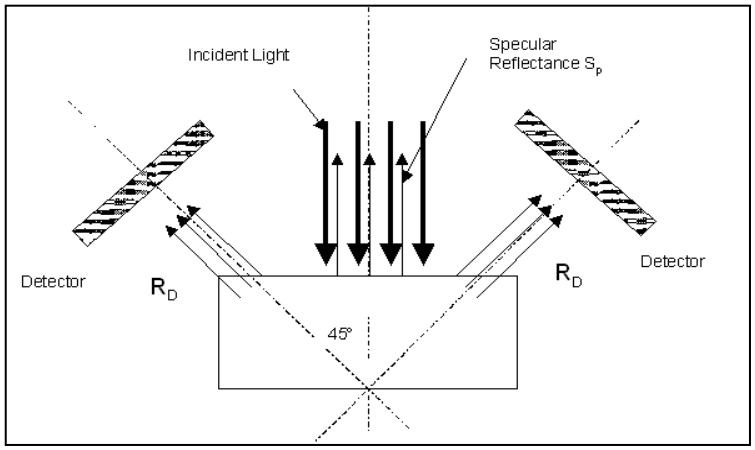
Application Note 171. NIR Calibration Development for Blood Meal using the Series 4000 FTNIR Spectrometer

Introduction:

Near Infrared Reflectance spectroscopy is best performed in the 1900 to 2500nm region of the electromagnetic spectrum. Within this spectral region, Protein (N-H 2120nm), Moisture (O-H, 1940nm) and Fat (C-H, 2350nm) absorb NIR energy. Using 0 – 45 degree illumination and detection optics, as shown in figure 1, provides a means of collecting NIR spectra from samples such as ground meals and ground pellets used in the stock feed industry. Using a Fourier Transform (FTNIR) spectrometer to collect diffuse reflectance spectra from meals and pellets provides a very accurate and precise means of developing NIR calibrations for a wide range of chemical components in the meal and pellets, including: Crude Protein, Moisture, Fat, Fibre as well as derived calibrations for Digestible Energy, Metabolisable Energy and Ash.

