Matching Hay Quality to Nutrient Requirements

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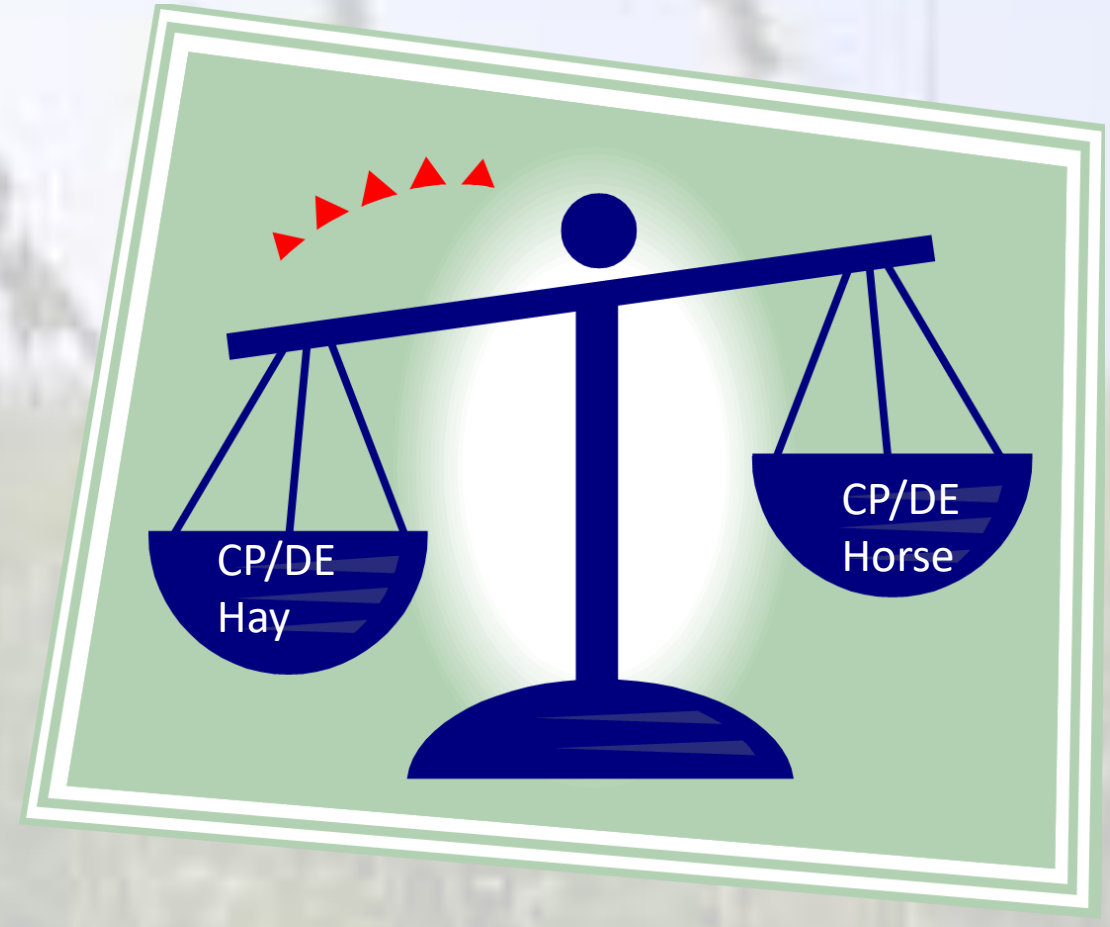
Balancing the Ration



What is Hay Quality?

- High quality hay has a high nutritive content, and high intake and acceptability.
- Low in cellulose and fiber and free of dust, musty odor, mold, and foreign material.
- High quality hay reduces supplementation.

What is Hay Quality?

What is Hay Quality?

- *Hay quality is the ability of a forage to support the desired levels of animal performance and is a function of both voluntary intake and nutritive value.*

What Influences Quality?

