NIRS for optimized forage efficiency in ruminant nutrition

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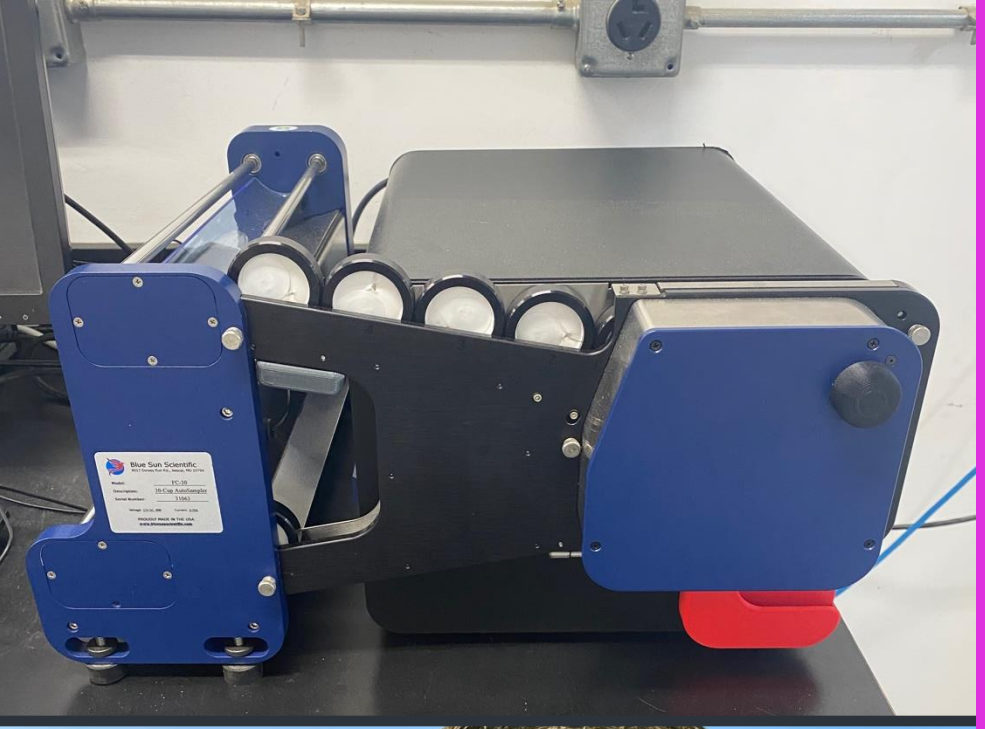
Ward Laboratories Inc. Feed Testing Product Manager

NIRS Consortium

Forage and Feed



Agenda

Understanding a Forage Report

Making Supplementation Decisions

Animal Performance and Health Implications

NIRS Consortium
Forage and Feed

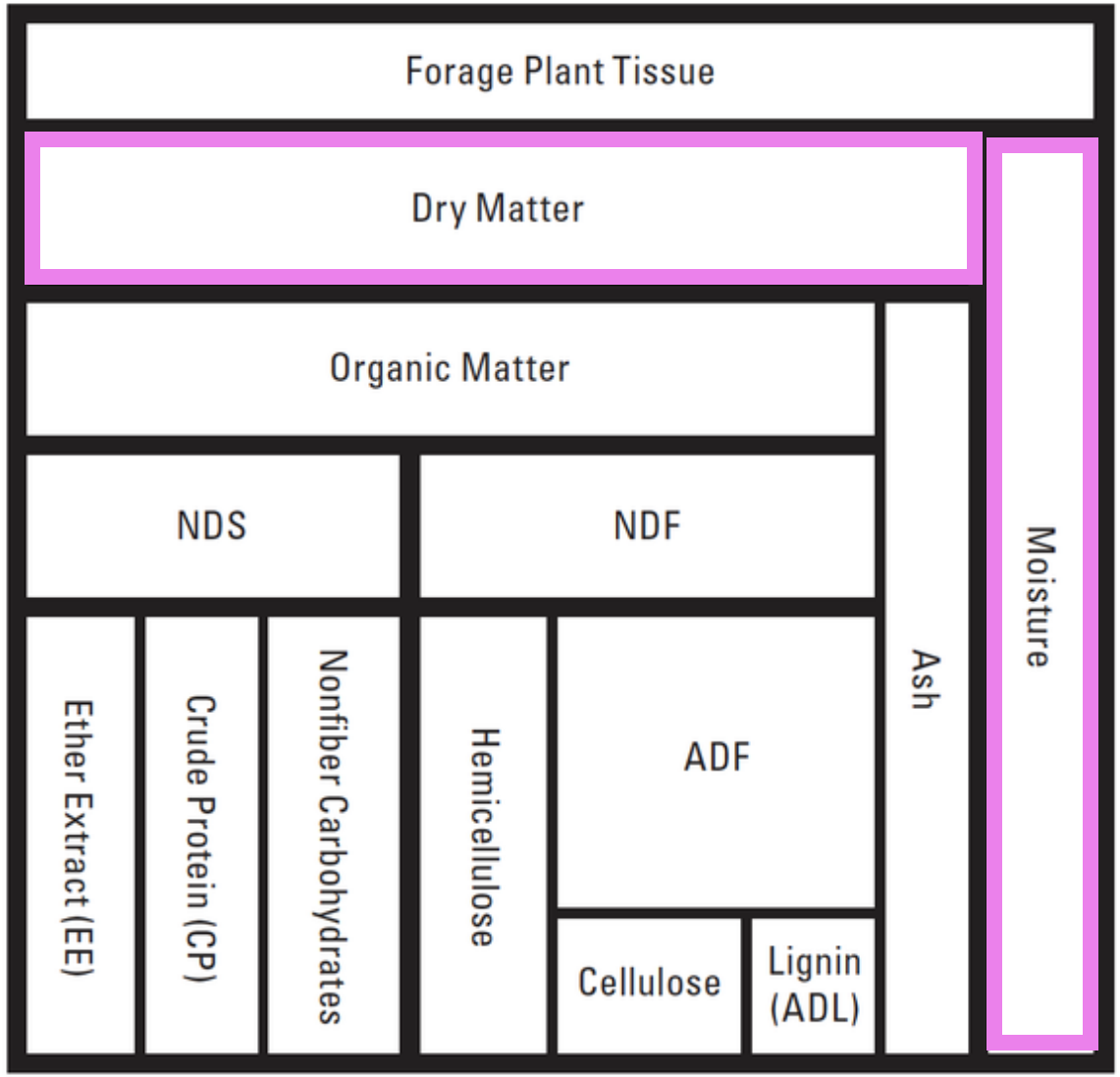
Fractions of Forages

Forages make up about 2/3 of feeds tested here

We mostly serve grazing livestock and feedlot cattle

Forage is the base of grazing livestock diets.

