0.18		0.19	0.21		
	\$/lb Milk			0.16		0.17	0.19		
<b>IOFC</b>				<b>12.36</b>		<b>12.22</b>	<b>8.25</b>		
Grain lbs				15	15	18	20		
Milk: Grain	Lb/lb			3.6	3.3	3.0	2.6		
Avg NDFd30	% of NDF			66	63	64	63		

				Pasture	Pasture	Pasture	Winter	Winter	Ideal
		As Fed		Good Blg	Poor Blg	Poor Bale	Good	Poor	
	NDFd 30h	\$ / T	% DM	A	B	C	D	E	F
<b>Pasture</b>	<b>70</b>	<b>36</b>	<b>18</b>	<b>18</b>	<b>18</b>	<b>18</b>			
Balage 1	65	130	66				11.5		
Balage 2	60	130	66	10			11.5	8	
Balage 3	50	68	34		10	7		8	
Corn Meal		400	88	5	5	8	5	5	
Pro Mix 16%		650	89	10	10	10	15	15	
DMI lbs				43	43	43	43	43	
Forage %				65	65	58	54	37	
CP %				18	17	17	15	14	
ME Milk lbs				54	50	54	51	52	
Rumen Fill	lbs			4.25	5.30	4.30	4.54	4.36	
	% of DM			9.9	12.3	10.0	10.6	10.1	
Milk \$				19.96		20.21	17.18	17.95	
Cost \$/hd	\$/hd			7.60		7.99	8.93	10.11	
	\$/lb DM			0.18		0.19	0.21	0.24	
	\$/lb Milk			0.16		0.17	0.19	0.21	
<b>IOFC</b>				<b>12.36</b>		<b>12.22</b>	<b>8.25</b>	<b>7.84</b>	
Grain lbs				15	15	18	20	27	
Milk: Grain	Lb/lb			3.6	3.3	3.0	2.6	2.6	
Avg NDFd30	% of NDF			66	63	64	63	55	

				Pasture	Pasture	Pasture	Winter	Winter	Ideal
		As Fed		Good Blg	Poor Blg	Poor Bale	Good	Poor	
	NDFd 30h	\$/ T	% DM	A	B	C	D	E	F
<b>Pasture</b>	<b>70</b>	<b>36</b>	<b>18</b>	<b>18</b>	<b>18</b>	<b>18</b>			
Balage 1	65	130	66				11.5		
Balage 2	60	130	66	10			11.5	8	
Balage 3	50	68	34		10	7		8	
Corn Meal		400	88	5	5	8	5	5	
Pro Mix 16%		650	89	10	10	10	15	15	
DMI lbs				43	43	43	43	43	
Forage %				65	65	58	54	37	
CP %				18	17	17	15	14	
ME Milk lbs				54	50	54	51	52	
Rumen Fill	lbs			4.25	5.30	4.30	4.54	4.36	
	% of DM			9.9	12.3	10.0	10.6	10.1	
Milk \$				19.96		20.21	17.18	17.95	
Cost \$/hd	\$/hd			7.60		7.99	8.93	10.11	
	\$/lb DM			0.18		0.19	0.21	0.24	
	\$/lb Milk			0.16		0.17	0.19	0.21	
<b>IOFC</b>				<b>12.36</b>		<b>12.22</b>	<b>8.25</b>	<b>7.84</b>	
Grain lbs				15	15	18	20	27	
Milk: Grain	Lb/lb			3.6	3.3	3.0	2.6	2.6	
Avg NDFd30	% of NDF			66	63	64	63	55	

				Pasture	Pasture	Pasture	Winter	Winter	Ideal
		As Fed		Good Blg	Poor Blg	Poor Bale	Good	Poor	
	NDFd 30h	\$/ T	% DM	A	B	C	D	E	F
<b>Pasture</b>	<b>70</b>	<b>36</b>	<b>18</b>	<b>18</b>	<b>18</b>	<b>18</b>			<b>27</b>
Balage 1	65	130	66				11.5		
Balage 2	60	130	66	10			11.5	8	5
Balage 3	50	68	34		10	7		8	
Corn Meal		400	88	5	5	8	5	5	7
Pro Mix 16%		650	89	10	10	10	15	15	8
DMI lbs				43	43	43	43	43	47
Forage %				65	65	58	54	37	68
CP %				18	17	17	15	14	18
ME Milk lbs				54	50	54	51	52	63
Rumen Fill	lbs			4.25	5.30	4.30	4.54	4.36	4.18
	% of DM			9.9	12.3	10.0	10.6	10.1	8.9
Milk \$				19.96		20.21	17.18	17.95	23.73
Cost \$/hd	\$/hd			7.60		7.99	8.93	10.11	7.73
	\$/lb DM			0.18		0.19	0.21	0.24	0.16
	\$/lb Milk			0.16		0.17	0.19	0.21	0.16
<b>IOFC</b>				<b>12.36</b>		<b>12.22</b>	<b>8.25</b>	<b>7.84</b>	<b>16.00</b>
Grain lbs				15	15	18	20	27	15
Milk: Grain	Lb/lb			3.6	3.3	3.0	2.6	2.6	4.2
Avg NDFd30	% of NDF			66	63	64	63	55	68

# Thank you: Questions?