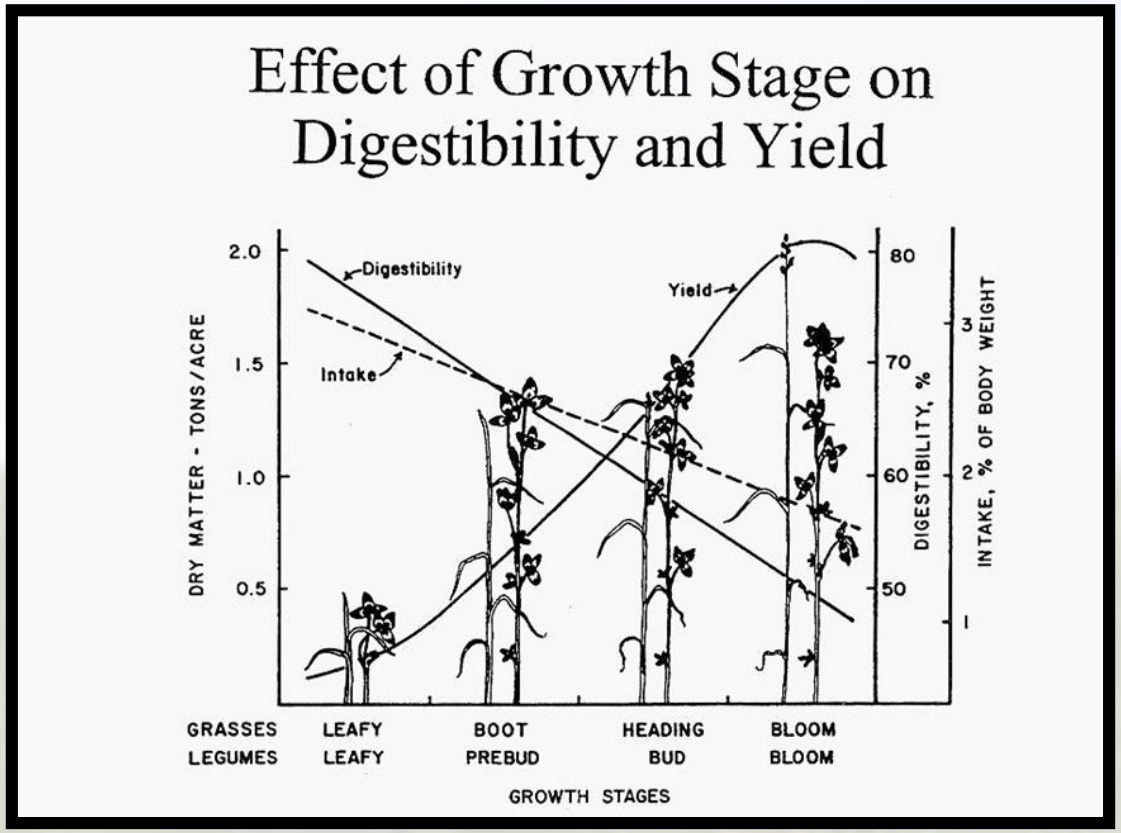
Factors that affect hay Quality (Production)

- Stage of maturity at harvest
- Species
- Curing
- Soil Fertility

Hay Quality Factors (Feeding Value)

- Stage of maturity at harvest
- Leafiness
- Color
- Foreign material
- Odor and condition
- Species?

Hay Maturity



- Has the single biggest influence on hay quality
- Hay making in the northern piedmont is often delayed due to weather

Leafiness

1. Ratio of leaves to stem
2. Most loss occurs during curing and handling
3. 60% of TDN, 70% of protein, 90% of vitamins are found in the leaf

Color

✓ Color is affected by bleaching from the sun, rain during curing, fermentation in the bale, maturity of the plant

- Can be deceiving
- Bright color indicates hay was rapidly cured with no rain damage
- ***HOWEVER,*** hay cut at an early maturity stage that is rain damaged and off color, may have a higher nutritive value than bright green hay that was cut late.

