

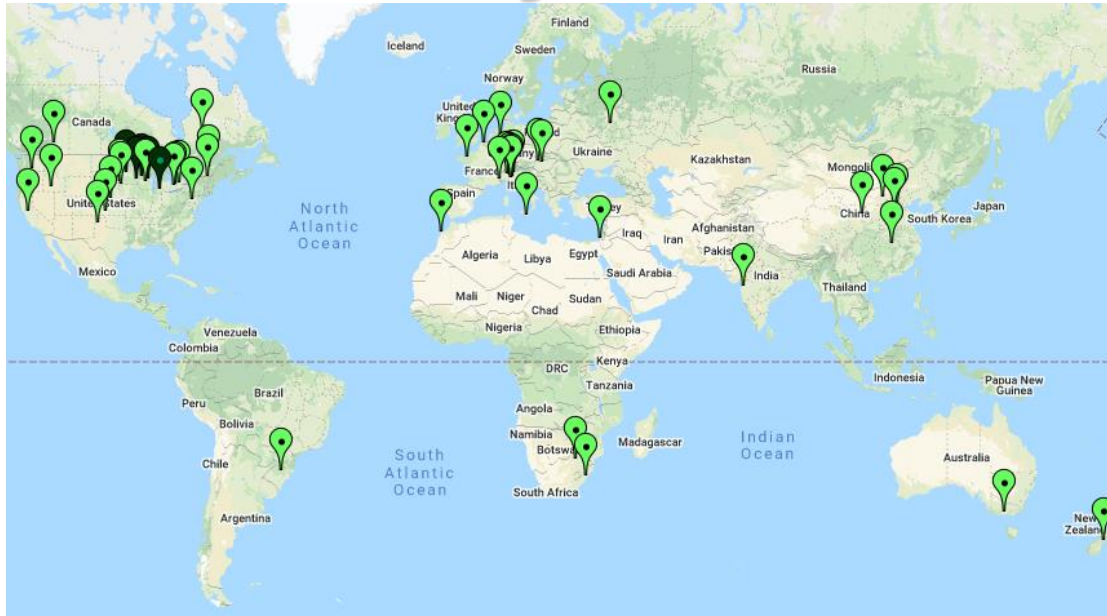
Key Measures of Forage Quality



DAIRYLAND
Laboratories, Inc.

Dave Taysom
President

Family- owned Independent Testing Laboratory .



1958

Dairyland Laboratories
established

7

Laboratories in the US
owned/operated

>78

NIR Affiliated
locations worldwide

>70

Trained chemists and
technicians



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**Cultivating value
by quantifying
variation in
agriculture's
inputs**

PROGRESSIVE DAIRYMAN



58 For the record

An inside look at the dairy that's home to world milk record holder Belz-Pralle Aftershock 3916

FEBRUARY 28, 2018



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60 The path to genetic progress

Discover which road will take you where you want to go.

28 Direct milk supply contracts

Less volatility and risk, but more vertical integration?

- **New World Record Holder for 365 Day Lact Milk Production**
- **78,169# Milk**
- **214# Milk Produced/Day**
- **3,094# Butterfat (4.0% Butterfat)**
- **2,393# Protein (3.1% Protein)**
- **Herd Averages 106.7# Milk/Day**

What Traits are important to Dairy Nutritionists for optimum Milk production.

- ▶ Moisture(Dry Matter).
- ▶ Protein
- ▶ Ash
- ▶ Fiber (aNDFom) and Fiber Digestibility (uNDF or NDFD)
- ▶ Starch and Starch Digestibility(IVSD7hr.)
- ▶ Used to estimate Net Energy of Lactation(Nel)
- ▶ Balance these traits for optimum Milk Production or Animal Performance.

Dry Matter

- ▶ The **inverse of Moisture**. This represents the fraction of the sample that is **not water** and is measured by loss on drying by various methods depending on the feed type and analysis requested.
- ▶ **100% - Moisture = Dry Matter**

