Application Note 71: Calibration of Protein, Fat and Moisture in Animal Feed Pellets using a Cropscan 2000B.

Introduction:
NIR systems have long tested protein and moisture in grains and other raw materials that are used in the creation of stock feed pellets. The pellets themselves proved to be difficult to scan in their normal state due to the inconsistency in pellet size and packing density. After testing several methods of sampling, it was determined that use of a burr grinder to reduce the pellets to a powdered state, and then sampling using a 4mm wide squeeze cell in a Cropscan2000B, provided the best and most consistent method of sampling.

This study was undertaken to demonstrate the feasibility of measuring protein, Fat and moisture in the finished product of animal feed pellets. The Cropscan2000B was used for the purpose of this study.

Procedure:
28 samples of stock feed pellets were prepared using a hand grinder to reduce the pellet size and then a burr grinder to reduce the pellets to the consistency of coarse powder. With this done the powdered pellets were then placed in the squeeze cell of the Cropscan 2000B and scanned over the wavelength range of 720nm to 1100nm at a pathlength of 4mm. A total of 10 scans were collected and each sample was repacked and presented to the instrument three times. The spectra were averaged over the ten scans and then uploaded into NTAS (NIR Technology Australia Software) and Partial Least Squares Regression (PLS) was used to develop a calibration for Protein and Moisture.

Results:
Figure 1, below, shows the NIT spectra of the 46 samples of ground pellets.

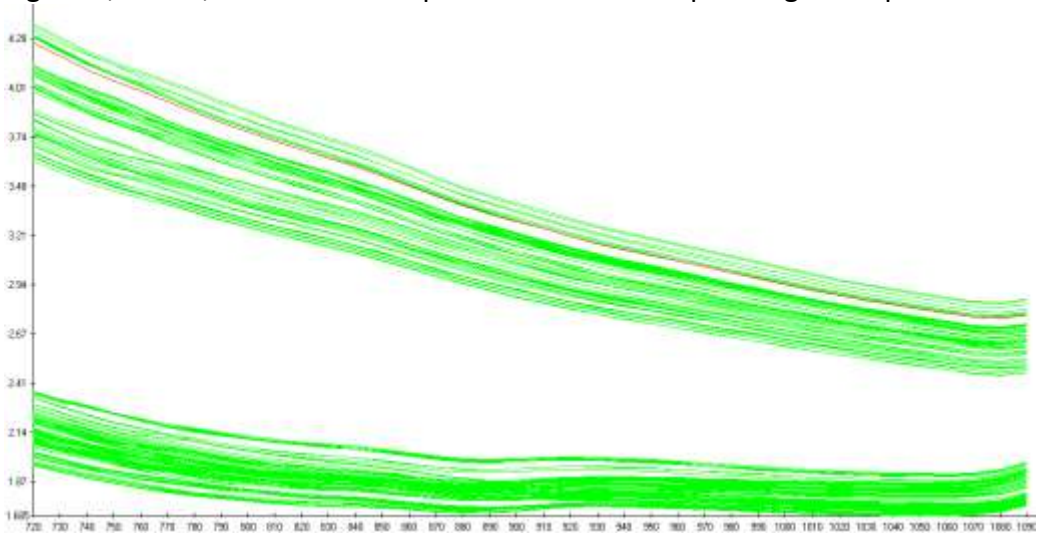

Figure 1: Plot of NIR Spectra for scanned stock feed pellets.

As can be seen above the pellets clearly separated in to two distinct groups. Therefore each group was calibrated separately. The upper group was comprised of marine foods, which are darker in colour. Where as the lower group was comprised for other feed types including dog feed pellets and beef cubes.

We shall illustrate the upper group of 15 samples of marine feed first.

Figure 2, below, shows the calibration statistics for the NIR protein values versus the reference protein value for the marine feeds. The Standard Error of Calibration is 0.59% with a correlation (R^2) of 0.96.