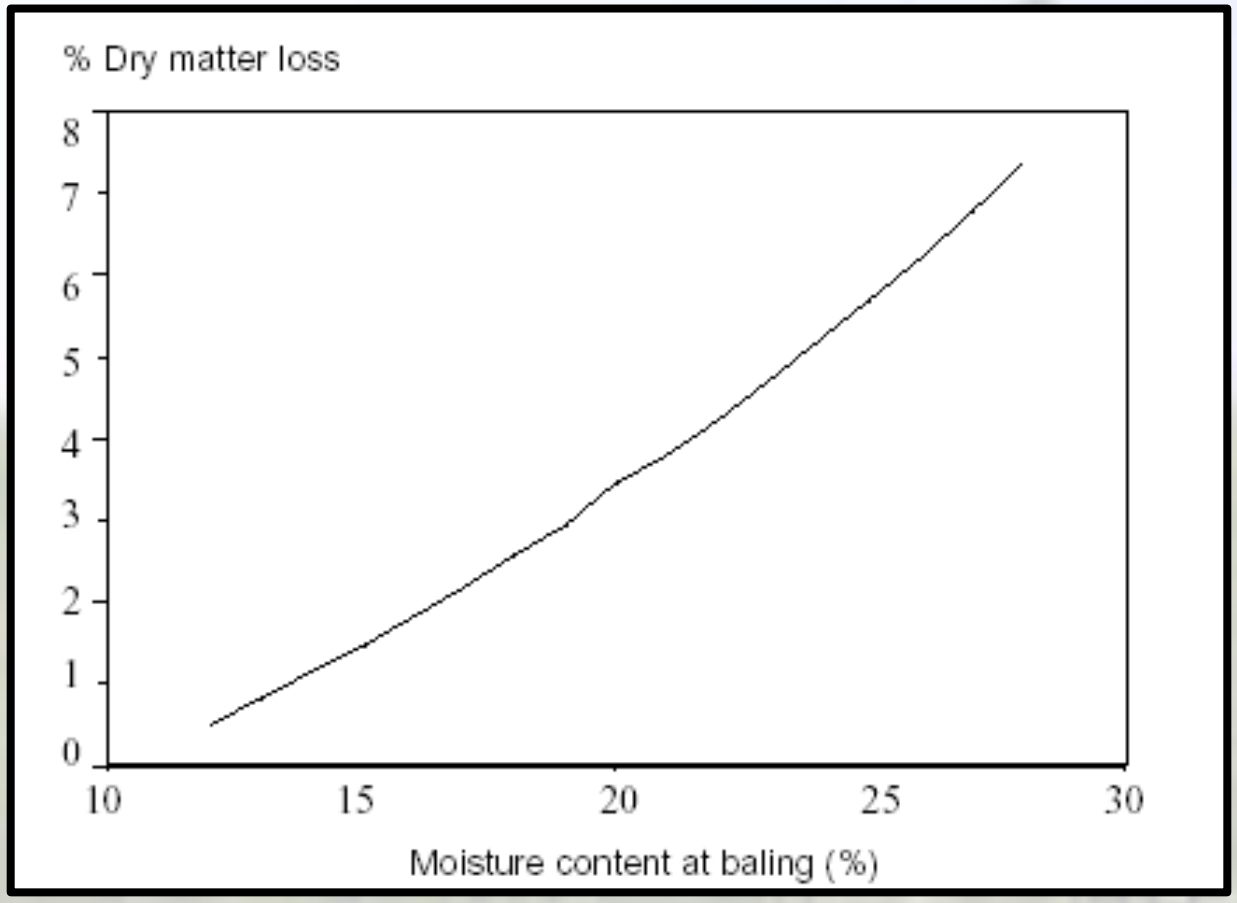
Evaluating hay based on color

Color	Problem	Quality
Green	None	Usually good
Light yellow on outside of bale	Sun bleaching	Decreases palatability and carotene, but not serious
Yellow throughout	Over-mature when cut	Decrease in palatability, horses may not eat it
Dark brown or black	Rain, heavy dew or fog	Decreased nutrient content, leaf shattering, brittle
Brown	Mold growth, baled too moist	Musty, moldy, loss of nutrients, clumps

