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, ground pellets and straw used in the stock feed industry. Using a Fourier Transform (FTNIR) spectrometer to collect diffuse reflectance spectra provides a very accurate and precise means of developing NIR calibrations for Protein and Moisture in the straw and hay.
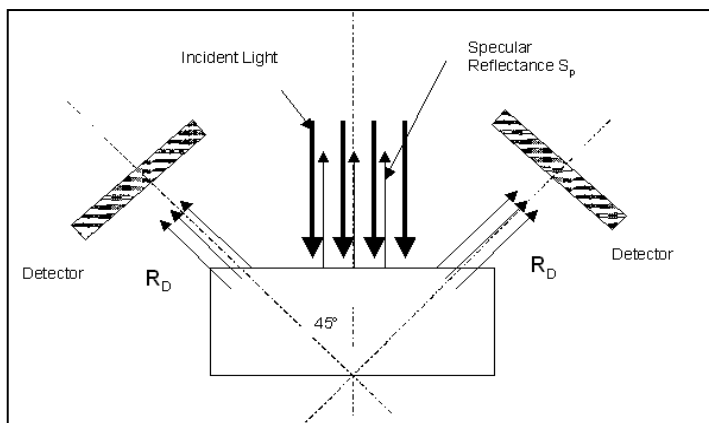

This study reports the results of developing calibrations for Straw and Hay protein and moisture using the MultiScan Series 4000 FTNIR Spectrometer.

Figure 1. Diffuse Reflectance

Procedure:

28 spectra were collected from 14 samples of straw and hay across the wavelength range 1000 to 2500nm in Diffuse Reflectance using the Series 4000 FTNIR Spectrometer. Figure 2 below shows the nature of these samples.

Figure2. Straw and ground straw in sample holder

Approximately 10 grams of Straw ground down to form a uniform powder. This was poured into a 5mm deep dish. The powder was levelled within the dish by gently shaking in order to evenly fill the dish. The straw powder was compressed slightly. The dish was placed into the Series 4000's rotating sample dish holder and the scan initiated. 10 scans are collected and averaged from each of the 10gm sample portions. The sample dish was removed and the sample repacked and re-analysed as above saving all spectral data.

Each of the 14 samples had been analysed 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 280 spectra of the straw samples were imported into NTAS (NIR Technology Analysis Software) where Partial Least Squares Regression was applied to develop calibrations for protein and moisture.

Results:

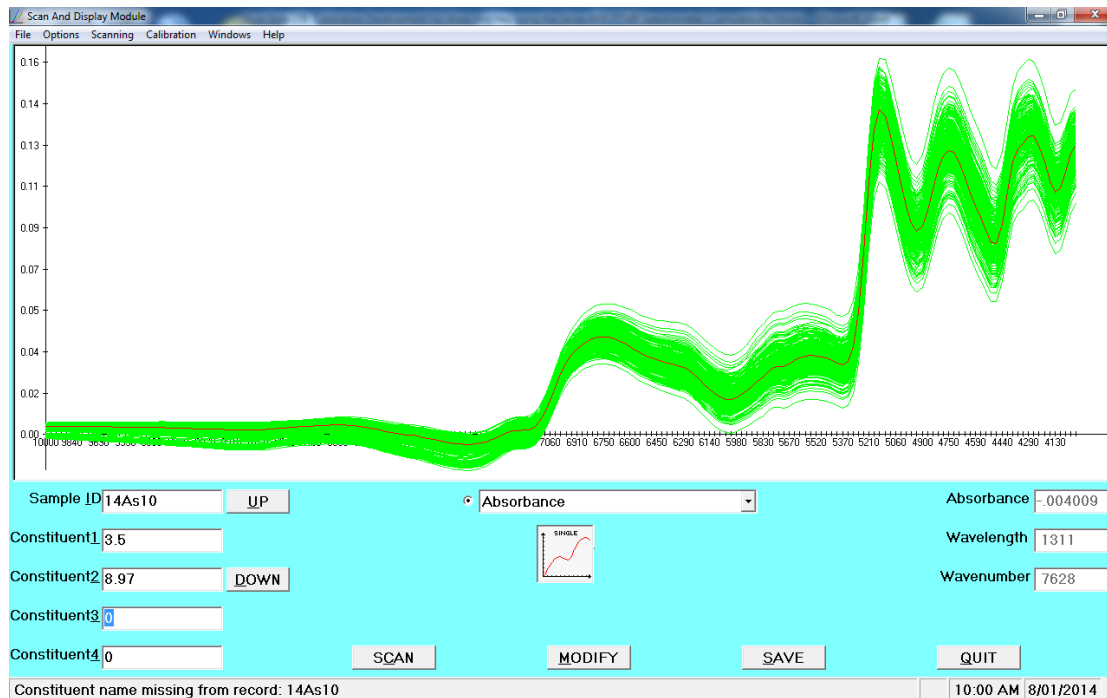Figure 3. Diffuse Reflectance Spectra of Straw Samples

Figure 2. NIR Spectra

Figures 4 & 5 show the results of the protein and moisture calibration respectively.
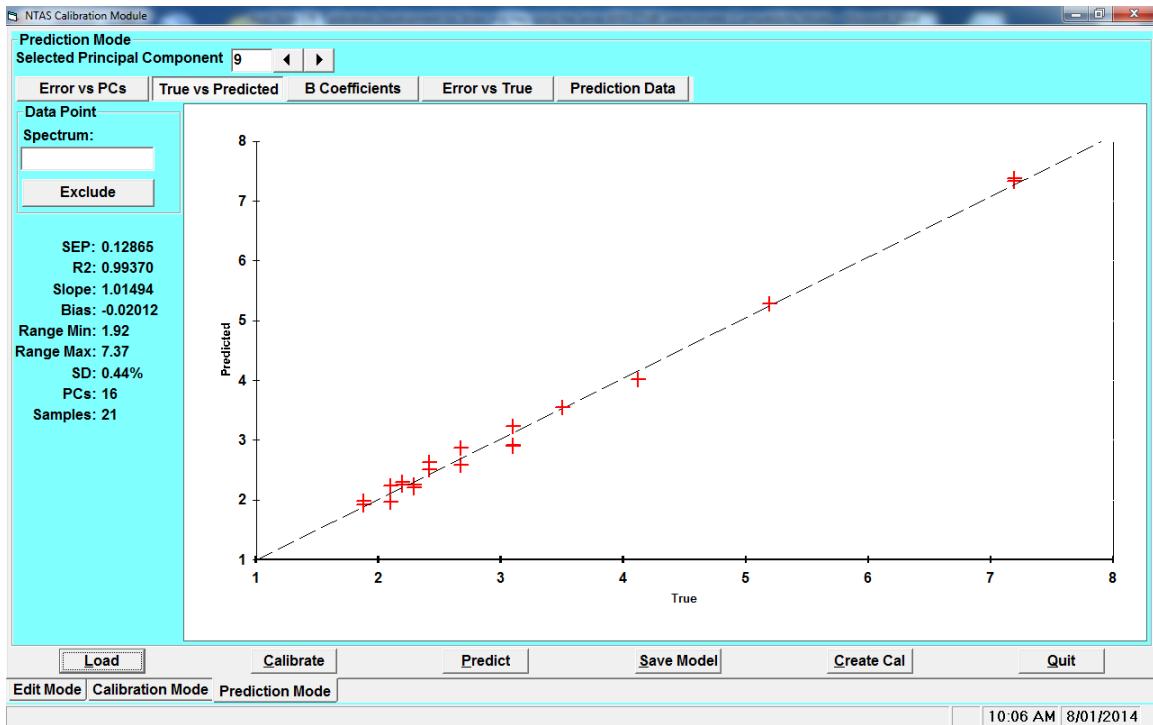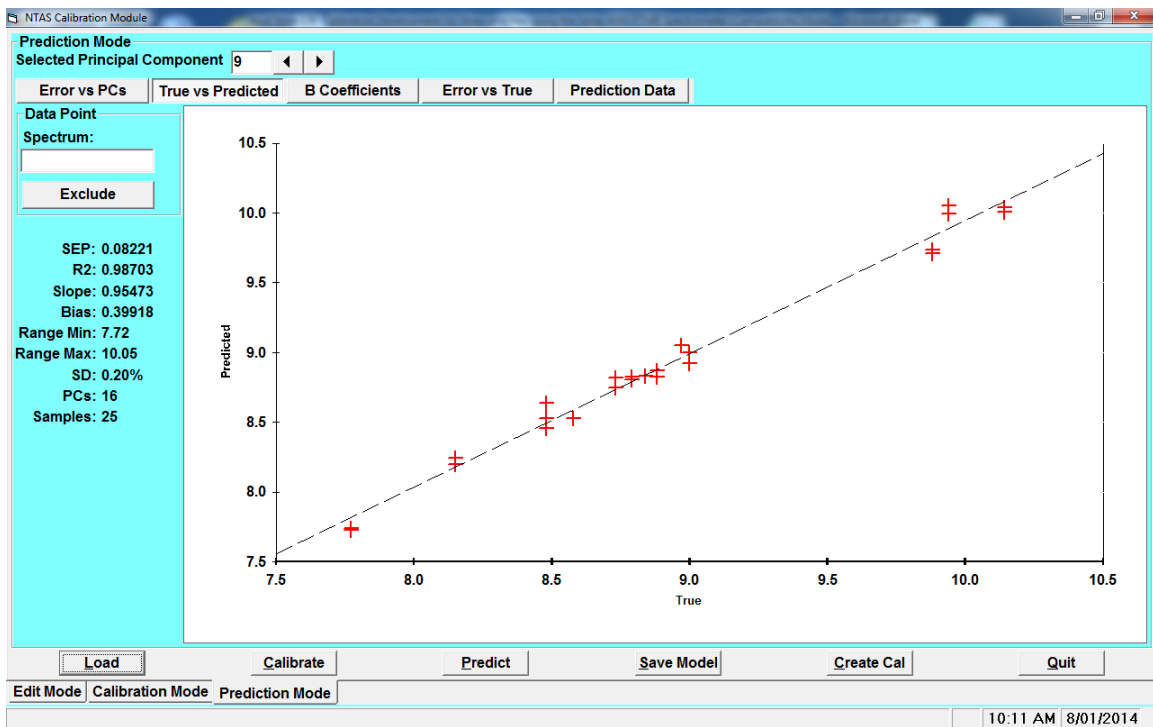
Figure 4. Protein Calibration Plot.

Figure 5. Moisture Calibration Plot

Discussion:

Near Infrared Reflectance spectroscopy is a well established technique for the rapid prediction of protein and moisture.

The objective of this report is to demonstrate that the Series 4000 FTNIR Spectrometer provides a means of accurately measuring Straw and Hay samples.

The data presented in this report shows that the Series 4000 FTNIR Spectrometer can be calibrated to measure protein and moisture in straw and hay. Clearly more samples will be required to develop a robust calibration particularly in the higher proteins (above 4% with this sample set).