Supplements and rations formulated around the characteristics of the forage



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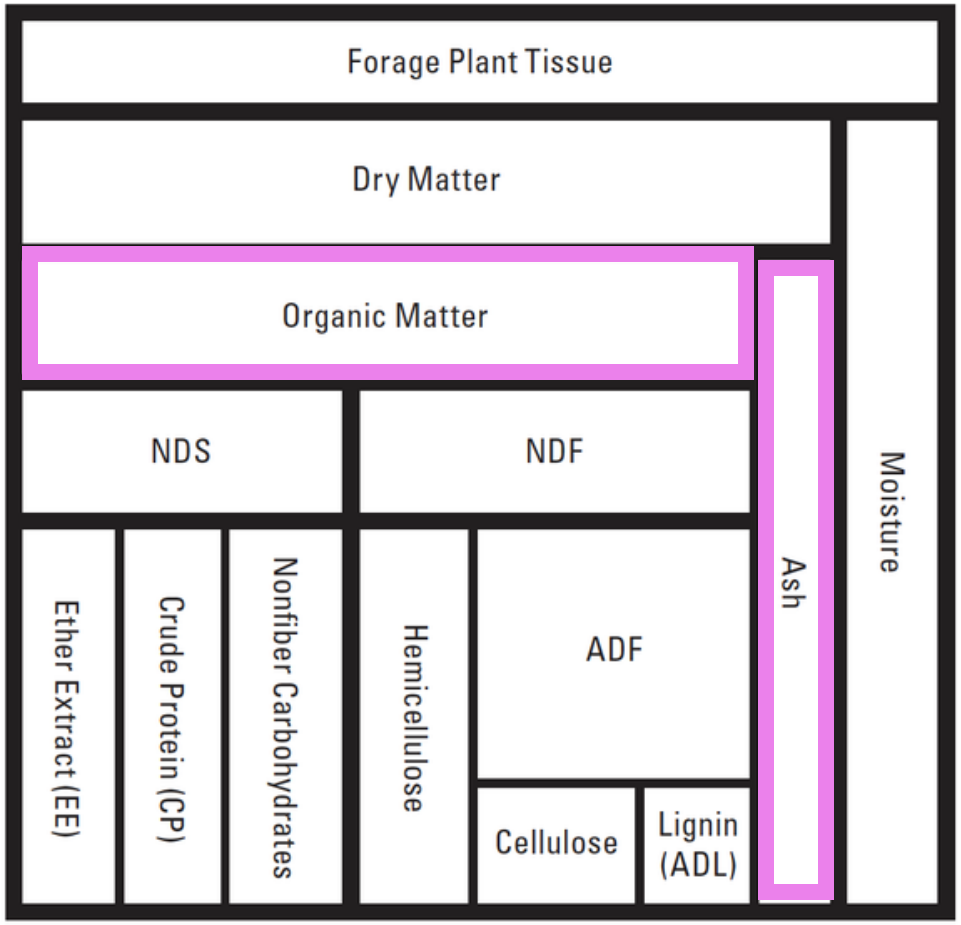
NIRS Consortium Forage and Feed

Dry Matter & Moisture

- **Dry Matter** – portion of feed which is not water.
  - Livestock diets are formulated on a dry basis and converted back to as received for mixing.
  - Feedstuffs should always be compared on a dry basis.
- **Moisture** – The amount of water in a feed.
  - Moisture for bales hay:
    - <14% Brittle
    - 14-18% Optimal
    - 18-22% Moderate Heating Risk : Mold, Mycotoxins, Yeast
    - >22% High Heat Risk : Spontaneous Combustion

Fractions of Feed



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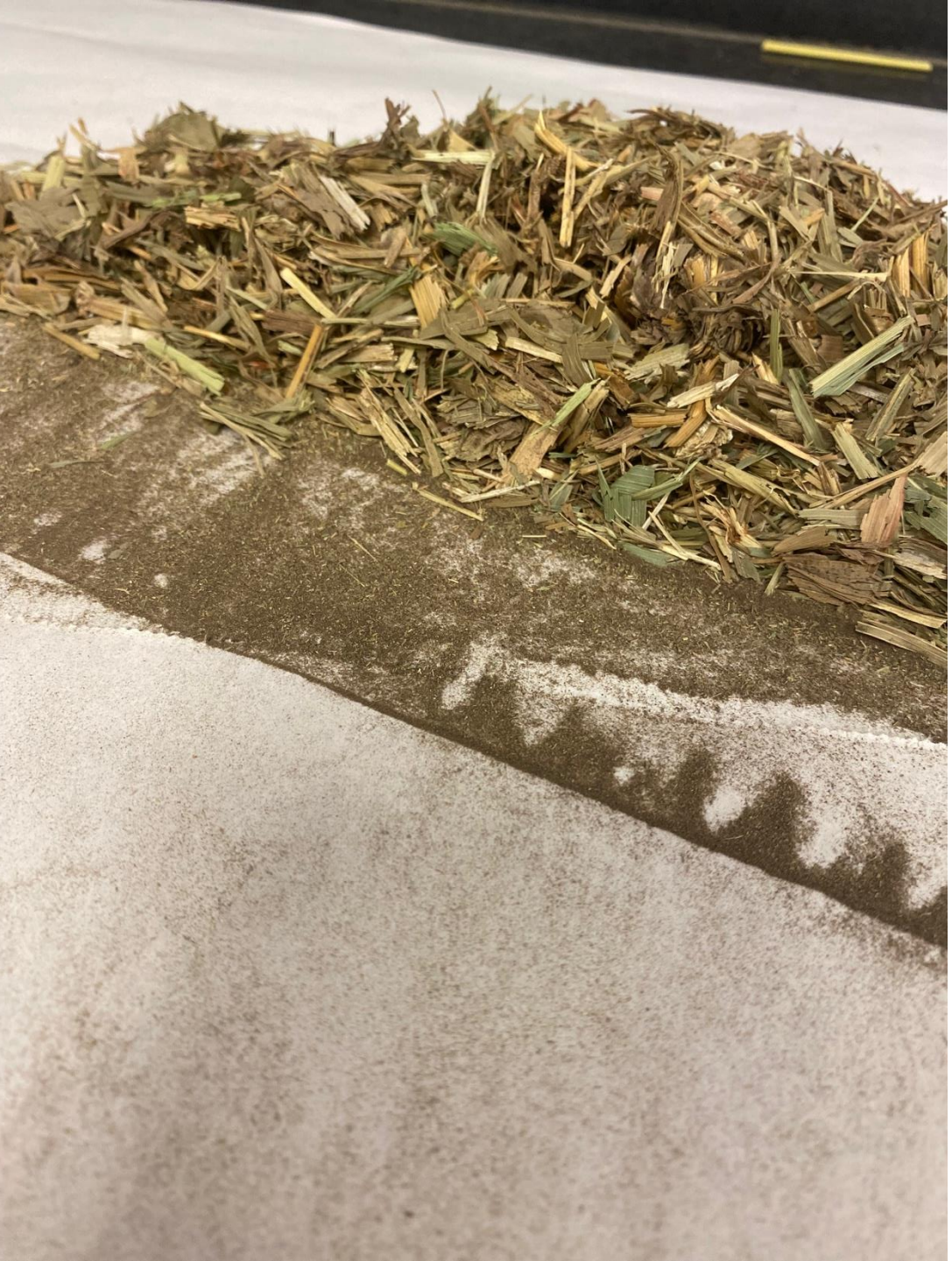