Quality Effects

- All hay baled above 15% moisture will undergo some elevation in temperature in first 3 weeks
- Dry matter loss directly related to heat generation
- Heat generation related to moisture level
- Moisture = microbes

Dry matter loss in baled hay is a direct result of microbial activity



- Heating of moist hay causes a chemical reaction that fuses plant sugar and amino acids into an indigestible compound.
- Heat damaged protein may be nearly indigestible

- First cutting hay normally baled around 15% moisture
- Most baled hay will reach 12% moisture in about two months
- 4 to 5% dry matter loss
- Energy, protein, phosphorus, and calcium levels change little at this moisture

- Dry matter loss during storage is primarily non-structural carbohydrates.
- These are the most digestible portions of the plant
- Increases the concentration of structural carbohydrates = less digestible.
- Protein is lost at a much slower rate
- Percentage of protein can actually increase (due to loss of NSC and water)
- One nutrient that does change is vitamin A. Greatest loss is at harvest, so change after 6 months is relatively small.
- Long term storage of hay could increase the dryness.
- Plants become brittle increase dustiness

Table 2. Minimum nutrient concentration in total horse and pony diets (dry matter basis)[a]

Animal	Digestible energy (Mcal/kg)	Digestible energy (Mcal/lb)	Dietary proportions Concentrate (%)	Dietary proportions Hay (%)	Crude protein (%)	Lysine (%)	Ca (%)	P (%)	Mg (%)	K (%)	Vitamin A[4] (IU/kg)	Vitamin A[4] (IU/lb)
Mature horses												
Maintenance	2.00	0.90	0	100	8.0	0.28	0.24	0.17	0.09	0.30	3660	1660
Stallions, breeding season	2.40	1.10	30	70	9.6	0.34	0.29	0.21	0.11	0.36	4805	2184
Pregnant mares												
9 months	2.25	1.00	20	80	10.0	0.35	0.43	0.32	0.10	0.35	6195	2806
10 months	2.25	1.00	20	80	10.0	0.35	0.43	0.32	0.10	0.36	6095	2772
11 months	2.40	1.10	30	70	10.6	0.37	0.45	0.34	0.11	0.38	6095	2772
Lactating mares												
Foaling to 3 months	2.96[5]	1.37[5]	50	50	13.2	0.46	0.52	0.34	0.10	0.42	4592	2088
3 months to weaning	2.79[5]	1.31[5]	35	65	11.0	0.37	0.33	0.22	0.09	0.33	5043	2288
Working horses												
Light work[b]	2.70[5]	1.26[5]	35	65	9.8	0.35	0.30	0.22	0.11	0.37	4896	2220
Moderate work[c]	2.91[5]	1.32[5]	50	50	10.4	0.37	0.31	0.23	0.12	0.39	4404	2002
Intense work[d]	3.14[5]	1.43[5]	65	35	11.4	0.40	0.35	0.25	0.13	0.43	3549	1620
Growing horses												
Weanling, 4–5 months	2.90	1.40	70	30	14.5	0.60	0.60	0.38	0.08	0.30	2639	1202
Weanling, 6–11 months												
Moderate growth	2.90	1.40	70	30	14.5	0.61	0.56	0.31	0.08	0.30	3123	1420
Rapid growth	2.90	1.40	70	30	14.5	0.61	0.61	0.34	0.08	0.30	2722	1236
Short yearling, 12–17 months												
Moderate growth	2.80	1.30	60	40	12.6	0.53	0.43	0.24	0.08	0.30	3607	1637
Rapid growth	2.80	1.30	60	40	12.6	0.53	0.45	0.25	0.08	0.30	3206	1453
Long yearling, 18–23 months												
Not in training	2.50	1.15	45	55	11.3	0.48	0.34	0.19	0.08	0.30	3791	1720
In training	2.65	1.20	50	50	12.0	0.50	0.36	0.20	0.09	0.30	3006	1369
Two-year-old, 24–36 months												
Not in training	2.45	1.15	35	65	10.4	0.42	0.31	0.17	0.09	0.30	4409	2000
In training	2.65	1.20	50	50	11.3	0.45	0.34	0.20	0.10	0.32	3407	1553