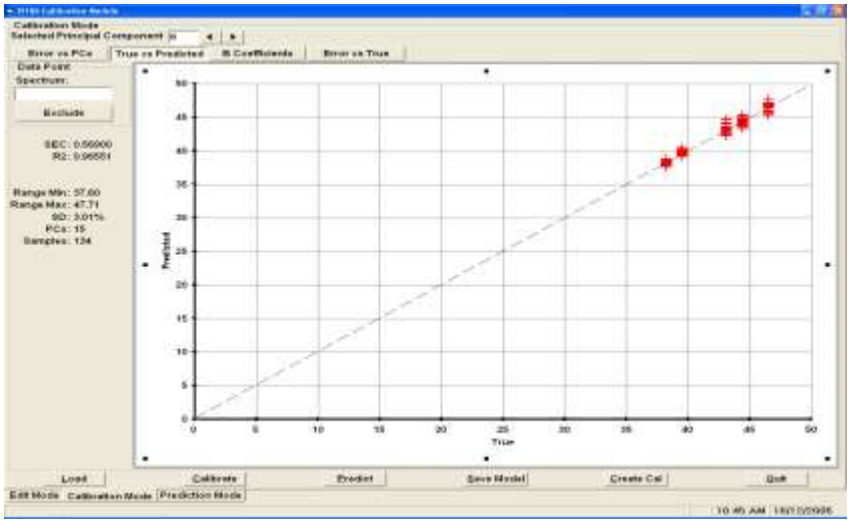

Figure 2: Plot NIR Predicted Protein value vs. Reference Protein value.

Figure 3, shows the calibration statistics for the NIR Fat values versus the reference Fat value for the marine feeds. The Standard Error of Calibration is 0.5% with a correlation (R^2) of 0.98.

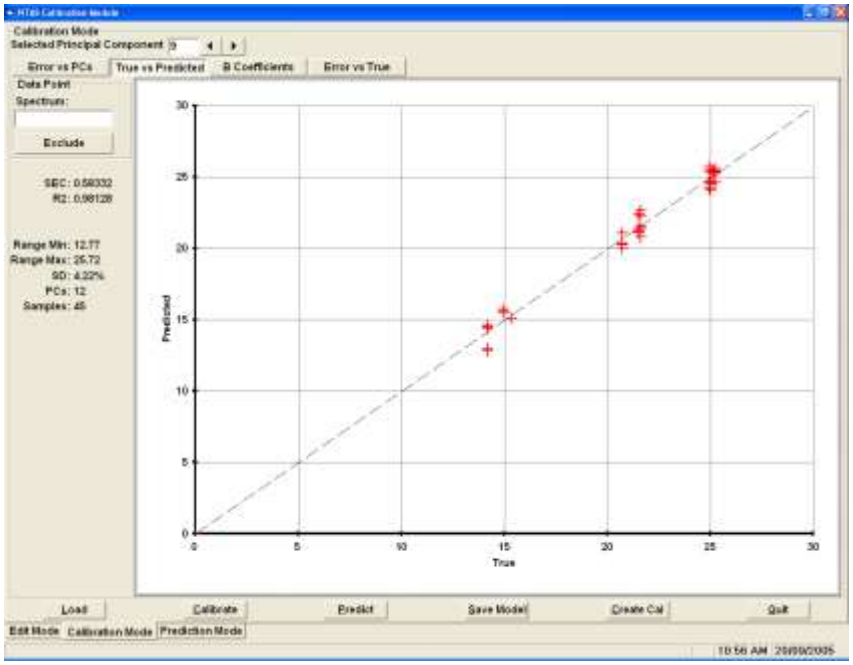

Figure 3: Plot NIR Predicted Fat value vs. Reference Fat value.

Figure 4, shows the calibration statistics for the NIR Moisture values versus the reference Moisture value for the marine feeds. The Standard Error of Calibration is 0.08% with a correlation (R^2) of 0.93.