Ash

- **Ash** – total elemental content of the feed
  - Normal range in a plant is 4-6%
  - Hay or stored forages should be 8-10%
  - >10% indicates over raking
  - Extreme soil contamination can be as high as 18%
  - Soil contamination of the feed can reduce dry matter intake
  - Extreme cases can cause gut impactions

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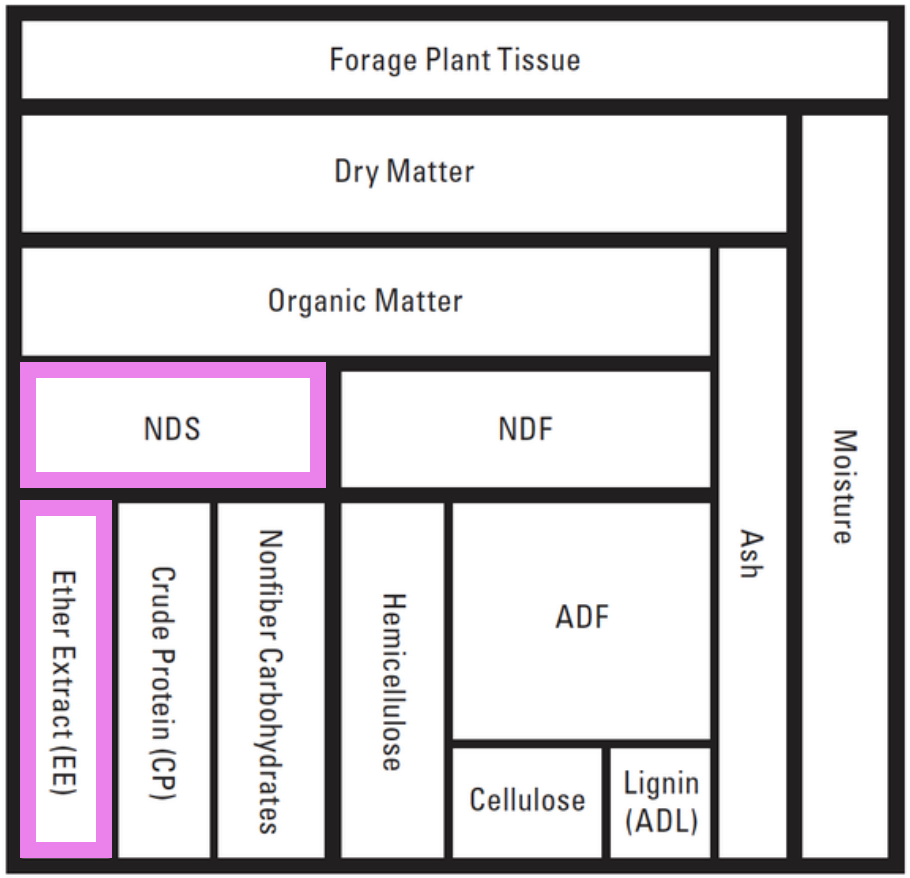
Fractions of Feed



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Fat (Ether Extract)

- Fat Provided 2.25 times more energy than carbohydrates
- Fat delivers fat soluble vitamins such as A, D, E and K
- Forages typically <2% fat

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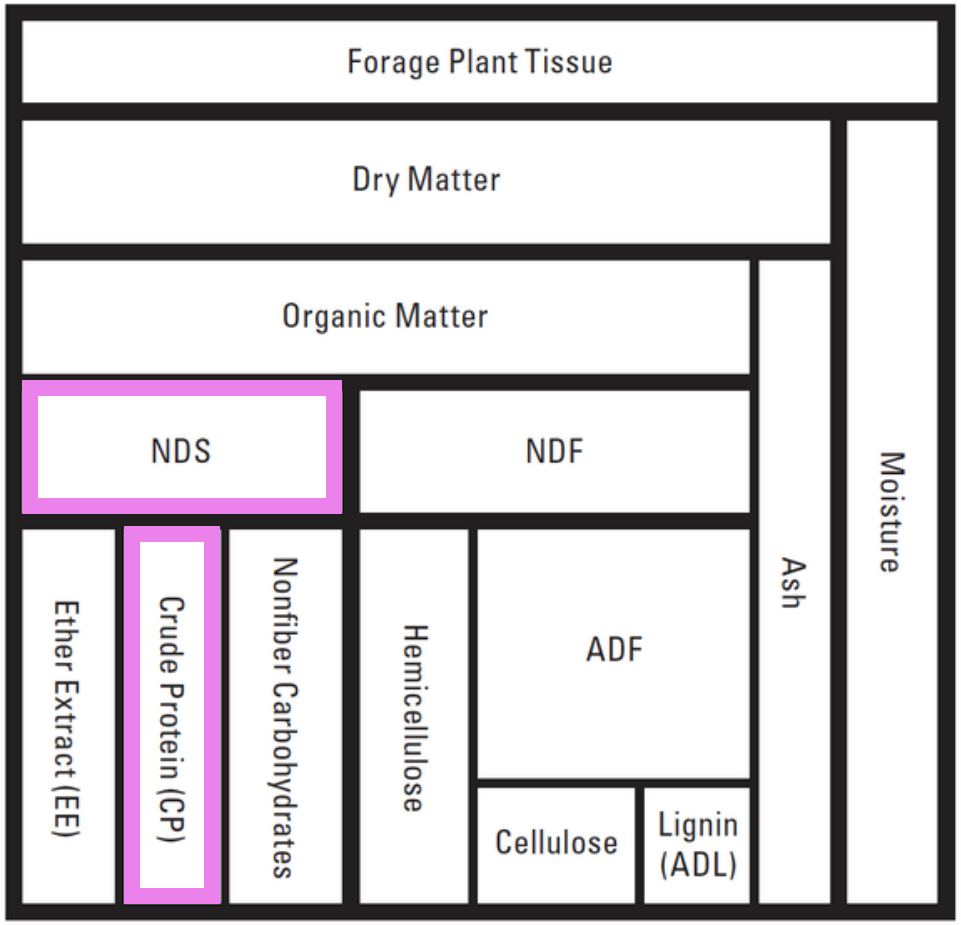
Fractions of Feed