Cumberland Valley Analytical Services

Laboratory services for agriculture ... from the field to the feed bunk.

Farm: [redacted] **Copies to:**
Desc: OG
Submitter: MIZE, TIMOTHY
Account: VIRGINIA COOPERATIVE EXT-WARRENTON

Lab ID: 18349 226
Sampled:
Arrived: 07/02/2015
Completed: 07/02/2015
Reported: 07/02/2015

OG

SAMPLE INFORMATION			
Lab ID:	18349 226	Version:	1.0
Crop Year:	2015	Series:	
Feed Type:	MMG FORAGE	Cutting#:	2
Package:	BASIC NIR		

NIR ANALYSIS RESULTS	
Moisture	10.6
Dry Matter	89.4

PROTEINS	% SP	% CP	% DM
Crude Protein			17.9
Adjusted Protein			17.9
Soluble Protein		25.0	4.5
Ammonia	11.4	2.8	0.51
ADF Protein (ADICP)		9.2	1.65
NDF Protein (NDICP)		36.8	6.59
NDR Protein (NDRCP)			
Rumen Degr. Protein		62.5	11.2
Rumen Deg. CP (Strep.G)			

FIBER	% NDF	% DM
ADF	59.3	34.3
aNDF		57.8
aNDFom		54.1
NDR (NDF w/o sulfite)		
peNDF		
Crude Fiber		
Lignin	7.96	4.60
NDF Digestibility (12 hr)		
NDF Digestibility (24 hr)		
NDF Digestibility (30 hr)		
NDF Digestibility (48 hr)		
NDF Digestibility (120 hr)		
NDF Digestibility (240 hr)		
uNDF (30 hr)		
uNDF (120 hr)		
uNDF (240 hr)		

CARBOHYDRATES	% Starch	% NFC	% DM
Silage Acids			
Ethanol Soluble CHO (Sugar)		46.0	8.4
Water Soluble CHO (Sugar)			
Starch		16.2	3.0
Soluble Fiber			
Starch Dig. (7 hr, 4 mm)			
Fatty Acids, Total			2.01
Fatty Acids (%Fat)			50.8
Crude Fat			3.96

MINERALS	
Ash (%DM)	8.60
Calcium (%DM)	0.65
Phosphorus (%DM)	0.36
Magnesium (%DM)	0.31
Potassium (%DM)	2.20
Sulfur (%DM)	0.31
Sodium (%DM)	
Chloride (%DM)	
Iron (PPM)	
Manganese (PPM)	
Zinc (PPM)	
Copper (PPM)	
Nitrate Ion (%DM)	
Selenium (PPM)	
Molybdenum (PPM)	

ENERGY & INDEX CALCULATIONS	
pH	
TDN (%DM)	63.9
Net Energy Lactation (mcal/lb)	0.65
Net Energy Maintenance (mcal/lb)	0.64
Net Energy Gain (mcal/lb)	0.37
NDF Dig. Rate (Kd, %HR, Van Amburgh, Lignin*2.4)	
NDF Dig. Rate (Kd, %HR, uNDF)	
Starch Dig. Rate (Kd, %HR, Mertens)	
Relative Feed Value (RFV)	100
Relative Feed Quality (RFQ)	
Milk per Ton (lbs/ton)	
Dig. Organic Matter Index (lbs/ton)	
Non Fiber Carbohydrates (%DM)	11.7
Non Structural Carbohydrates (%DM)	11.4
DCAD (meq/100gdm)	
CNCPS / CPM Lignin Factor	
Summative Index %	
Additional sample information, source and lab pictures	