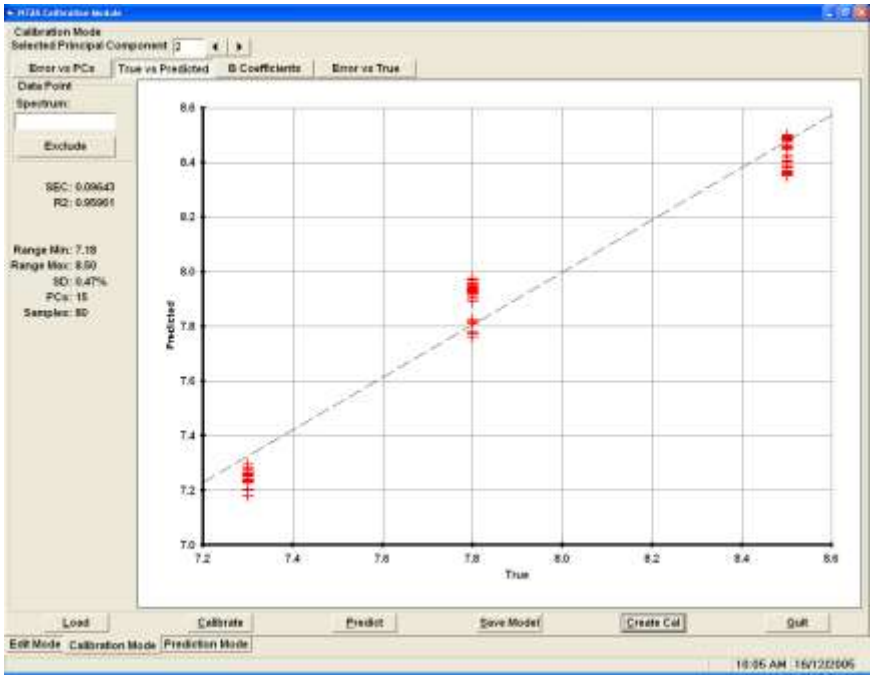

Figure 4: Plot NIR Predicted Moisture value vs. Reference Moisture value.

The Following are all in relation to the lower group of animal feed pellets.

Figure 5 shows the calibration statistics for the NIR Protein values versus the reference Protein values. The Standard Error of Calibration is 0.17% with a correlation (R^2) of 0.98.

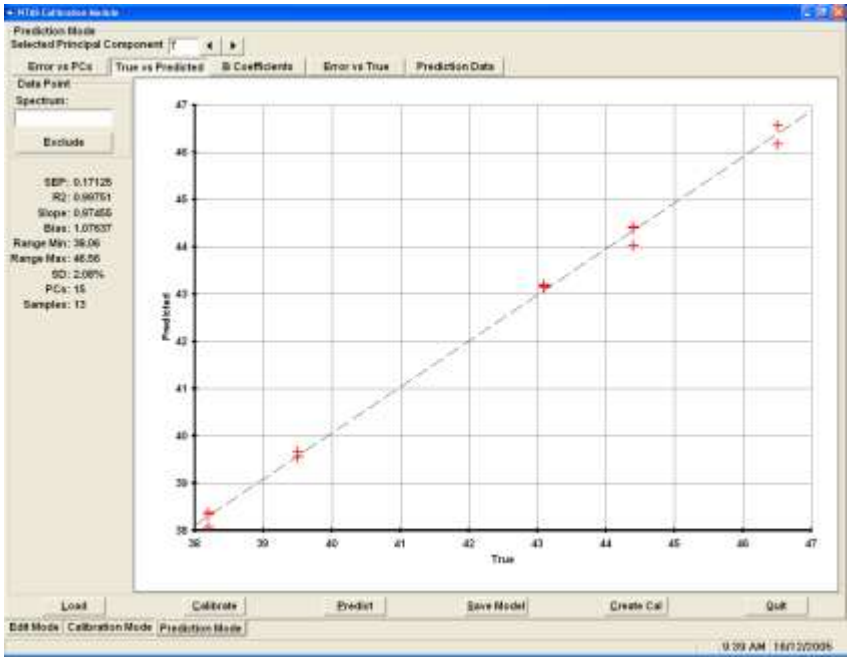

Figure 5: Plot NIR Predicted Protein value vs. Reference Protein value.

Figure 6 shows the calibration statistics for the NIR Fat values versus the reference fat values. The Standard error of calibration is 0.11% with a correlation of 0.98. