

SYMPOSIUM

**Energy and Protein Interaction in Dairy Cattle–
Efficiency and Environmental Impact
Nitra, Slovakia.**

14.00h on the 10th May to 16.00h 11th May, 2011



REDNEX

**Progress on the rapid analysis of feed
composition to meet Industry needs**

Chris Woodley Aunir

Technical Service Manager



*Innovative and practical management
approaches to **reduce nitrogen**
excretion by ruminants*

What Do Industries Need in using NIR Predictive Analysis?

Rapid Results

Reliable and Reproducible

Cost Effective

Relevant

The logo for Aunir features a stylized yellow 'A' with a black arrow pointing left through its center. The letters 'unir' are in a bold, black, sans-serif font.

Aunir

Making Light Work

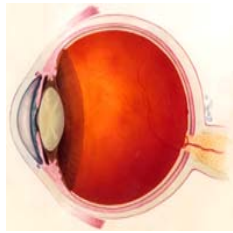
A smaller version of the Aunir logo, featuring a stylized yellow 'A' with a black arrow pointing left through its center, followed by the letters 'unir' in a bold, black, sans-serif font.

Aunir

Understanding NIR



Understanding NIR



Animal
Dog
Alsatian
German Shepherd

*Deutscher
Schäferhund*

Image

Detector

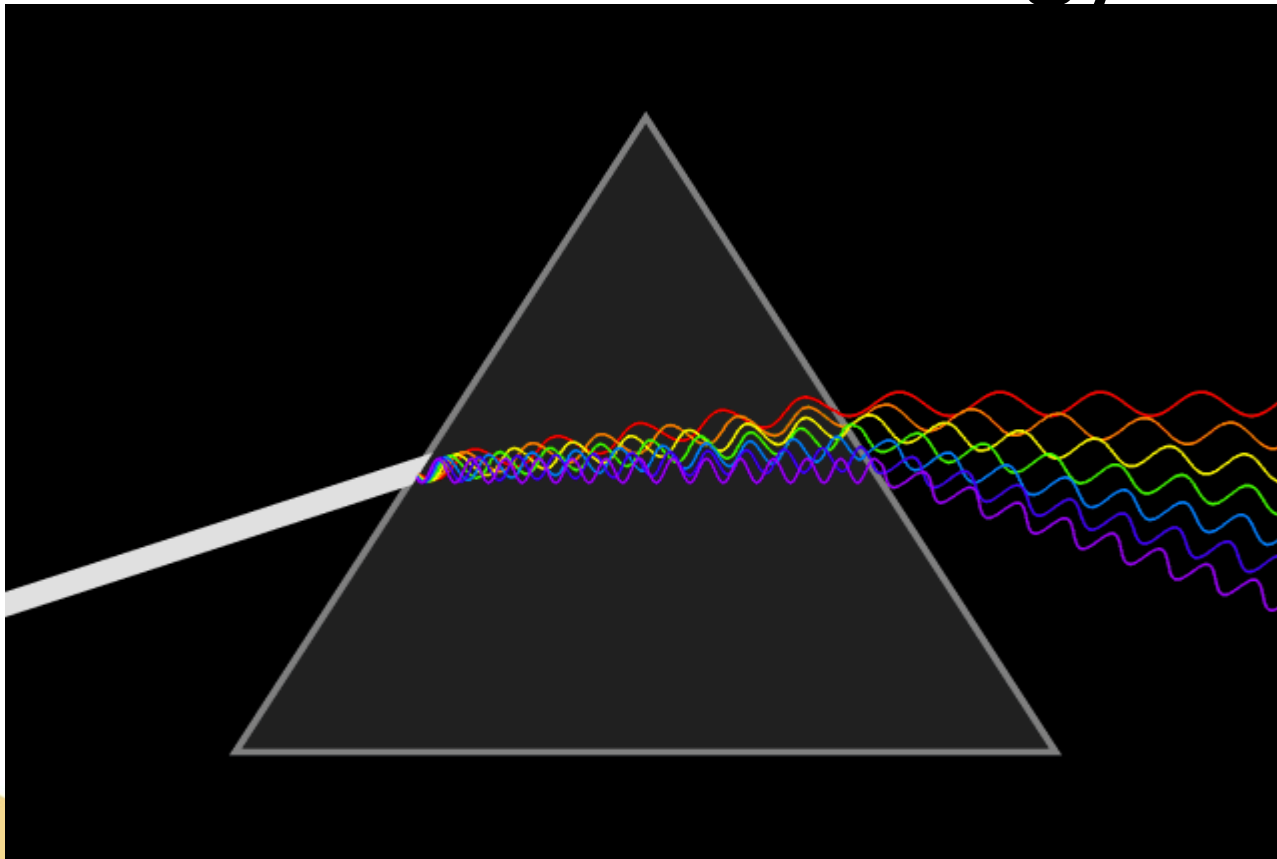
Processor

Data

Answer

Understanding NIR

Black Box Technology



Understanding NIR



comquality ABVista
ABVista
Corn Quality Report 2010

Proximate components and AME prediction

| Sample ID | Sample # | Moisture (%) | Starch (%) | Cellulose (%) | hemicellulose (%) | Lignin (%) | Cellulose AME (MJ/kg DM) | Starch AME (MJ/kg DM) | Cellulose AME (MJ/kg DM) |
|-----------|-----------|--------------|------------|---------------|-------------------|------------|--------------------------|-----------------------|--------------------------|
| 100000001 | 100000001 | 15.8 | 72.2 | 14.8 | 1.8 | 1.8 | 11.2 | 31.2 | 81.8 |
| 100000002 | 100000002 | 15.7 | 72.1 | 14.8 | 1.8 | 1.8 | 11.2 | 31.1 | 81.7 |
| 100000003 | 100000003 | 15.8 | 72.2 | 14.8 | 1.8 | 1.8 | 11.2 | 31.2 | 81.8 |

Sample Details
100000001: 2010 THAILAND - 01
100000002: 2010 THAILAND - 02
100000003: 2010 THAILAND - 03

Betagro Public Co., Ltd., THAILAND
a member since
Official Certified Group Member
www.betagro.com

A SERVICE PROVIDED BY  Anir

The results were produced by analyzing these data through specific and approved the sample as provided. The information given in this report is, to the best of our knowledge, true and correct. However, in matters of interpretation, a general report is subject to the discretion of the analyst and the user.