OG 1.28

Values in bold were analyzed by wet chemistry methods.
Definitions and explanation of report terms

Cumberland Valley Analytical Services

Laboratory services for agriculture ... from the field to the feed bunk.

Farm: [redacted] **Copies to:**
Desc: OG ROUND BALES
Submitter: MIZE, TIMOTHY
Account: VIRGINIA COOPERATIVE EXT-WARRENTON

Lab ID: 18349 224
Sampled:
Arrived: 07/02/2015
Completed: 07/02/2015
Reported: 07/02/2015

OG ROUND BALES

SAMPLE INFORMATION			
Lab ID:	18349 224	Version:	1.0
Crop Year:	2015	Series:	
Feed Type:	GRASS FORAGE	Cutting#:	1
Package:	BASIC NIR		

NIR ANALYSIS RESULTS	
Moisture	16.2
Dry Matter	83.8

PROTEINS	% SP	% CP	% DM
Crude Protein			11.8
Adjusted Protein		98.3	11.6
Soluble Protein		33.8	4.0
Ammonia	19.4	6.5	0.77
ADF Protein (ADICP)		11.7	1.38
NDF Protein (NDICP)		34.7	4.08
NDR Protein (NDRCP)			
Rumen Degr. Protein		66.9	7.9
Rumen Deg. CP (Strep.G)			

FIBER	% NDF	% DM
ADF	61.3	40.7
aNDF		66.4
aNDFom		63.5
NDR (NDF w/o sulfite)		
peNDF		
Crude Fiber		
Lignin	7.17	4.76
NDF Digestibility (12 hr)		
NDF Digestibility (24 hr)		
NDF Digestibility (30 hr)		
NDF Digestibility (48 hr)		
NDF Digestibility (120 hr)		
NDF Digestibility (240 hr)		
uNDF (30 hr)		
uNDF (120 hr)		
uNDF (240 hr)		

CARBOHYDRATES	% Starch	% NFC	% DM
Silage Acids			
Ethanol Soluble CHO (Sugar)		46.7	7.1
Water Soluble CHO (Sugar)			
Starch		15.9	2.4
Soluble Fiber			
Starch Dig. (7 hr, 4 mm)			
Fatty Acids, Total			1.08
Fatty Acids (%Fat)			40.3
Crude Fat			2.68

MINERALS	
Ash (%DM)	8.04
Calcium (%DM)	0.39
Phosphorus (%DM)	0.31
Magnesium (%DM)	0.19
Potassium (%DM)	2.59
Sulfur (%DM)	0.19
Sodium (%DM)	
Chloride (%DM)	
Iron (PPM)	
Manganese (PPM)	
Zinc (PPM)	
Copper (PPM)	
Nitrate Ion (%DM)	
Selenium (PPM)	
Molybdenum (PPM)	

ENERGY & INDEX CALCULATIONS	
pH	
TDN (%DM)	59.0
Net Energy Lactation (mcal/lb)	0.59
Net Energy Maintenance (mcal/lb)	0.56
Net Energy Gain (mcal/lb)	0.31
NDF Dig. Rate (Kd, %HR, Van Amburgh, Lignin*2.4)	
NDF Dig. Rate (Kd, %HR, uNDF)	
Starch Dig. Rate (Kd, %HR, Mertens)	
Relative Feed Value (RFV)	80
Relative Feed Quality (RFQ)	
Milk per Ton (lbs/ton)	
Dig. Organic Matter Index (lbs/ton)	
Non Fiber Carbohydrates (%DM)	11.1
Non Structural Carbohydrates (%DM)	9.5
DCAD (meq/100gdm)	
CNCPS / CPM Lignin Factor	
Summative Index %	
Additional sample information, source and lab pictures	

OG 1.18

Values in bold were analyzed by wet chemistry methods.
Definitions and explanation of report terms

Cumberland Valley Analytical Services

Laboratory services for agriculture ... from the field to the feed bunk.