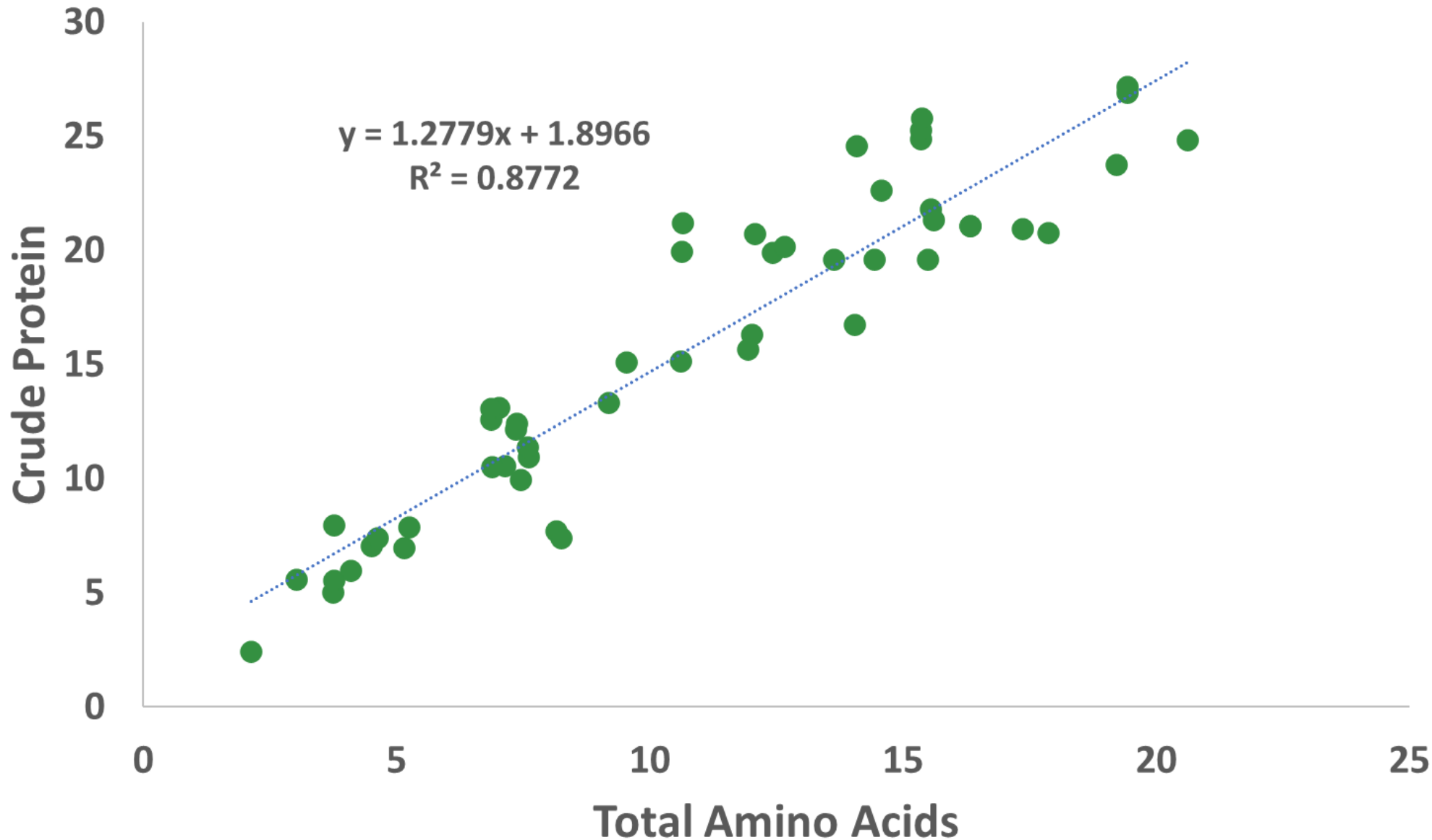


Crude Protein (CP)

- ▶ **Crude Protein** is a term for the total protein content of a feed source determined by its **nitrogen** content.
- ▶ Nitrogen x 6.25 = Crude Protein
- ▶ In general, samples with **greater amounts of Crude Protein** are considered **higher quality**, especially when comparing **hay crop forages**.