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Crude Protein

- Percent Nitrogen multiplied by 6.25 for most feeds
- Estimation of protein content
- Most rations and diets balanced based on crude protein
- Adjusted protein used when heat damage occurs

Heat Damaged Protein (HDP) / Acid Detergent Insoluble Protein (ADICP)

- Protein associated with the indigestible fiber portion of the feed
- If a lot of heat damage is present, then an **Adjusted Crude Protein** (ACP) should be used to balance rations

- If HDP/CP is less than 0.14 then no adjustment is needed.
- If HDP/CP is between 0.14 and 0.20 then:

$$ACP = CP - \left[\left(\frac{\left(\left(\frac{HDP}{CP}\right) \times 100\right) - 7}{100}\right) \times CP\right]$$

- If HDP/CP is greater than 0.20, then:

$$ACP = CP - HDP$$

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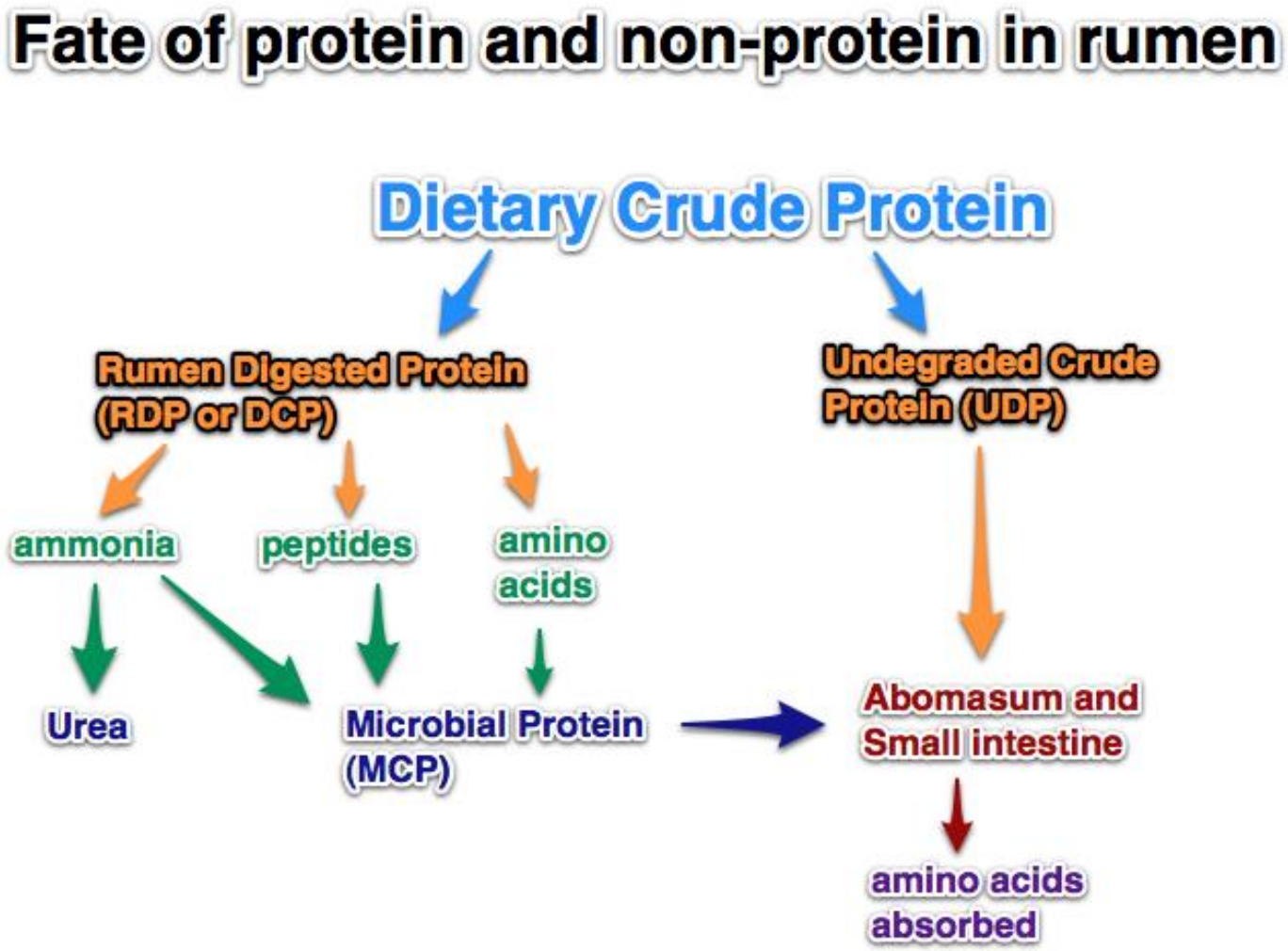
Neutral Detergent Insoluble Crude Protein (NDICP)

- Contains HDP + protein bound to the cell wall
- HDP is not available to the animal
- NDICP-HDP = Rumen Undegraded Protein (RUP)

Insoluble & Soluble Protein

- **Insoluble Protein** - protein which remains after extraction in a laboratory solution meant to simulate rumen degradation.
  - Estimation of RUP
- **Soluble Protein** – protein removed by a laboratory solution simulating rumen degradation.
  - Estimation of Rumen Degradable Protein (RDP)