Type: GRASS FORAGE
Farm: [redacted]
Desc: MIXED HAY
MIZE TIMOTHY
VIRGINIA COOPERATIVE EXT-

Copies to:

Regression: OH

Lab ID: 23711 082
Sampled: 02/21/2018
Arrived: 02/26/2018
Completed: 03/02/2018
Reported: 03/02/2018

MIXED HAY

SAMPLE INFORMATION			
Lab ID:	23711 082	Series:	
Crop Year:	2017	Version:	1.0
Cutting#:			
Feed Type:	GRASS FORAGE		

CHEMISTRY ANALYSIS RESULTS	
Moisture	14.8
Dry Matter	85.2

PROTEINS	% SP	% CP	% DM
Crude Protein			10.9
Adjusted Protein			10.9
Soluble Protein		24.2	2.7
Ammonia (CPE)			
ADF Protein (ADICP)			
NDF Protein (NDICP)			
NDR Protein (NDRCP)			
Rumen Degr. Protein		62.1	6.8
Rumen Deg. CP (Strep.G)			

FIBER	% NDF	% DM
ADF	59.3	35.4
aNDF		59.6
aNDFom		
NDR (NDF w/o sulfite)		
peNDF		
Crude Fiber		
Lignin		
NDF Digestibility (12 hr)		
NDF Digestibility (24 hr)		
NDF Digestibility (30 hr)		
NDF Digestibility (48 hr)		
NDF Digestibility (240 hr)		
uNDF (30 hr)		
uNDF (240 hr)		

CARBOHYDRATES	% Starch	% NFC	% DM
Silage Acids			
Ethanol Soluble CHO (Sugar)			
Water soluble CHO (Sugar)			
Starch			
Soluble Fiber			
Starch Digestibility (7 hr)			
Fatty Acids, Total (%DM)			
Crude Fat			
Acid Hydrolysis Fat			

MINERALS	
Ash (%DM)	7.95
Calcium (%DM)	0.69
Phosphorus (%DM)	0.27
Magnesium (%DM)	0.45
Potassium (%DM)	3.07
Sulfur (%DM)	
Sodium (%DM)	0.03
Chloride (%DM)	
Iron (PPM)	326
Manganese (PPM)	102
Zinc (PPM)	26
Copper (PPM)	9
Molybdenum (PPM)	
Selenium (PPM)	
Nitrate Ion (%DM)	

FERMENTATION	
Total VFA	
Lactic Acid (%DM)	
Lactic as % of Total VFA	
Acetic Acid (%DM)	
Propionic Acid (%DM)	
Butyric Acid (%DM)	
Isobutyric Acid (%DM)	
1, 2 Propanediol (%DM)	

ENERGY & INDEX CALCULATIONS	
pH	
TDN (%DM)	61.5
Net Energy Lactation (Mcal/lb)	0.63
Schwab/Shaver NEL (Processed)	
Schwab/Shaver NEL (Unprocessed)	
Net Energy Maintenance (Mcal/lb)	0.62
Net Energy Gain (Mcal/lb)	0.35
NDF Dig. Rate (Kd, %HR, Van Amburgh, Lignin*2.4)	
NDF Dig. Rate (Kd, %HR, Van Amburgh, iNDF)	
Relative Feed Value (RFV)	96
Relative Forage Quality (RFQ)	
Milk per Ton (lbs/ton)	
Dig. Organic Matter Index (lbs/ton)	
Non Fiber Carbohydrates (%DM)	21.5
Non Structural Carbohydrates (%DM)	
DCAD (meq/100gdm)	

DE 1.23 mcal/lb

Definitions and explanation of report terms

Additional sample information, source and lab pictures

Cumberland Valley Analytical Services

Laboratory services for agriculture ... from the field to the feed bunk.