Image

Detector

Processor

Data

Answer

Understanding NIR

- Chemistry allows us to understand the makeup of different compound
- Physics allows us to understand what vibrations are permitted and at what frequency (wavelength) they will occur
- Therefore if we knew all the compounds in a sample we could build the spectrum from 1st principles

UNFORTUNATLEY WE DON'T

Understanding NIR

- Feed analysis has evolved over 100+ years
- Many parameters we measure are not true compounds
- Nutritionist have had to relate what we can measure to animal performance
- Crude Fibre is merely what's left after the action of acid and alkali on a sample of feed – It does not exist in nature
- We are therefore forced to relate pure spectroscopy to poor reference chemistry

Feed and Ingredients

- Data collection from 1989
- First commercial version released 1990
- Products Compound Feed :Ingredients
- Samples from OVER 40 countries of the world
- Spectra Data base in excess of 120,000

Feed and Ingredients

- 2002 join forces with Cra_W.
- 2004 Agents' agreement with major NIR manufacturers.
- 2006 Data base transferred to all major platforms
- Present work focussing on authenticity, qualitative analysis, internet predictions,
- Grazing and Browsing material

Feed Nutrients

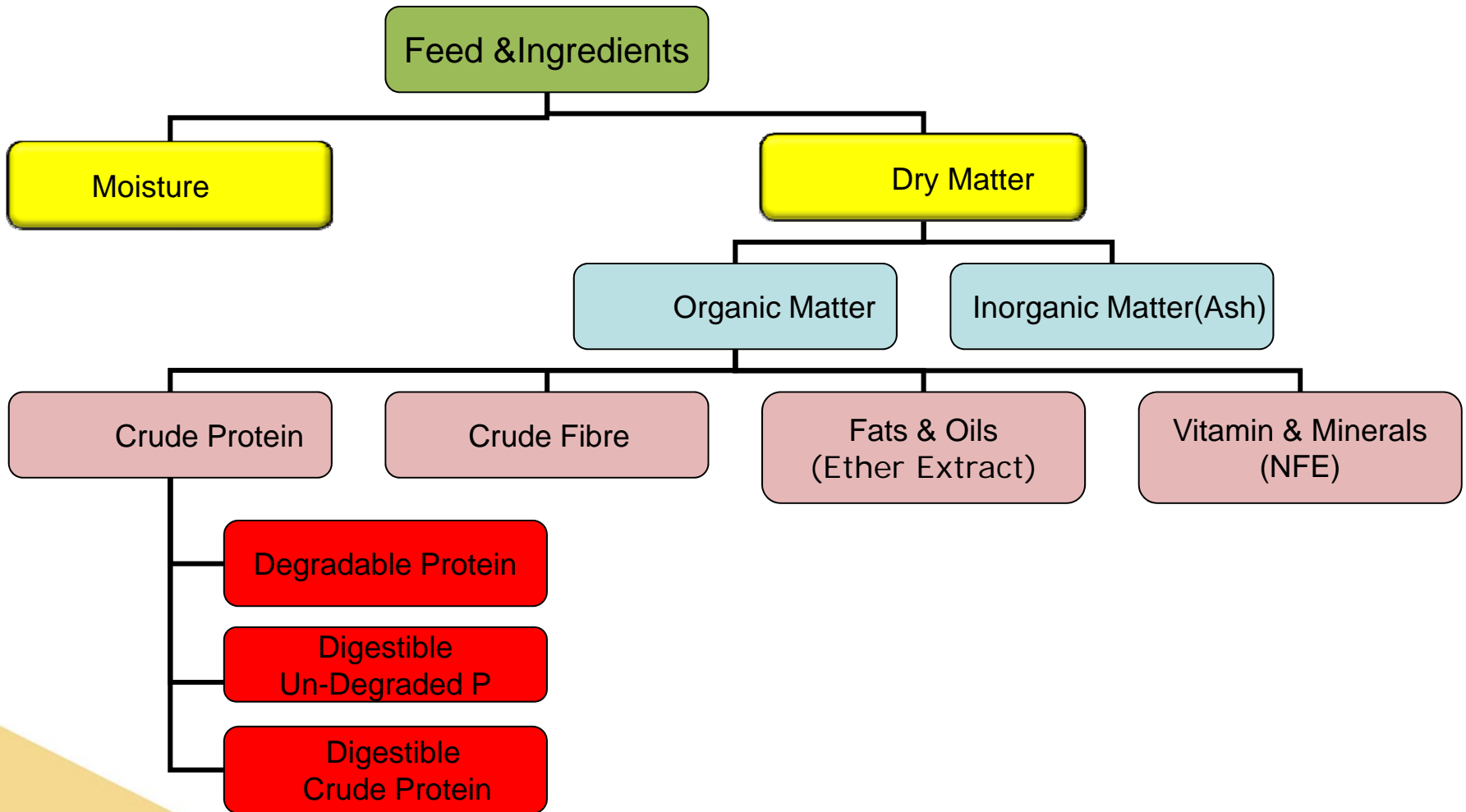
Objectives:

Identify major functions of basic nutrient groups and feeds that are sources for each.

5 Groups of Nutrients

- Energy Nutrients (carbohydrates, fats, and oils)
- Proteins
- Vitamins
- Minerals
- Water

Do all these nutrients tell us all about the nutritive value ?



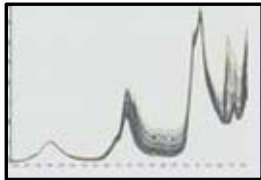
CALIBRATION DEVELOPMENT PROCESS

100 Samples
Requires Sampling Program
Initial collection could take 6-12 months

WHEAT



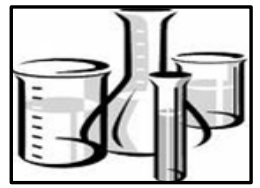
Accredited Wet Chemistry
Moisture, Fat, Protein, Fibre & Ash