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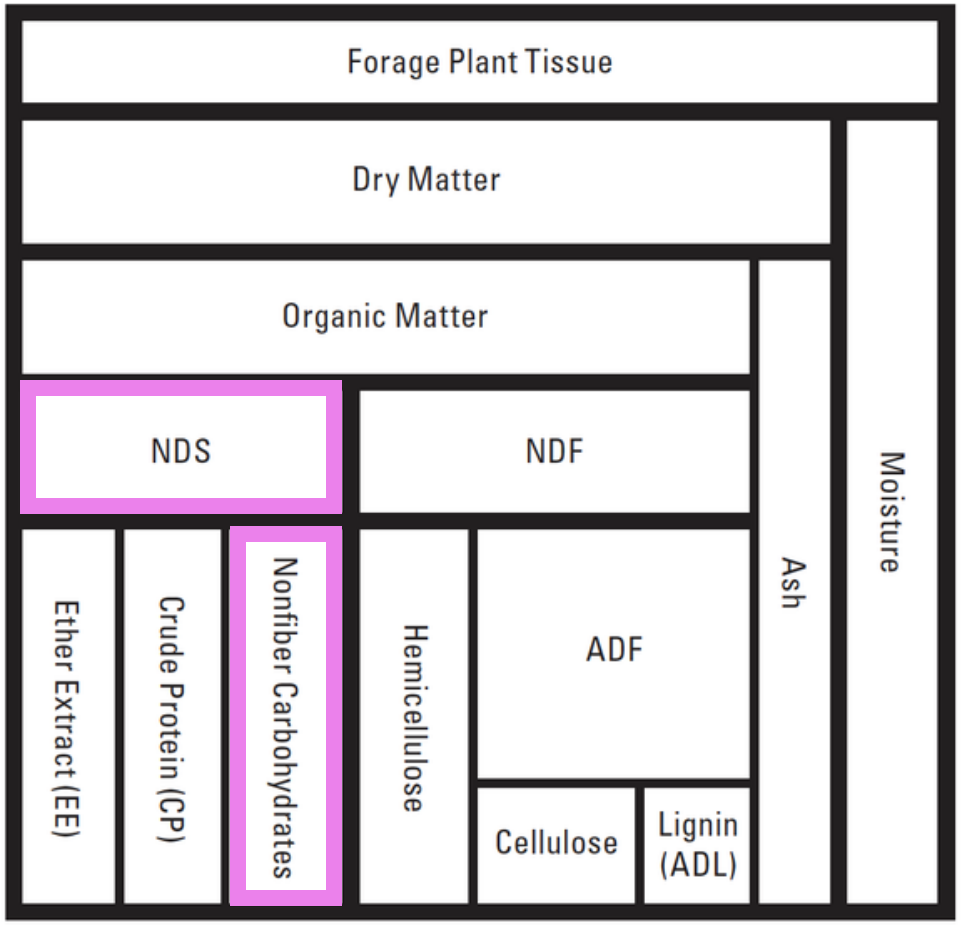
Fractions of Feed



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Non-Fiber Carbohydrates (NFC)

- NFC = 100-Protein-Fat-Ash-aNDF
- Includes:
  - **Starch** - a rapidly available carbohydrate.
    - A high starch diet indicates a risk for bloating.
  - **Ethanol Soluble Carbohydrates** (ESC)
  - **Water Soluble Carbohydrates** (WSC)

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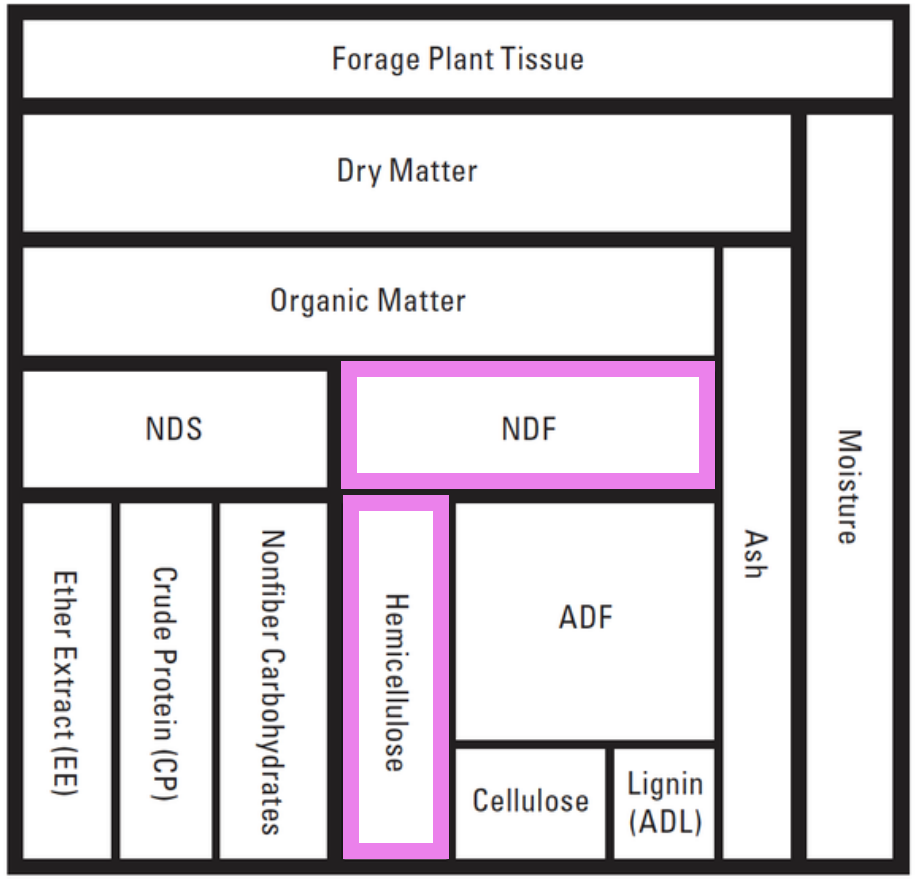
Fractions of Feed



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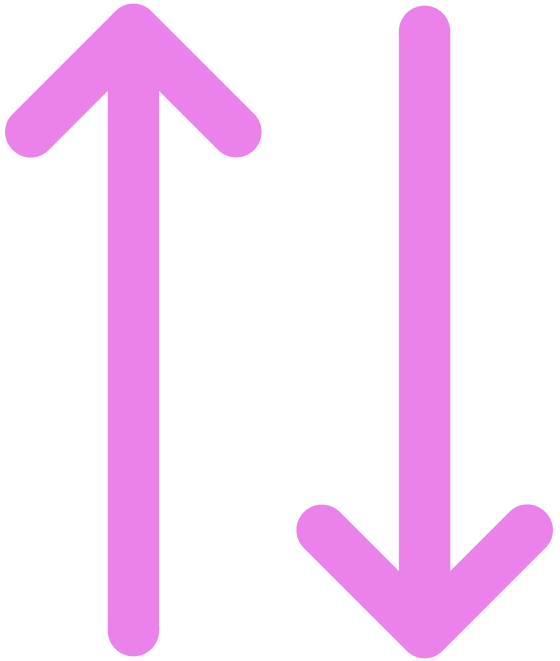
amylase-treated Neutral Detergent Fiber (aNDF)

aNDF - Represents the indigestible and slowly digestible portion of a feed.