Type: GRASS FORAGE
Farm: [redacted]
Desc: D2 MIXED GRASS HAY
MIZE TIMOTHY
VIRGINIA COOPERATIVE EXT-

Copies to:

Regression: OH

Lab ID: 23315 073
Sampled:
Arrived: 12/18/2017
Completed: 12/20/2017
Reported: 12/20/2017

D2 MIXED GRASS HAY

SAMPLE INFORMATION			
Lab ID:	23315 073	Series:	
Crop Year:	2017	Version:	1.0
Cutting#:	1		
Feed Type:	GRASS FORAGE		

CHEMISTRY ANALYSIS RESULTS	
Moisture	17.3
Dry Matter	82.7

PROTEINS	% SP	% CP	% DM
Crude Protein			7.3
Adjusted Protein		82.8	6.0
Soluble Protein			
Ammonia (CPE)			
ADF Protein (ADICP)			
NDF Protein (NDICP)			
NDR Protein (NDRCP)			
Rumen Degr. Protein			
Rumen Deg. CP (Strep.G)			

FIBER	% NDF	% DM
ADF	65.6	50.6
aNDF		77.2
aNDFom		
NDR (NDF w/o sulfite)		
peNDF		
Crude Fiber		
Lignin		
NDF Digestibility (12 hr)		
NDF Digestibility (24 hr)		
NDF Digestibility (30 hr)		
NDF Digestibility (48 hr)		
NDF Digestibility (240 hr)		
uNDF (30 hr)		
uNDF (240 hr)		

CARBOHYDRATES	% Starch	% NFC	% DM
Silage Acids			
Ethanol Soluble CHO (Sugar)			
Water soluble CHO (Sugar)			
Starch			
Soluble Fiber			
Starch Digestibility (7 hr)			
Fatty Acids, Total (%DM)			
Crude Fat			
Acid Hydrolysis Fat			

MINERALS	
Ash (%DM)	
Calcium (%DM)	
Phosphorus (%DM)	
Magnesium (%DM)	
Potassium (%DM)	
Sulfur (%DM)	
Sodium (%DM)	
Chloride (%DM)	
Iron (PPM)	
Manganese (PPM)	
Zinc (PPM)	
Copper (PPM)	
Molybdenum (PPM)	
Selenium (PPM)	
Nitrate Ion (%DM)	

FERMENTATION	
Total VFA	
Lactic Acid (%DM)	
Lactic as % of Total VFA	
Acetic Acid (%DM)	
Propionic Acid (%DM)	
Butyric Acid (%DM)	
Isobutyric Acid (%DM)	
1, 2 Propanediol (%DM)	

ENERGY & INDEX CALCULATIONS	
pH	
TDN (%DM)	48.8
Net Energy Lactation (Mcal/lb)	0.49
Schwab/Shaver NEL (Processed)	
Schwab/Shaver NEL (Unprocessed)	
Net Energy Maintenance (Mcal/lb)	0.42
Net Energy Gain (Mcal/lb)	0.17
NDF Dig. Rate (Kd, %HR, Van Amburgh, Lignin*2.4)	
NDF Dig. Rate (Kd, %HR, Van Amburgh, INDF)	
Relative Feed Value (RFV)	60
Relative Forage Quality (RFQ)	
Milk per Ton (lbs/ton)	
Dig. Organic Matter Index (lbs/ton)	
Non Fiber Carbohydrates (%DM)	
Non Structural Carbohydrates (%DM)	
DCAD (meq/100gdm)	

.97 DE