Scanned on NIR

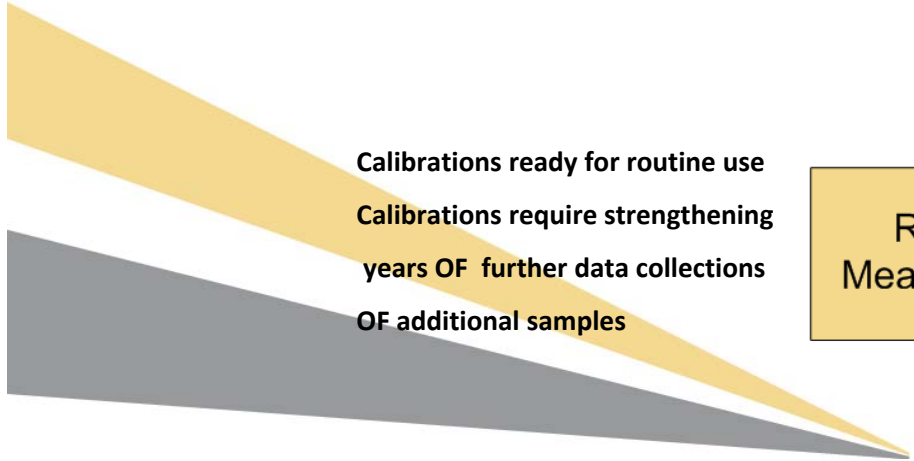
CALINGOT®

Wet Chemistry Analysis



Calibration Development

Processing of data
Requires skilled scientist
Requires specialist software
Validation required