- Cellulose
- Hemicellulose
- Lignin

Inversely related to feed intake

- aNDF increases, Feed Intake decreases
- aNDF > 60% start concern over intake
- More aNDF slows rumen passage rate and increases time spent on rumination and breaking down feed.
- Less time spend consuming feed = less feed consumed



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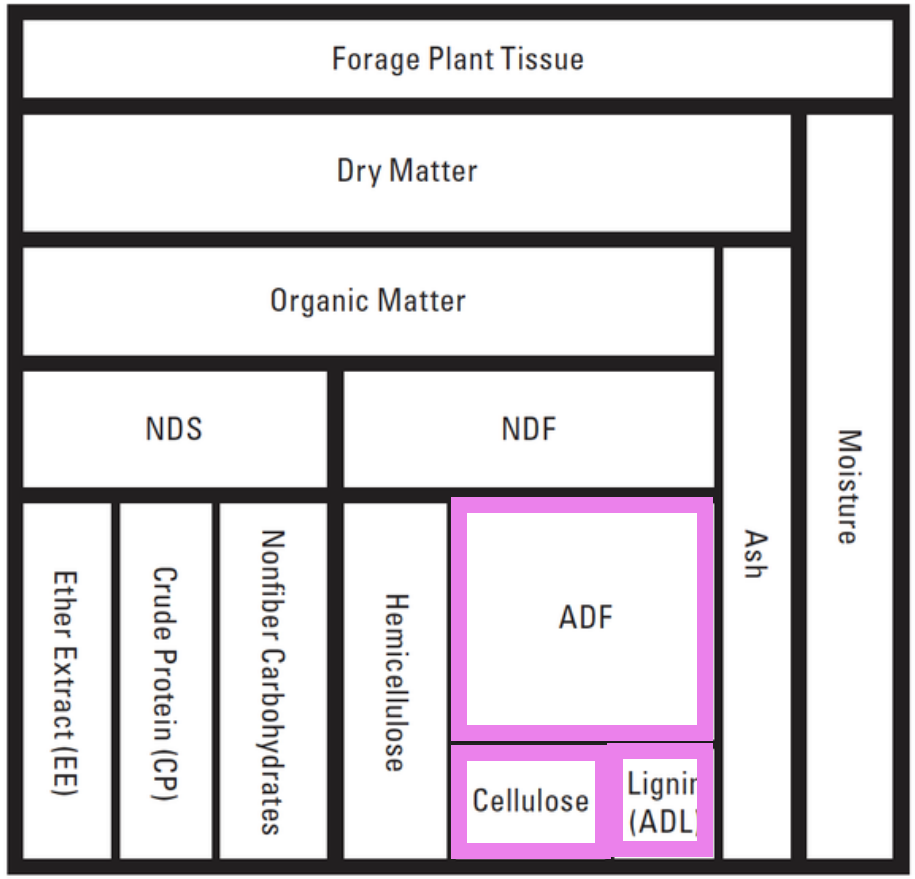
Fractions of Feed



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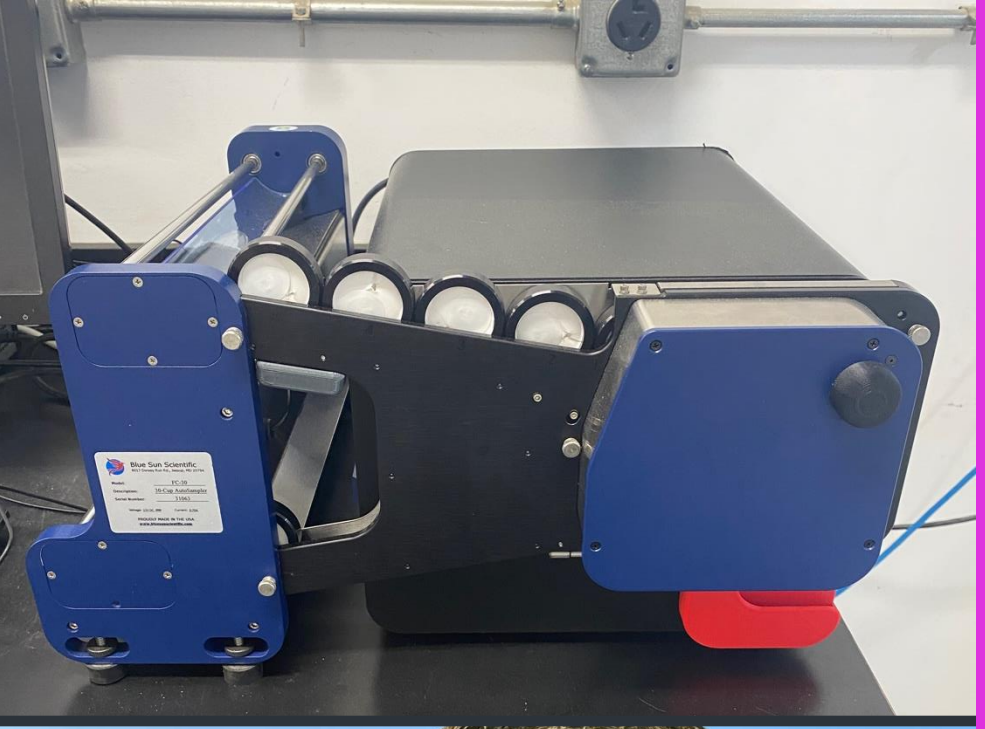
Acid Detergent Fiber (ADF)

- The least digestible portion of a feed.
- Parameter used to determine energy value in many feeds.
- Cellulose
- **Lignin** - indigestible compound prevalent in straw, woods, and hulls.
    - High lignin content in a feed indicates low feed digestibility.
- Pectin



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“
The results help us make informed decisions regarding our cattle feed supplementation needs. ...an important tool to utilize as we balance cattle nutrition and manage feed and supplementation costs.
-Ryan P.
Ashby, NE
Prime Producers
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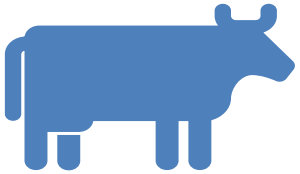
Under Supplementation of Protein & Energy

Negative Impact on Animal Health

No energy to “Fight off” infectious agents

Immune system compromised

Lack of protein to create antibodies and other immune factors



Decreased Production Performance

Reduced Reproduction Rates

Reduced Milk Production

Gestation “Open Cows”

Reduced Growth or Weight Gain

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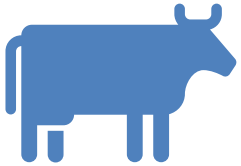
Over Supplementation of Protein & Energy