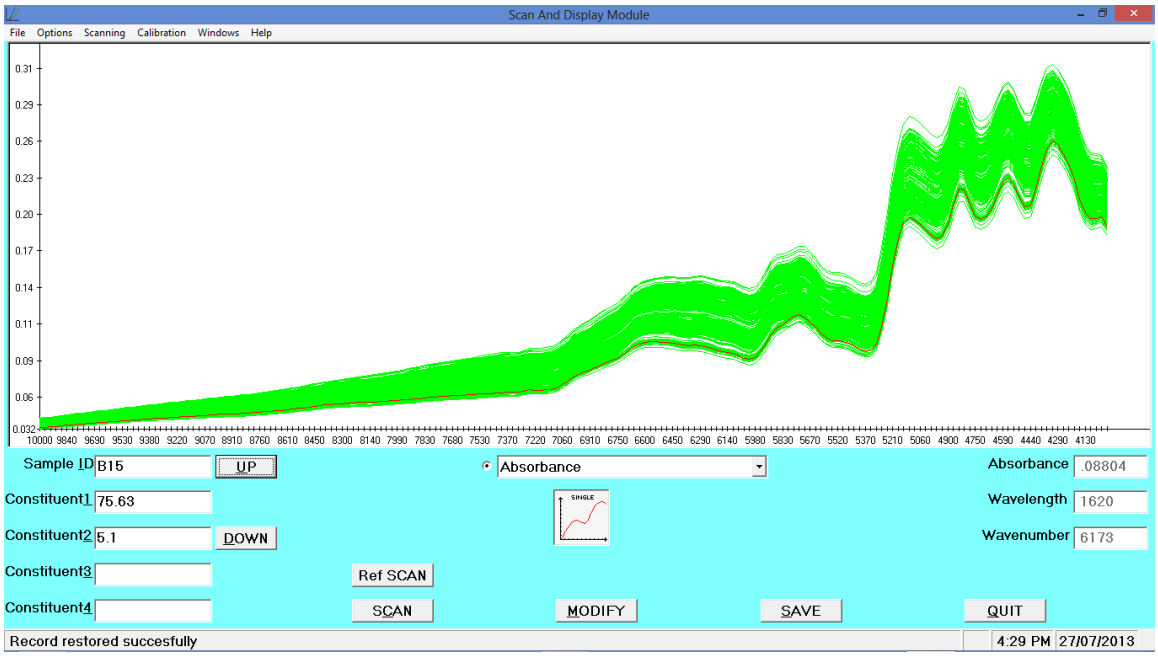


This study reports the results of developing calibrations for Blood Meal for their nutrient profile using the MultiScan Series 4000 FTNIR Spectrometer.

Figure 1. Diffuse Reflectance

Procedure:

300 spectra were collected from 15 samples of Blood Meal across the wavelength range 1000 to 2500nm in Diffuse Reflectance using the Series 4000 FTNIR Spectrometer. Figure 2 shows the NIR spectra of these samples.



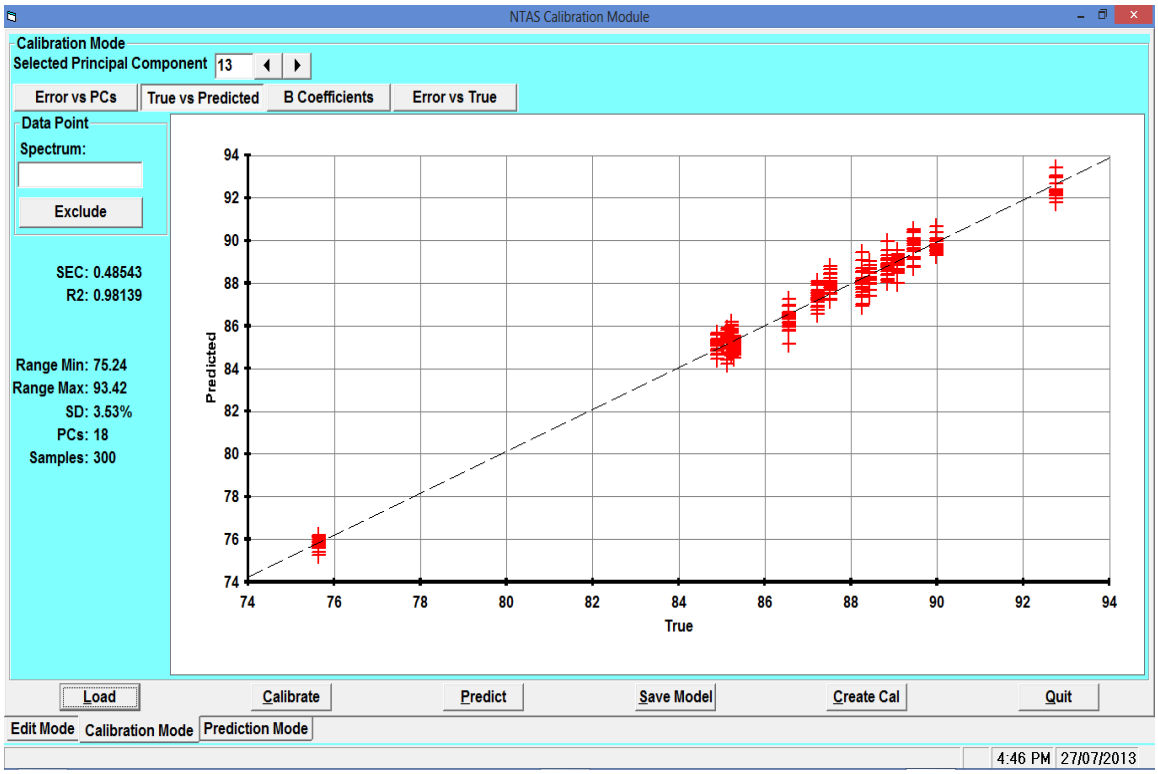
Approximately 40 grams of blood meal was poured into a 5mm deep dish. The meal was scrapped across the dish with a flat blade in order to evenly fill the dish. The excess meal was scrapped off the dish and the blade used to flatten the top surface. The meal was not compressed. The dish was placed into the Series 4000's rotating sample dish holder and the scan initiated. The dish holder has a Teflon Powder Reference disk fitted to one end of the dish. The 100% reference scan is stored in memory and then the dish is rotated to the first scan position. This process is repeated for 10 portions of the sample. 10 scans are collected and averaged from each of the 10 sample portions. The average scan of each portion was stored in memory. The sample dish was removed, emptied and refilled with another sample taken from the same meal container. As such 20 spectra were collected for each of the 15 samples.

Each of the 15 samples had been analysed in duplicate for protein using a VELP Scientifica, NDA701 Dumas Analyser and for moisture using the Oven Drying method. The protein and moisture values for each meal sample were recorded with the spectral data.

The 300 spectra of the blood meal samples were imported into NTAS (NIR Technology Analysis Software) where Partial Least Squares Regression was applied to develop calibrations for protein and moisture.

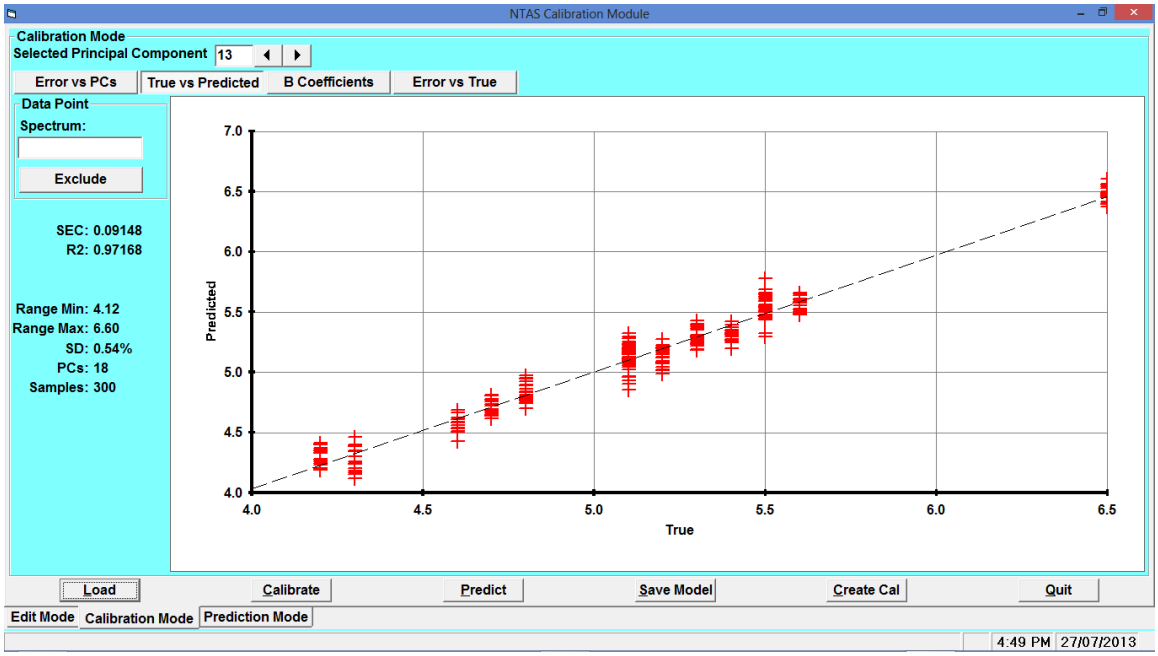
Results:

Figure 3. shows the results of the protein calibration for the 300 blood meal spectra.



Protein Calibration Plot.

Figure 4. shows the results of the moisture calibration for the 300 blood meal spectra.



Moisture Calibration Plot

Discussion:

Near Infrared Reflectance spectroscopy has been used for measuring protein and moisture in meals and animal feed pellets for decades. As such the data presented in this report is not revolutionary. Fat and Ash can also be measured using NIR spectroscopy. Unfortunately the samples of blood meal provided for this study did not have reference values for fat and ash.

The objective of this report is to demonstrate that the Series 4000 FTNIR Spectrometer provides a means of accurately measuring meal samples such as Blood Meal.

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