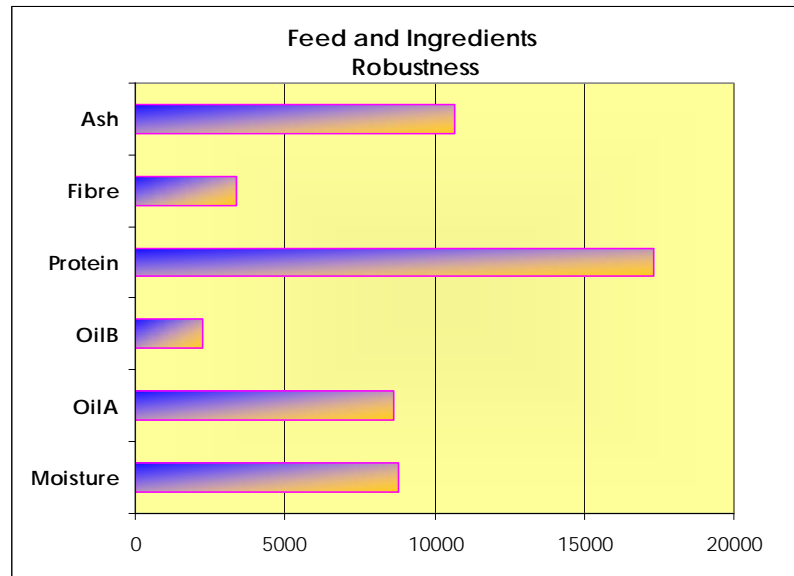
Routine Measurement



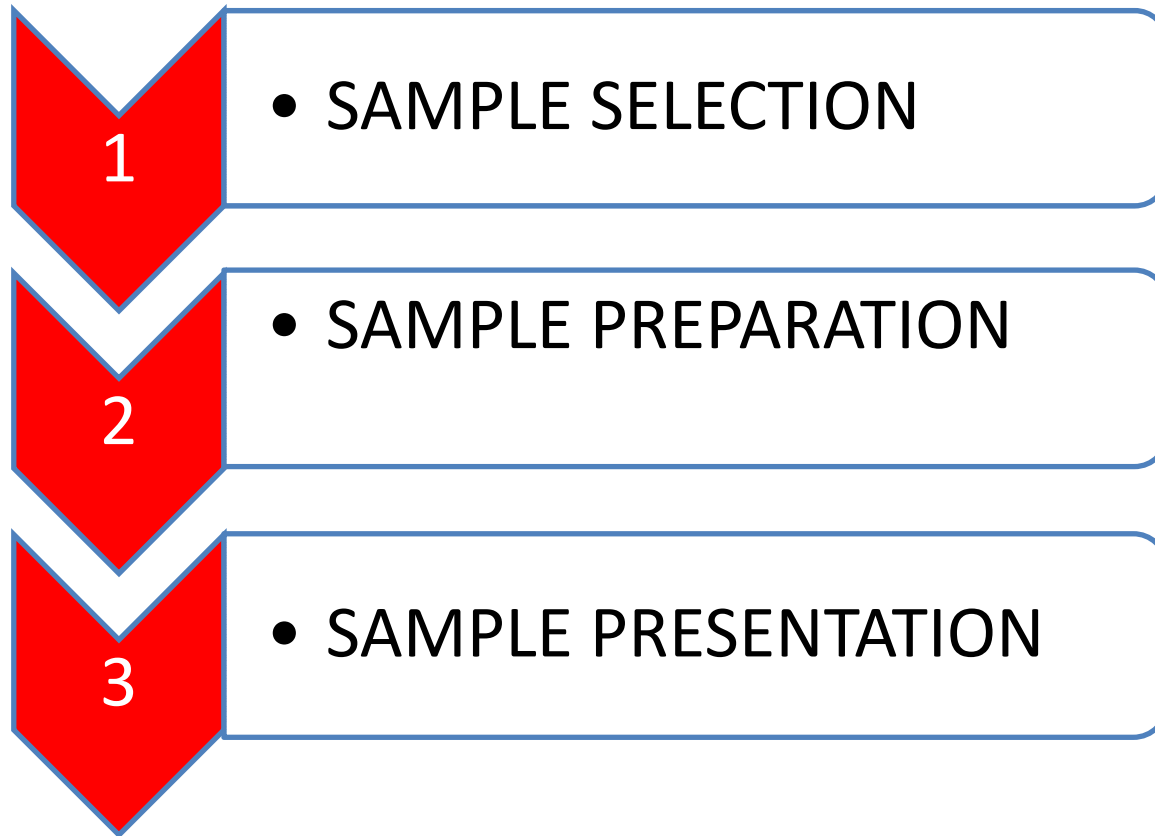
Feed and Ingredients

Data base now in excess of 120,000 samples

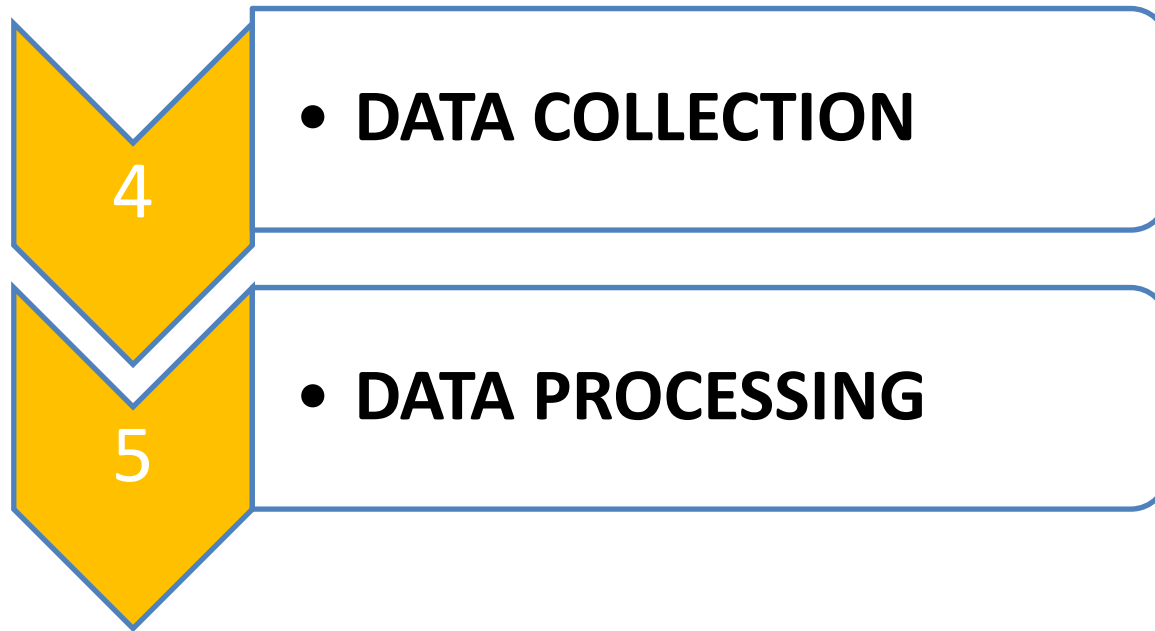
Limits of Chemometrics software approx 30,000 spectra



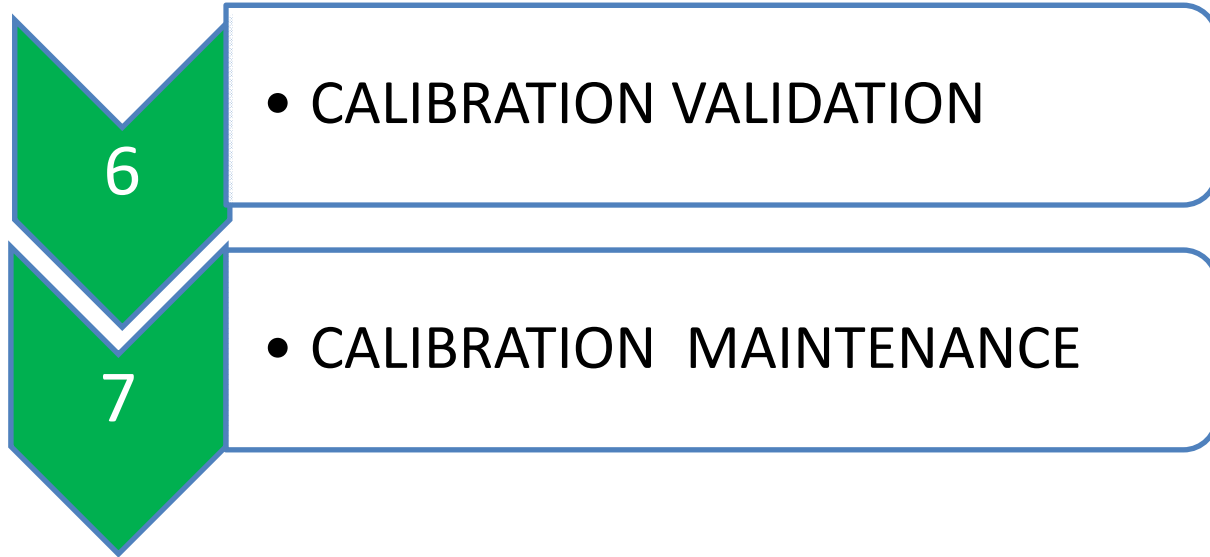
EXPERIMENTAL CALIBRATION DESIGN



EXPERIMENTAL CALIBRATION DESIGN



EXPERIMENTAL CALIBRATION DESIGN



EXPERIMENTAL CALIBRATION DESIGN

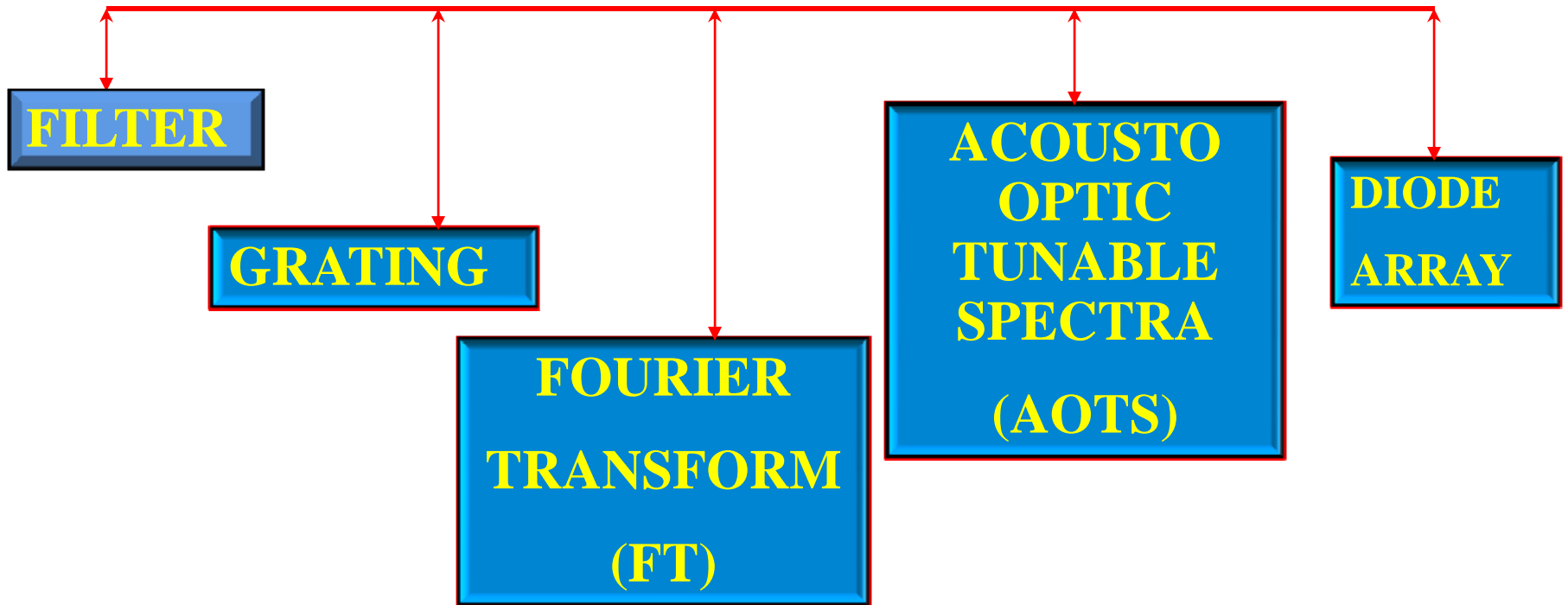


In early stages of routine use observe samples exhibiting high GH or NH values and put to one side for further investigation and inclusion back to the data set