Added Feed Cost



Decreased Production Performance

Fat Cows

Reduced Reproduction Rates

Reduced Milk Production

Gestation “Open Cows”

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Cost v. Benefit of Protein Analysis for Diet Formulation

Cost associated with not knowing protein content of feed when balancing a beef cow diet[a]							
Situation	**Percent Crude Protein[b]**				**$/cow/ day[c]**	**Cost Difference (Lab Determined Ration - Estimate Ration) /100 cows/day**	**Protein in Ration - Protein Requirement (Percent)**
Crude Protein	**Prairie Hay**	**Oat Hay**	**DDGS**	**Ration[d]**			
Determined by Lab Analysis	**6.5**	**10.7**	**34**	**8.9**	**1.38**		**0.1**
Estimated from NRC values low range	**4.74**	**6.17**	**28.12**	**9 (12.4[e])**	**1.48**	**-$10**	**3.6**
Estimated from NRC values high range	**8.78**	**11.29**	**33.46[f]**	**9 (6.9[e])**	**1.21**	**$17**	**-1.9**

a Based on crude protein requirement of lactating 1200lb beef cow 8.8%
b Dry matter basis
c Estimated from average commodity pricing
d Rations balanced using U of M Beef Cow Ration Balancer https://extension.umn.edu/beef/beef-nutrition
e Actual crude protein in ration
f Supplementation unnecessary in this situation

Ward Labs has been instrumental in our decision-making process regarding how, when and which group of hay bales to feed to our cattle for optimum performance.

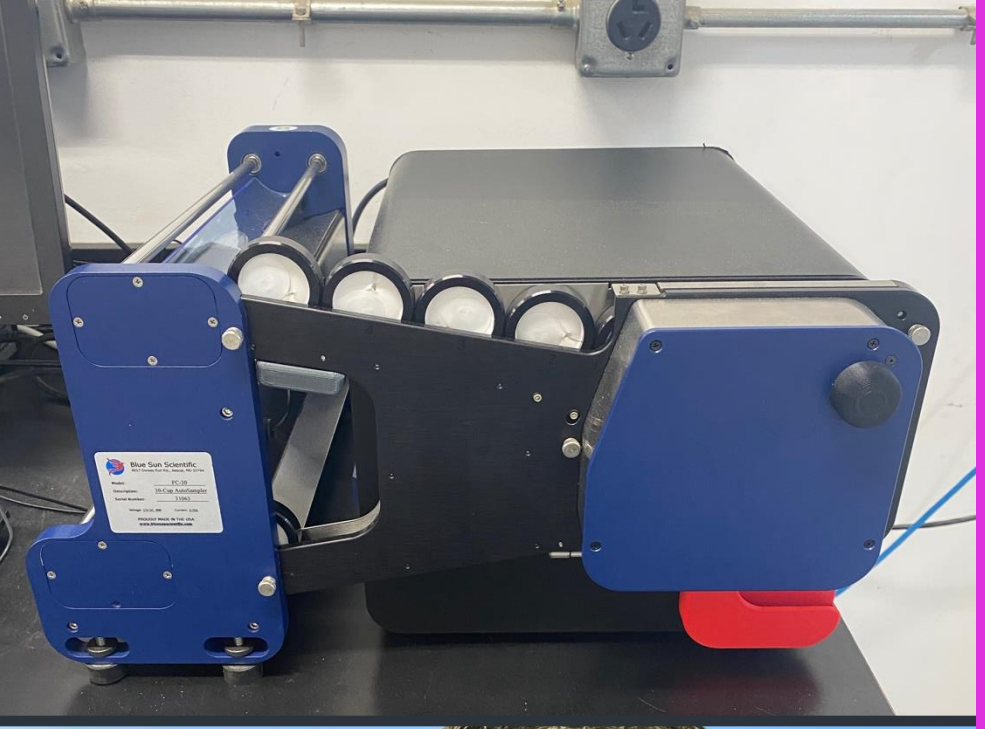
-Matt C.

Cherry County, NE

Prime Producers
Choose Ward

1300lb Lactating Beef Cow Requires 11% Crude Protein & 65% TDN

Description	Moisture	Protein	TDN	Cost	Energy DDGS (lb/hd/d)	Protein DDGS (lb/hd/d)	Final Req. DDGS (lb/hd/d)	Cost ($/hd/d)	DDGS % of Diet	
Sorghum Sudan	12.76	6.72	53.98	$ 90.00	9.79	6.01	9.79	$ 1.97	31%	*Rumen Health may
Millet	12.27	8.08	51.80	$ 125.00	11.06	4.36	11.06	$ 1.61	35%	be a concern at
Alfalfa	8.22	18.98	57.08	$ 135.00	7.70	9.64	9.64	$ 1.24	30%	>20% of Ration
Alfalfa	11.02	14.02	60.22	$ 135.00	5.14	4.49	5.14	$ 2.00	16%	
Hay	9.38	12.93	61.45	$ 125.00	3.98	3.02	3.98	$ 1.64	12%	
GRASS/ALF	8.52	12.59	57.98	$ 125.00	7.02	2.53	7.02	$ 1.33	22%	
GRASS/ALF	8.68	9.63	58.14	$ 125.00	6.89	2.21	6.89	$ 1.36	22%	
DDGS	11.00	29.50	90.00	$ 142.00						



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Subclinical acidosis / subacute ruminal acidosis (SARA)

- Symptoms do not affect the whole herd
- Individual animals will show symptoms including:
  - reduced feed intake
  - lowered weight gain
  - potentially lameness
  - some undigested grain in the manure
- With enough individuals experiencing SARA overall herd performance can be reduced.
- Reduction in production performance results in costly economic losses.

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Subclinical acidosis / subacute ruminal acidosis (SARA)

Prevention:

1. Reduce ration variability
   - Maintain consistent levels of fiber, energy and protein
   - Adjust rations to accommodate forage variability

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A case of acidosis

Symptoms:

- **Unthrifty**
- **“Bloaty”**
- **Reduced appetite**
- **Recently switched silage piles**

Pathogen in the Corn Silage?

- **Listeria**

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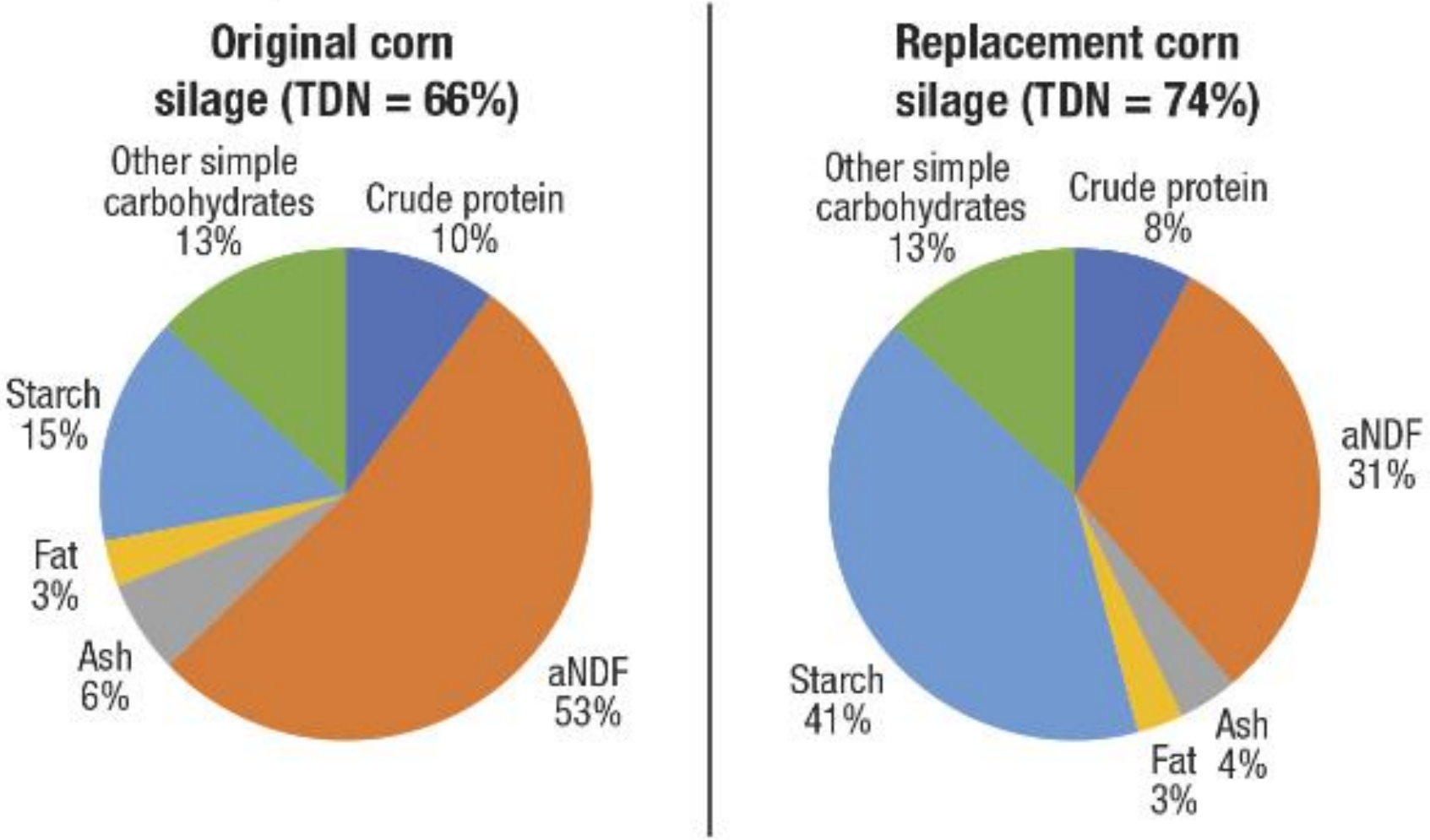
A case of acidosis

FIGURE 2 Nutrient and energy distribution of corn silage



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Subclinical acidosis / subacute ruminal acidosis (SARA)

Prevention through feed management:

1. Reduce ration variability
   - Maintain consistent levels of fiber, energy and protein
   - Adjust rations to accommodate ingredient variability
2. Ensure adequate mixing of the ration
3. Keep feeding frequency consistent

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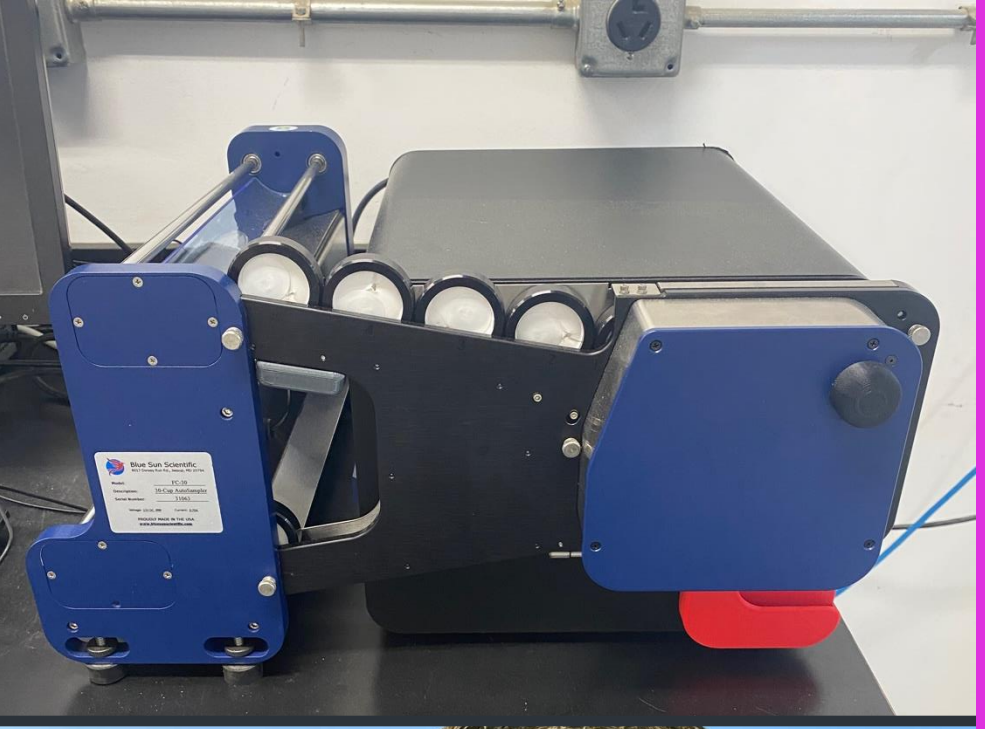

Conclusions

NIRS analysis of forage can provide A LOT of information about the forage sample nutritional parameters and characteristics that affect animal performance.

NIRS analysis of forage can aid in making economically efficient supplementation and feeding strategies.

Understanding variation in forages through NIRS analysis and managing feeding accordingly can ensure healthy animals and optimal production performance.

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Thank you!
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