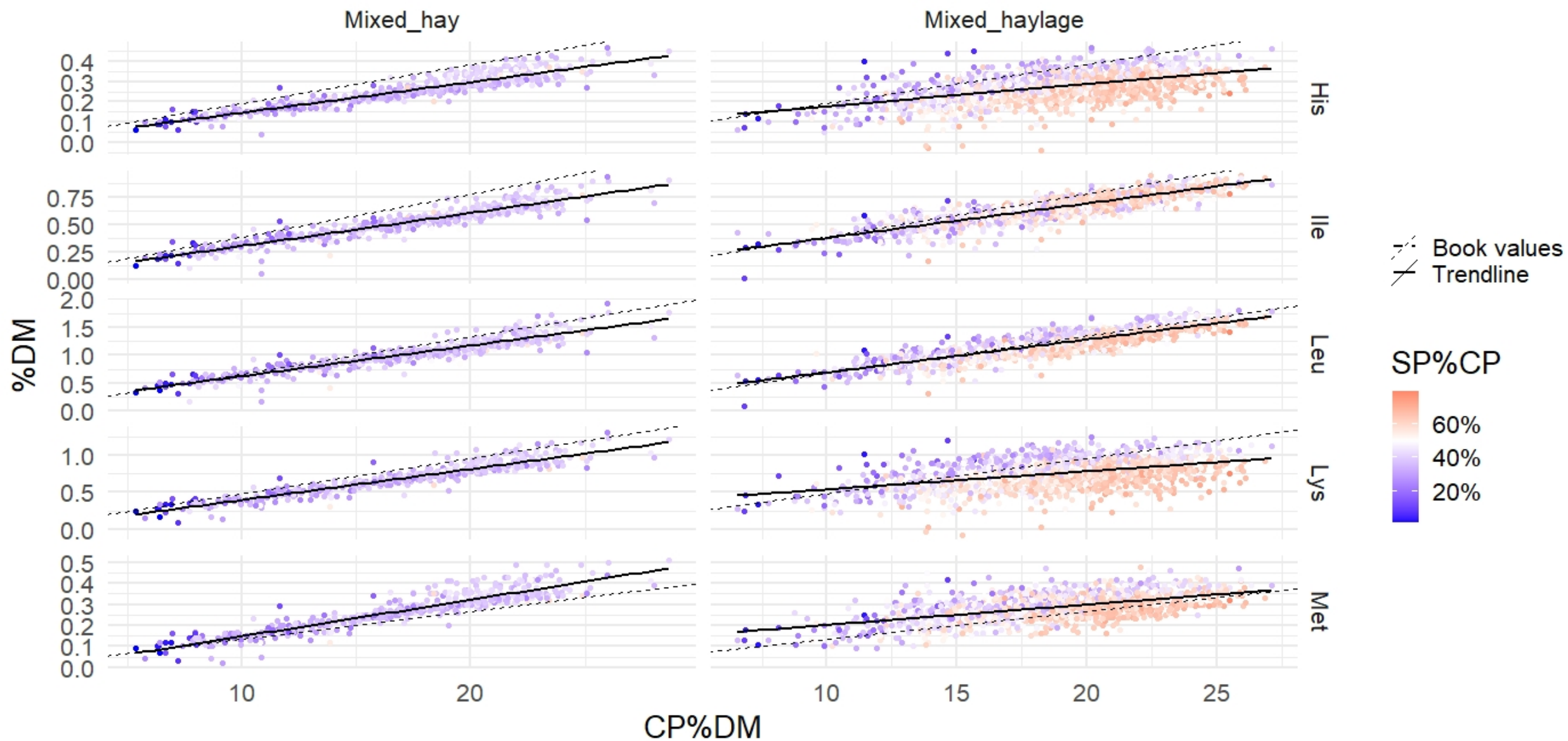


Crude Protein vs. True Protein (Amino Acids)



Does ensiling degrade amino acid content?

(Minimum 500 samples per feed type by NIR)



Data source: Dairyland Laboratories Inc.

aNDF – Neutral Detergent Fiber

- ▶ Neutral Detergent - dissolves sugar, starch, pectin, fat, and protein.
- ▶ aNDF – Amylase and Sodium Sulfite were used. Amylase added to remove Starch contamination. Sodium Sulfite added to reduce protein contamination.
- ▶ **aNDF** is a key nutritional component that is important to **RFV, RFQ**, and nearly all of the modern **energy calculations**.
- ▶ In general, **lower amounts of NDF = higher quality**.





Boil 0.5 gram of sample in NDF solution with amylase and sodium sulfite for 1 hour



Filter through gooch crucibles 2 minutes each:
1) Hot water and amylase
2) Hot water
3) Acetone
4) Acetone

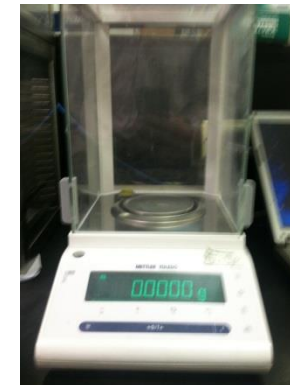


Oven dry 100C for 4 hours



Neutral Detergent dissolves some ash but not all. In general, minerals will be dissolved but silica will not.

aNDF



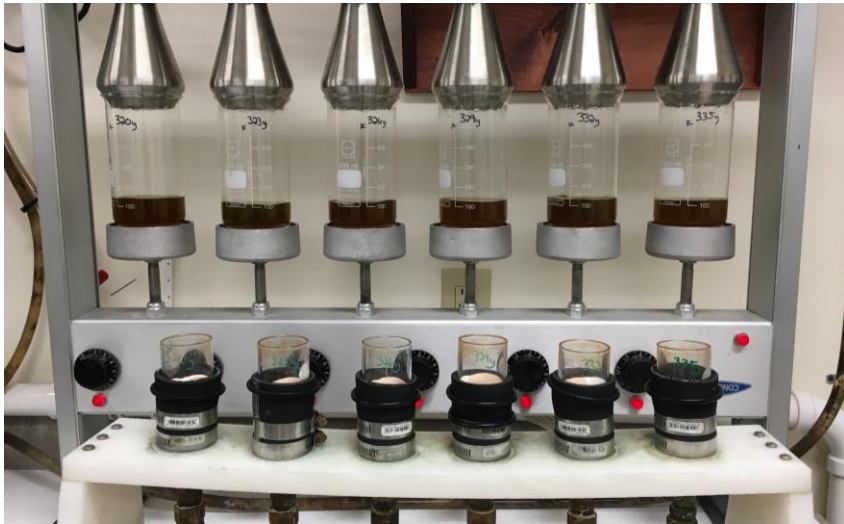
Weigh dry crucible

aNDF procedure

Ash

- ▶ **Inorganic material - minerals and soil contamination**
- ▶ A certain amount of ash is normal in all samples, but elevated levels indicate soil contamination.
- ▶ **Ash has zero energy value and has a negative impact on quality.**
- ▶ **Higher ash = lower quality.**

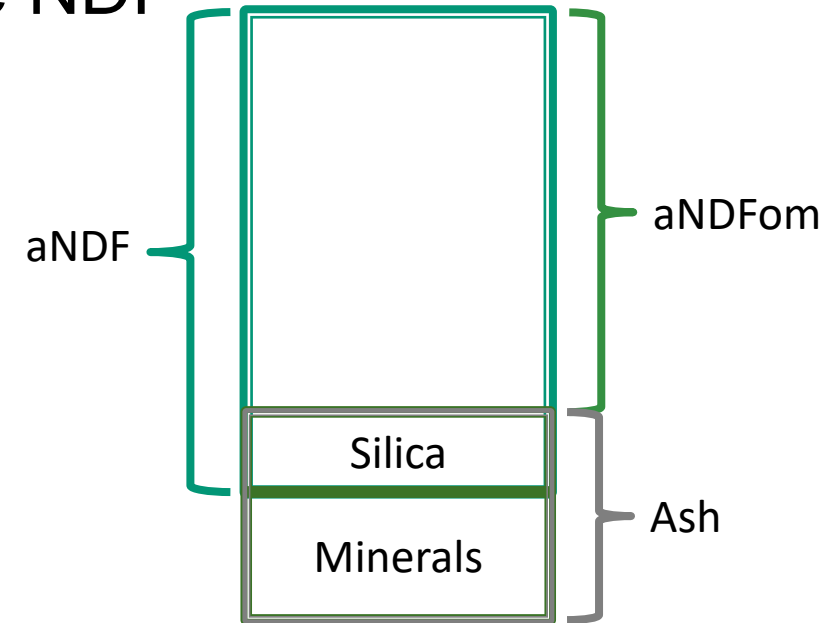




Progressing towards ideal nutritive entities

AOAC method included an option for ash-free NDF

aNDFom



aNDFom procedure



Boil 0.5 gram of sample in NDF solution with amylase and sodium sulfite for 1 hour



Filter through gooch crucibles 2 minutes each:
1) Hot water and amylase
2) Hot water
3) Acetone
4) Acetone



Oven dry 100C for 4 hours



aNDF

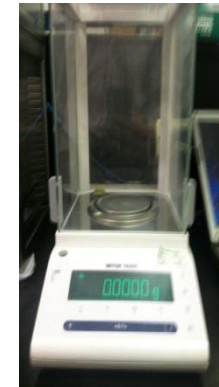
**aNDF – ash residue =
aNDFom**



Weigh ashed crucible



Oven dry 550C for 2h



Weigh dry crucible



Silica contamination

aNDF-aNDFom is indicator of soil contamination.

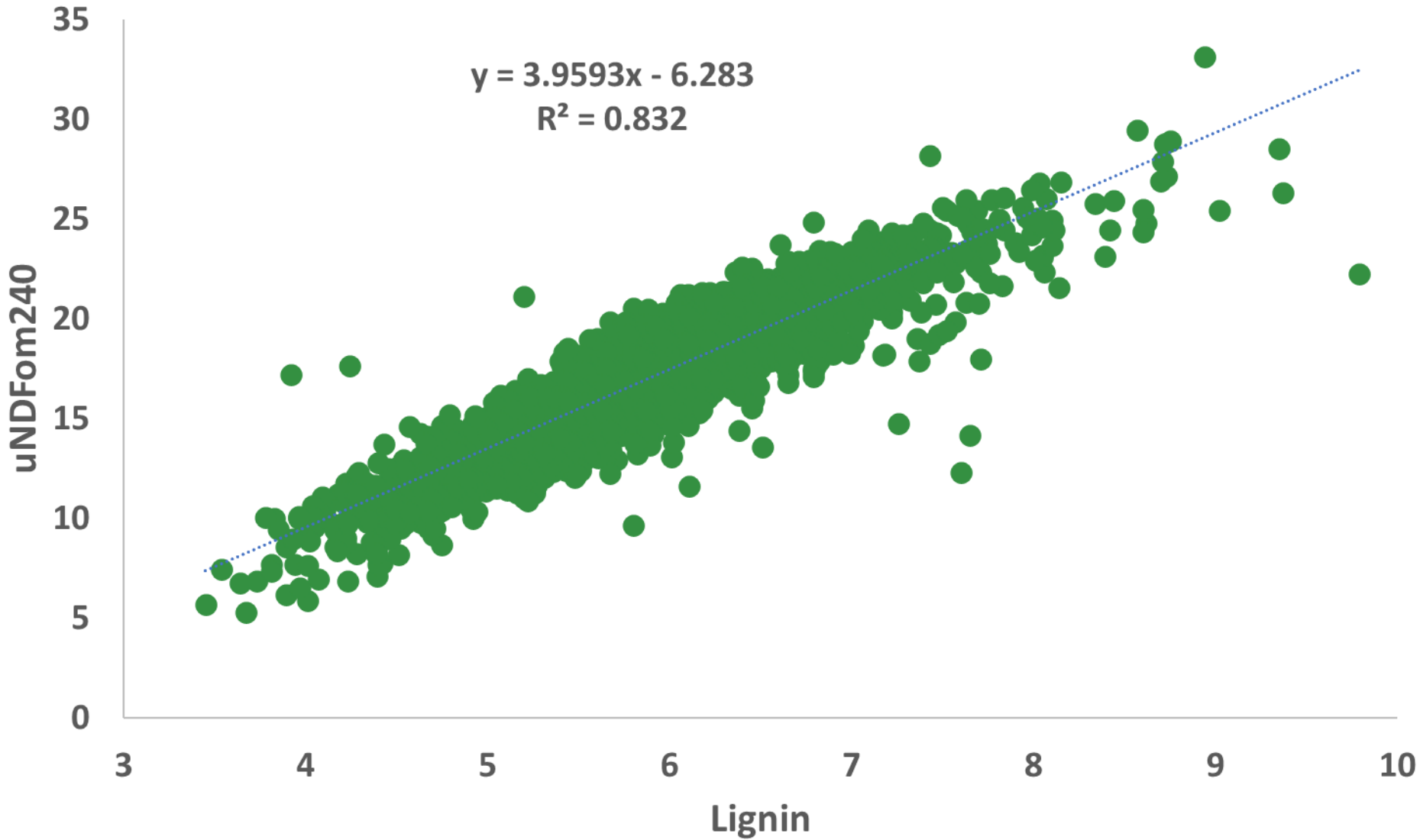
	Wet Chemistry aNDF-aNDFom difference				
	All grain	CS	Hay	Haylage	SGS
>2 pts	5.7%	8.1%	34.4%	40.9%	42.9%
> 5 pts	0.2%	1.2%	7.6%	9.9%	8.0%
>10 pts	0.0%	0.6%	2.1%	1.6%	1.8%
>15 pts	0.0%	0.0%	0.9%	0.7%	1.0%
>20 pts	0.0%	0.0%	0.6%	0.3%	1.0%
Count	947	813	2209	700	597

Lignin

- ▶ **Lignin is indigestible**, therefore **high lignin values** are associated with **poor quality feed**.
- ▶ **Lignin** is used to define fiber digestibility in energy calculations.
- ▶ Replaced by direct measurements of fiber digestibility **uNDFom 240 (undigestible NDF)**.



Lignin vs. uNDFom240



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NDFom, uNDFom, NDFD

- ▶ **NDF Digestibility** is calculated from **aNDFom** and **uNDFom**
- ▶ uNDF time points: **12, 24, 30, 48, 120, & 240 hours.**
- ▶ **uNDF/NDF = dNDF% of Dry Matter**
- ▶ **dNDF/NDF = NDFD% of NDF**
- ▶ **aNDFom – uNDFom240 = pdNDFom (potentially digestible NDF)**



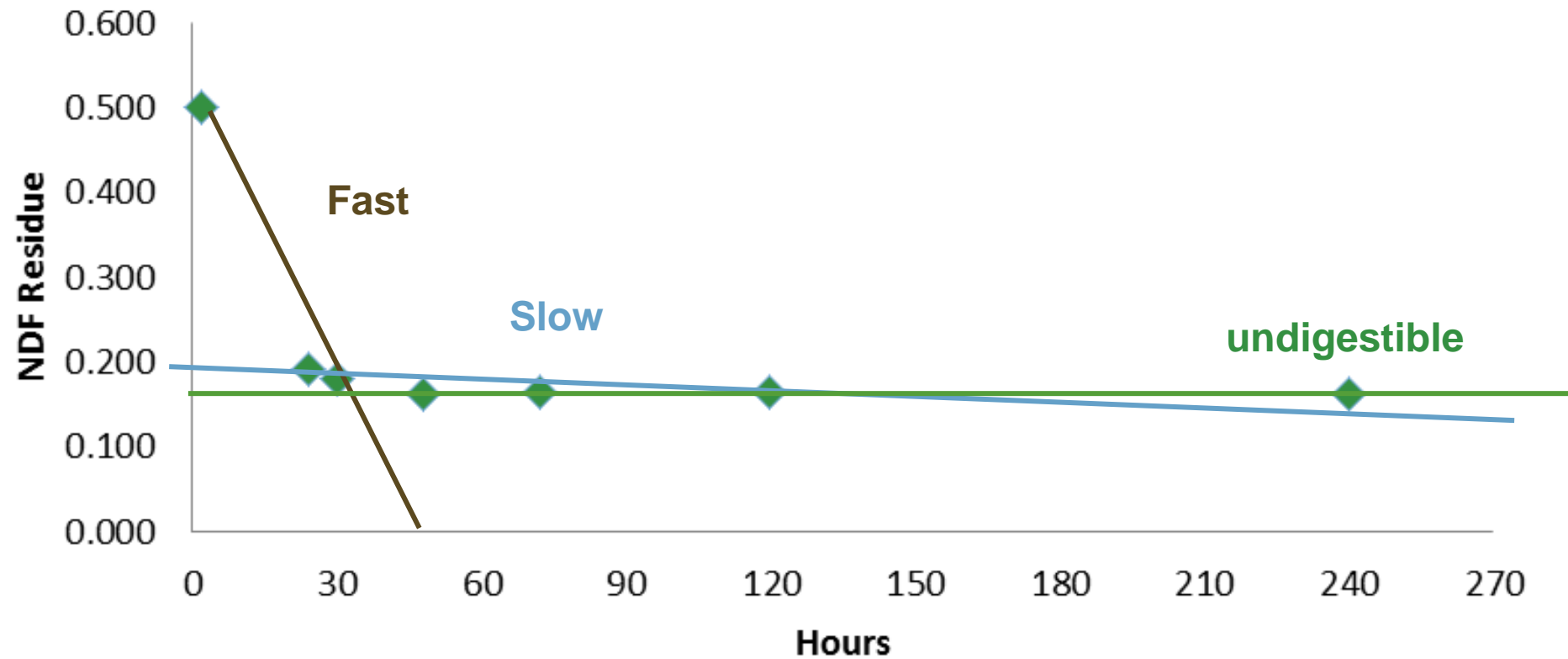
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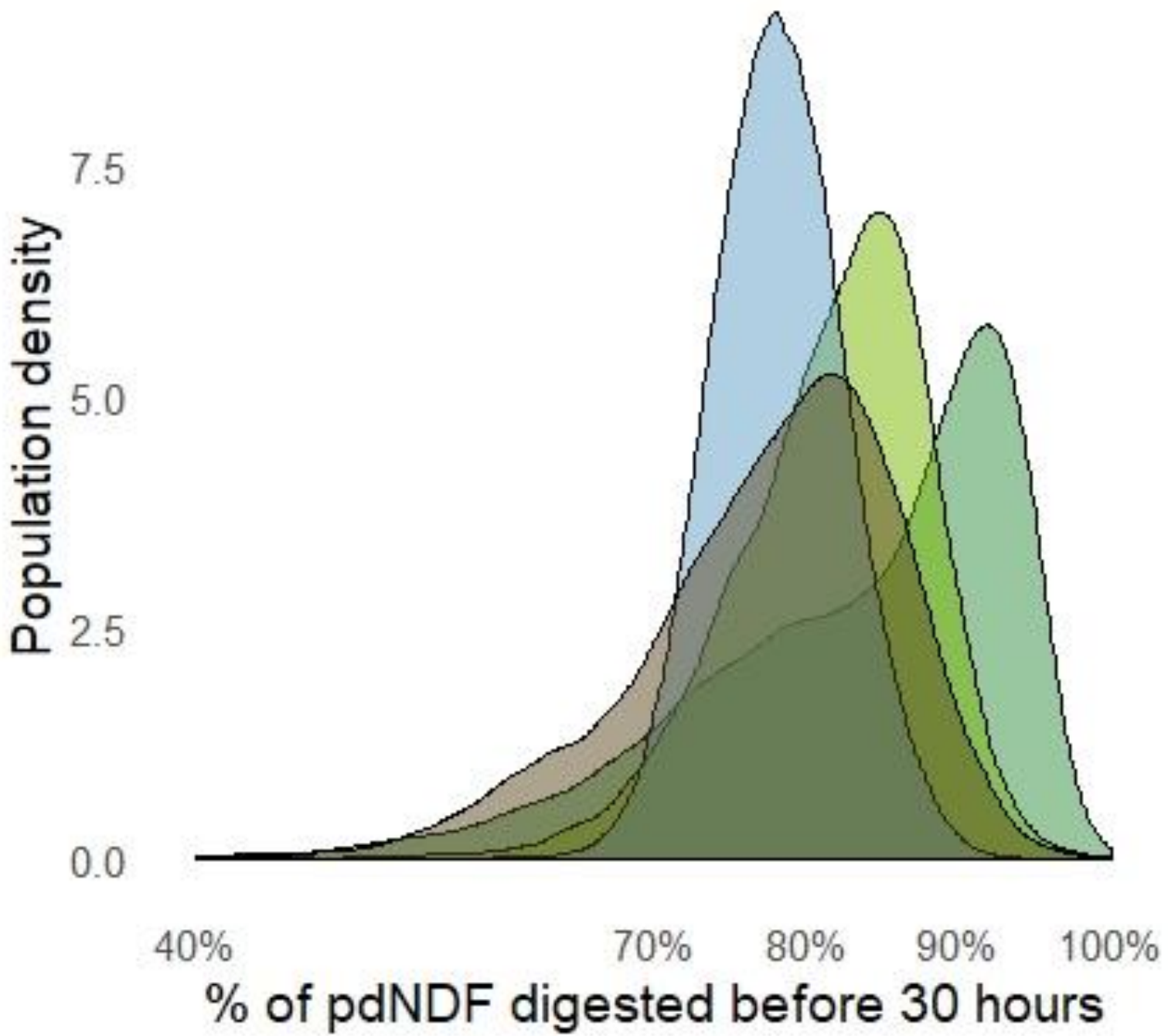
Key Inputs – uNDFom30/120/240 or NDFDom30/120/240.

- ▶ **Ration balancing programs** use multiple uNDF or NDFD time points to calculate kd rate.
 - 30/120/240 are used to establish fast and slow pool NDF digestion

Fast/Slow/Indigestible

Haylage





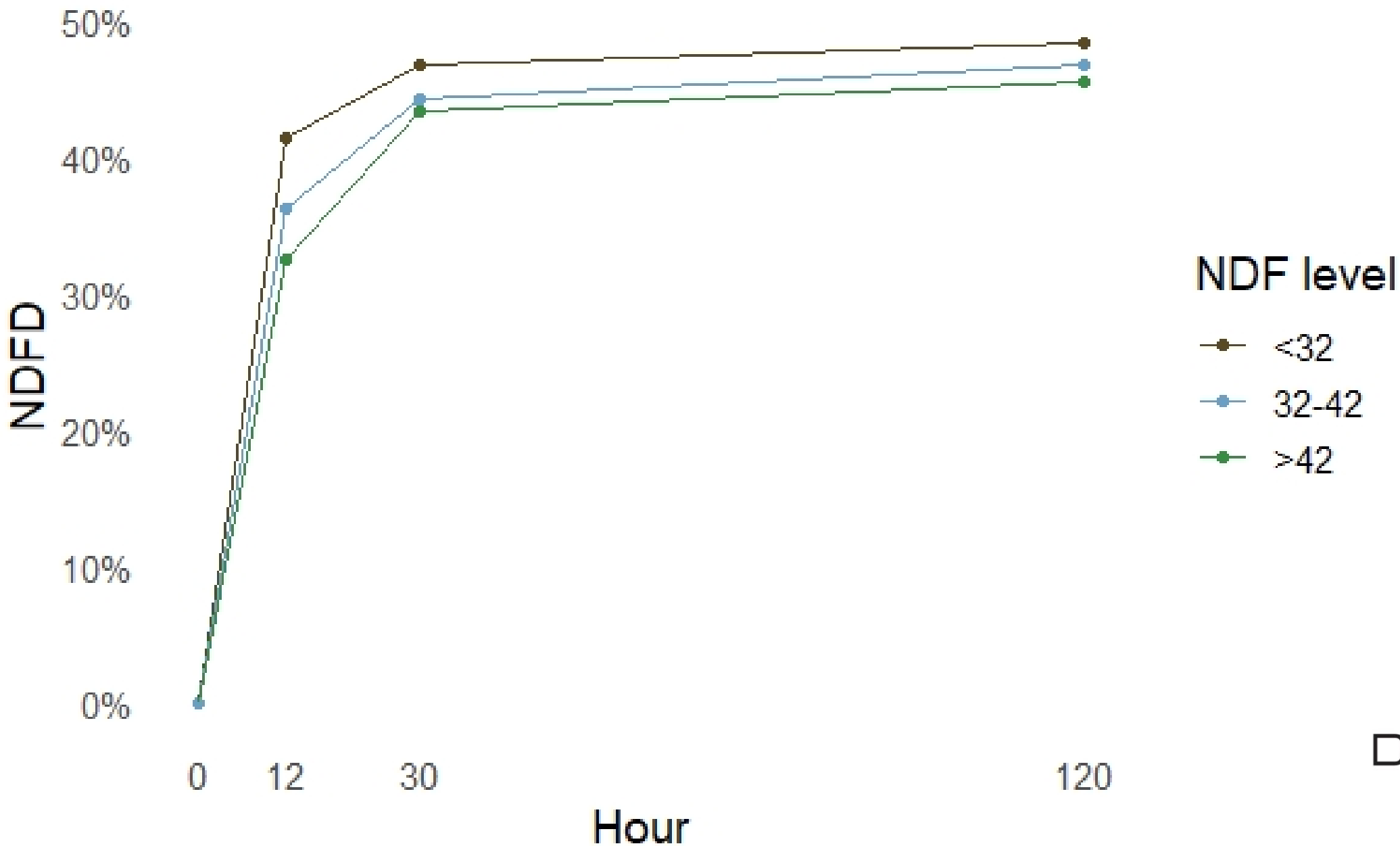
Feed type

- Alfalfa <32 NDF
- Alfalfa >42 NDF
- Corn silage
- Grass



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12hr NDFD allows greater differentiation of alfalfa



DL In Vitro System

2000 –Ankom system

2002 – Converted to GVS method using Water baths and crucible method

1 water bath – 72 flasks

2010 – 2nd water bath – 144 flasks

2011 – 3rd water bath – 216 flasks

2012 - 4th & 5th water baths – 360 flasks

2013 - warm room - total capacity > 1,000 flasks

uNDFom 12,24,30,48,72,96,120,240

IVSD7

Ross Undigested-N



February 2016

New 3500 square ft. building.
Dedicated for Digestion analysis.

- In vitro
- In situ,
- Gas Production



2 Pens of Fistulated Dairy animals.(8 total).

- 1) High Starch Diet
- 2) High Fiber Diet.

Located next to New Digestion Laboratory

2023 Added Second Warm Room



Minerals

Calcium (Ca)

Phosphorus (P)

Magnesium (Mg)

Potassium (K)

Sulfur (S)

Chloride (Cl)

Minerals are included in the **ash** measurement.

A certain amount of minerals is normal.



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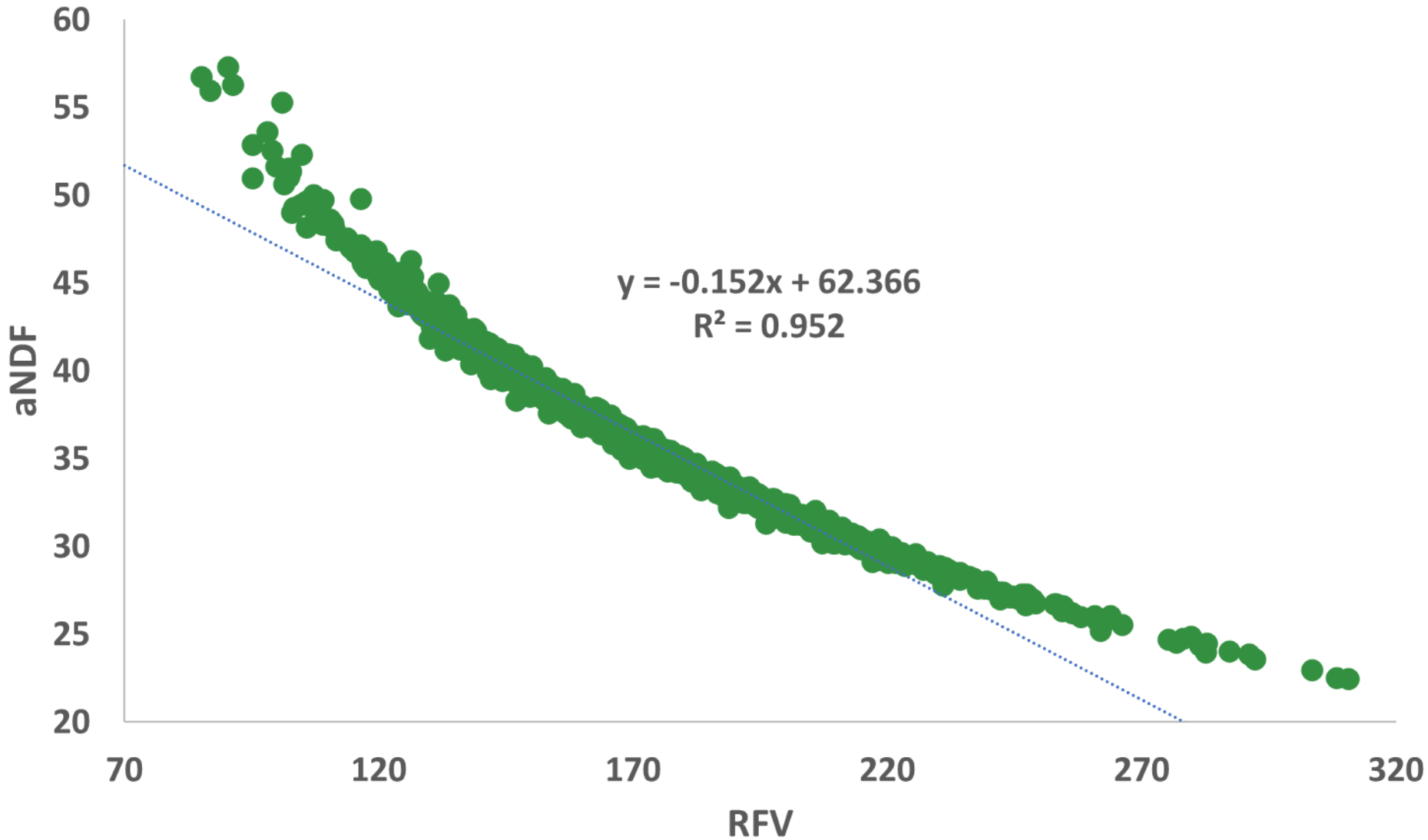
RFV

Relative Feed Value

- ▶ **RFV is an index for comparing various hay and haylage samples.**
- ▶ **RFV is derived from the ADF and NDF values in a feed sample.**
- ▶ **Higher RFV = lower ADF & NDF.**
- ▶ **Higher RFV = Better Quality**



RFV vs. aNDF



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RFQ

Relative Forage Quality

- ▶ **RFQ** is an index similar to RFV that also includes adjustments for **NDFD (NDF Digestibility) at 24, 30, or 48 hours.**
- ▶ **Higher NDFD equates to higher RFQ.**
- ▶ **Higher RFQ = Better Forage Quality.**



OARDC – TDN 1x, NEI, NEg, & NEm

OARDC Energy Calculations

- ▶ These **energy calculations** were developed by the **Ohio Agricultural Research and Development Center (OARDC)**.
- ▶ These calculations use a **summative approach** that **accounts for variation in protein, fiber, fat, and ash**.



MLK13 – TDN 1x, NEI, NEg, & NEm Milk 2013 Energy Calculations

- ▶ **These energy calculations were developed by the University of Wisconsin, and are a modification of the OARDC calculations that include adjustments for NDFD (NDF Digestibility – Fiber Digestibility) of hay, haylage, and small grain silage.**



Summary

Quality evaluation of Feeds and Forage is complex.

Balancing diets from Forage Analysis is complex.

Desire for a single number to evaluate forages very unlikely(my lifetime).

Thank you.



Typical Lactating Diet Nutrient Levels

- Crude Protein = 16-18%
- ADF – Acid Detergent Fiber – 18-22%
- NDF – Neutral Detergent Fiber – 25-33%
- Sugar – 4-10%
- Starch – 20-30%
- Soluble Fiber 5-10%
- NFC – Non-Fiber Carbohydrates – 38-45%
(Sugar, Starch, & Soluble Fiber)
- **Total Carbohydrates = 65-75% of the total diet!!!**