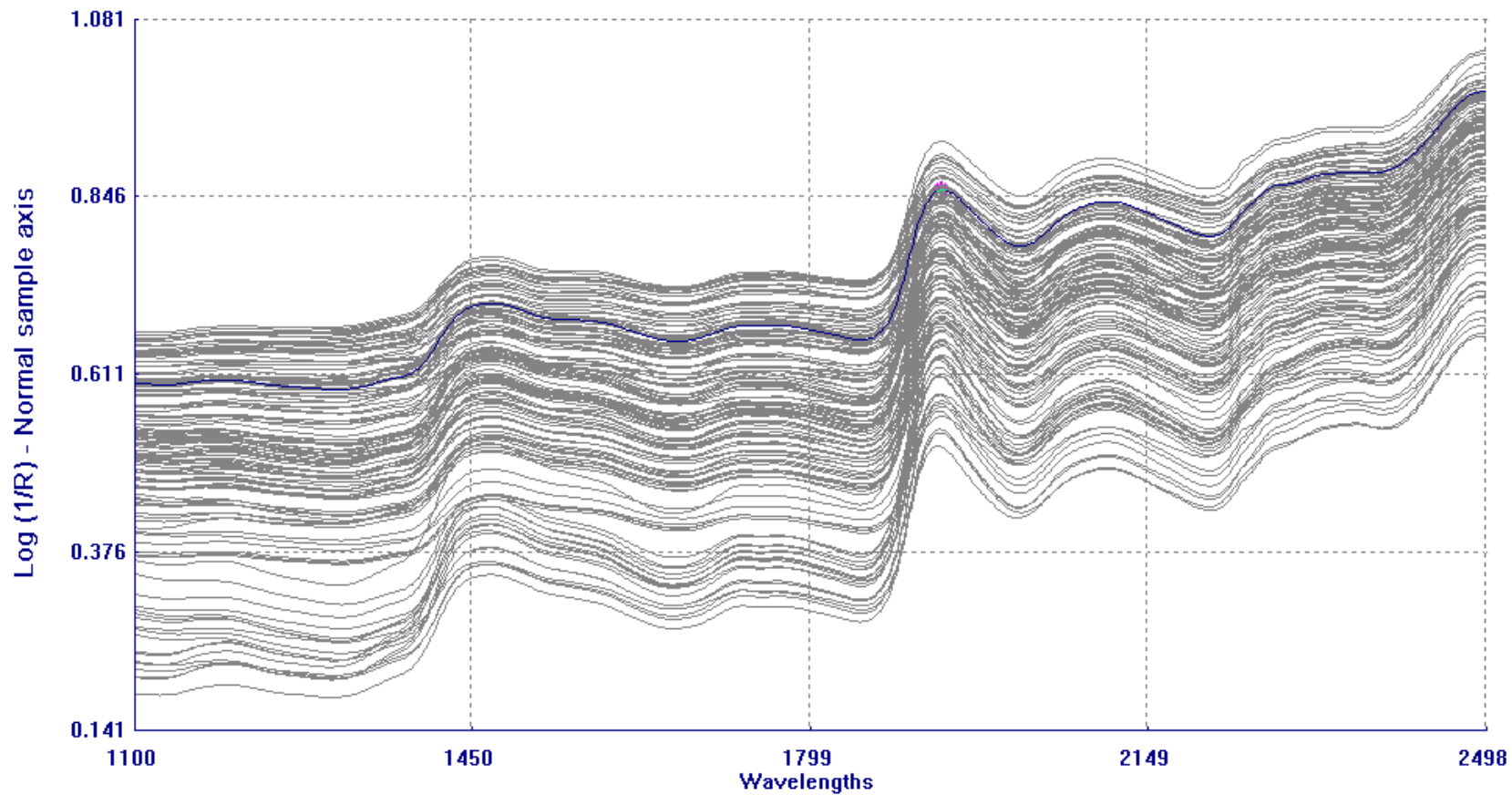
In routine use always as part of you procedure run a standard sample every batch

Bi annually perform a complete bias and skew check

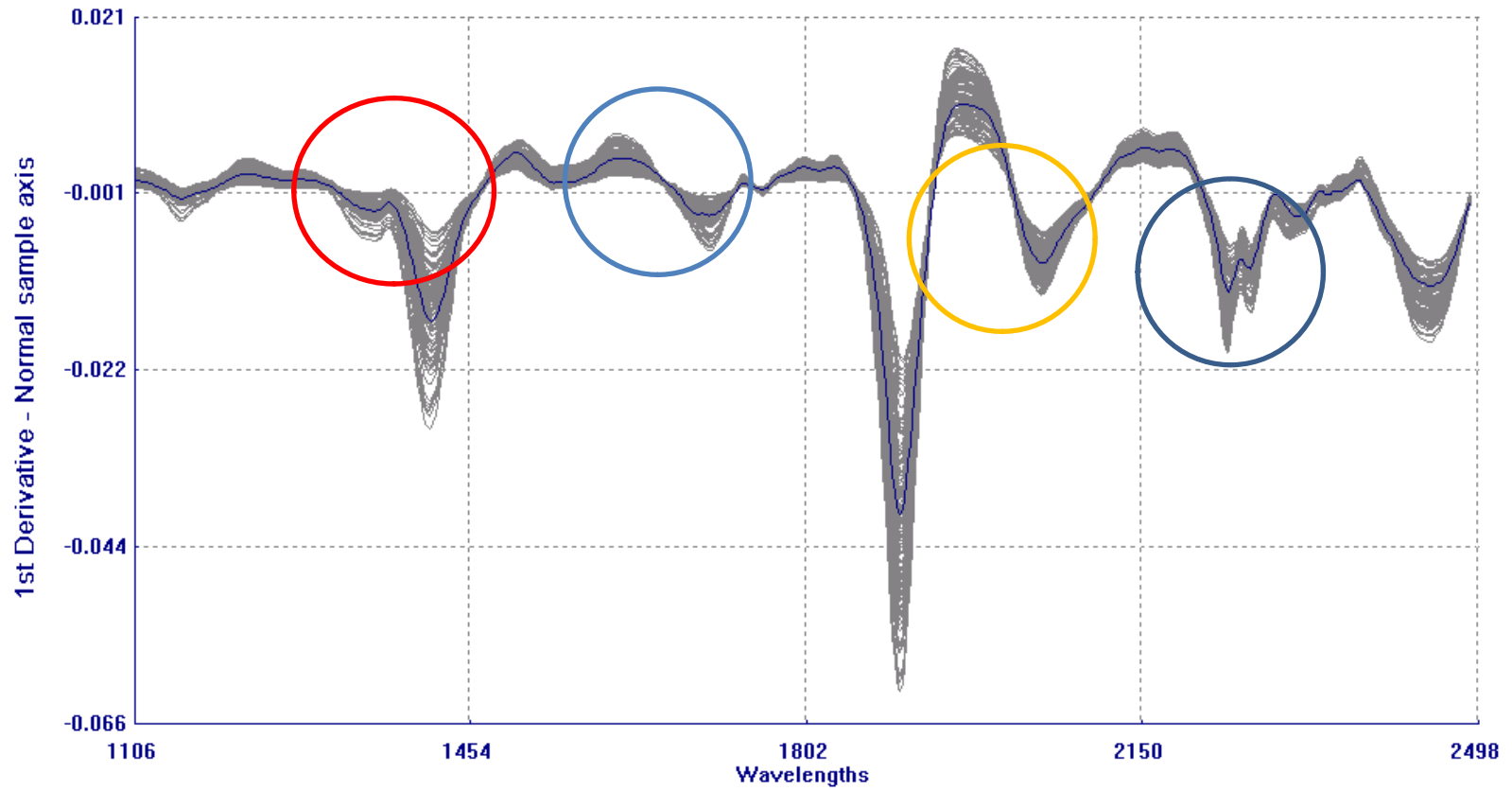
MONOCHROMATORS

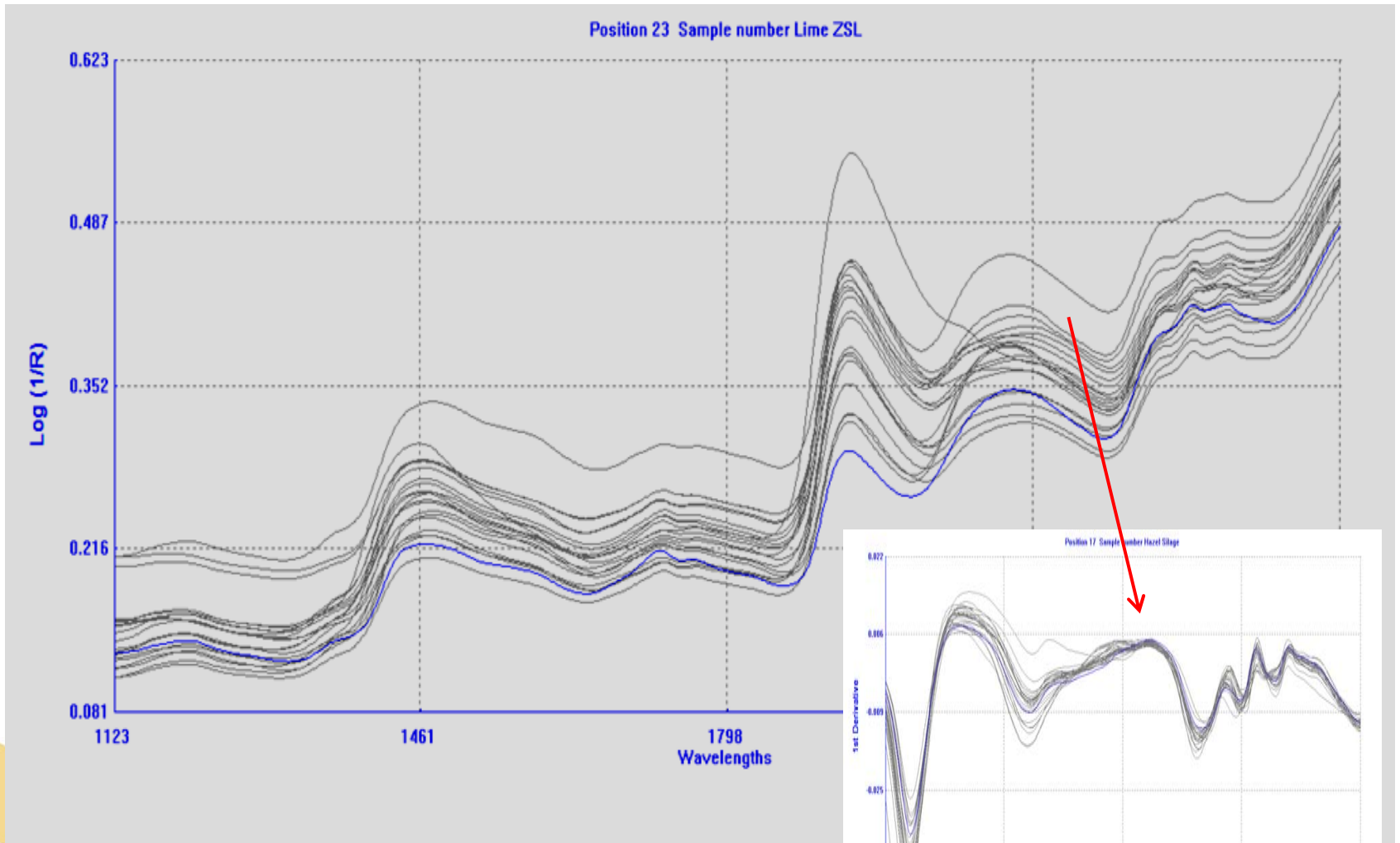


Position 1 Sample number 225022



Position 1 Sample number 225022

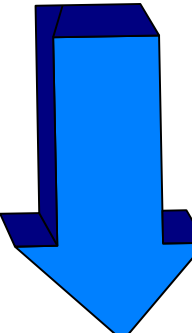




Uncertainty in analytical methods

- Sampling
- Sample preparation and pre-treatment
- Calibration of Instruments
- Analysis
- Data Processing
- Presentation of the final result

ANALYTICAL METHODS.

- 
- Methods secured by an agreed standard. e.g. Protein (Kjeldahl or Dumas).
 - Empirical methods defined by an agreed procedure. e.g. Oil, Crude fibre.
 - Subjective methods based on experience. e.g. Taste, smell.

LESSONS TO BE LEARNT

- Not all methods are the same and confidence in methods change according to the type
- All methods contain some uncertainty or error
- All methods contain some element of bias
- Don't confuse accuracy and precision
- Laboratories can and should calculate uncertainty by method
- Inter-laboratory variation should be used as the basis for comparing Lab vs. NIR
- We are replacing a wet lab with an NIR lab

The Challenge to Feed Manufacturers

- Are there other parameters outside the norm, which would be more useful (Biological)?
- Is it more useful to measure the quality of the Raw materials (yield of nutrients) ?
- Can we expand the work of Silage Intake(UK experience) ?

..... **ETC**

- NIR is a powerful tool, if you have a spectra this contains all you need to know.
- The problem is, relating this to a reference point(analysis)

Wet Forage



Outline of Forage Models

- What is forage?
- Why is it important?
- How do we analyse it?
- What should we expect?
- What does the analysis mean for the farmer?

Definition

- Crops usually grown for animal feed
- Form the base of ruminant rations
- Cereals
- Root crops
- Legumes

Types of forage

- Fresh grass (& clover)
- Silage
 - Grass silage
 - Maize silage
 - Wholecrop silage
 - Fermented
 - Alkali-treated
 - Peas/beans
- Lucerne/Alfalfa

NIR Calibration Parameters

Dry Matter
Ash
Protein
Ammonia
Neutral Detergent Fibre (NDF)
Neutral Detergent Insoluble Crude Protein (NDICP)
Acid Detergent Fibre (ADF)
Acid Detergent Insoluble Crude Protein (ADICP)
Lignin
Starch
Sugar
Fat
pH
Lactic Acid
Volatile Fatty Acids (VFA)
Digestible Organic Matter (DigOM)

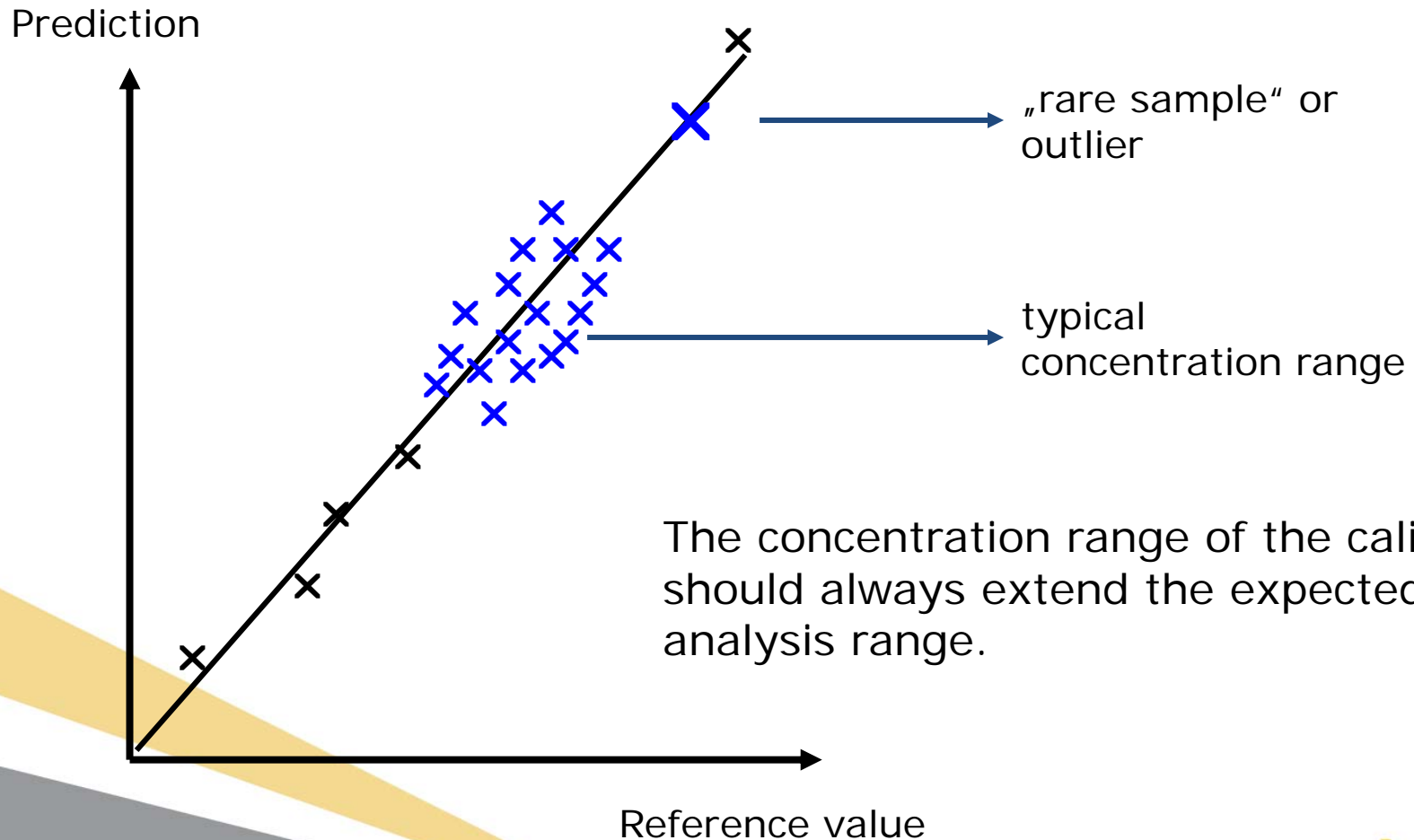
Associated Reference Methods

Toluene Distillation (Dean + Stark)
Muffle Furnace @550°C
Nitrogen by Dumas
Steam Distillation Kjeldahl
NDF with Amylase Pretreatment
Dumas Protein on NDF fraction
Cetyltrimethylammonium Bromide Digest
Dumas Protein on ADF fraction
Christian Lignin
Polarimetry
Luff-Schoorl
Ether Extract
Electrochemically using pH meter
Toluene
GC Profile
Calculated

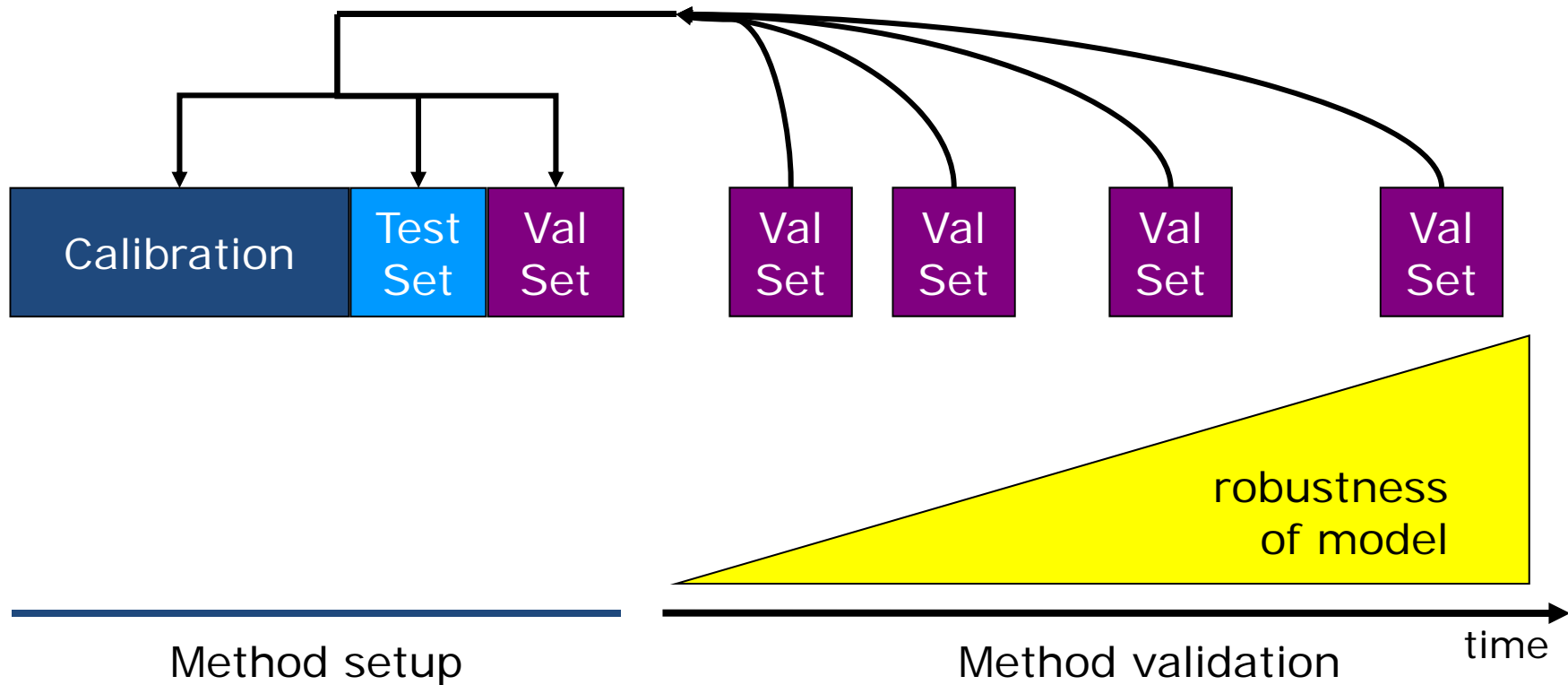
PERFORMANCE WET FORAGE

| Property | Mean | Min | Max | SEC | VALID ERROR | RSQ |
|-------------|-------|-------|--------|------|-------------|-------|
| Dry Matter | 52.09 | 0.00 | 100.00 | 1.07 | 1.08 | 1.000 |
| Ash | 7.89 | 1.17 | 14.61 | 0.76 | 0.77 | 0.890 |
| Protein | 11.94 | 0.43 | 23.45 | 0.97 | 0.98 | 0.940 |
| Ammonia | 6.70 | 0.00 | 15.66 | 0.55 | 0.58 | 0.970 |
| NDF | 54.87 | 18.51 | 91.23 | 2.98 | 3.03 | 0.940 |
| NDICP | 2.48 | 0.00 | 5.35 | 0.44 | 0.50 | 0.790 |
| ADF | 33.79 | 13.99 | 53.60 | 1.48 | 1.52 | 0.950 |
| ADICP | 0.80 | 0.00 | 1.64 | 0.18 | 0.20 | 0.610 |
| Lignin | 5.06 | 0.00 | 10.86 | 0.98 | 1.03 | 0.740 |
| Starch | 36.48 | 0.00 | 96.52 | 3.41 | 4.43 | 0.970 |
| Sugar | 3.67 | 0.00 | 9.73 | 0.20 | 0.22 | 0.990 |
| Fat | 3.06 | 0.34 | 5.78 | 0.23 | 0.24 | 0.940 |
| pH | 4.52 | 2.92 | 6.13 | 0.09 | 0.09 | 0.970 |
| Lactic Acid | 50.78 | 0.00 | 100.00 | 3.98 | 4.27 | 0.970 |
| VFA | 31.46 | 0.44 | 62.47 | 2.05 | 2.20 | 0.960 |
| DigOM | 66.38 | 52.45 | 80.32 | 0.73 | 0.76 | 0.980 |

Distribution of samples



Updating of methods and data sets with new samples (new batches, new recipes)



Val Set = dataset of independent samples

Summary of method development

- Well measured spectra and reference values
- Checking of data sets on outliers, unusual effects and samples
- Set up of first methods for control and selection of spectral ranges for optimization
- Optimization
- Selection and review of models from the optimization list
- Validation of models with independent samples, if possible over time

Frequent repeating of point 6 in routine usage!

Calibration Maintenance

REMEMBER

NO CALIBRATION MODEL LIVES
FOREVER WITHOUT SOME ADDITION OR REFINEMENT

This presentation has been carried out with financial support from the Commission of the European Communities, FP7, KBB-2007-1.



REDNEX

THANK YOU FOR YOUR INTEREST

It does not necessarily reflect its view and in no way anticipates the Commission's future policy in this area.



*Innovative and practical management approaches to **reduce nitrogen excretion** by ruminants*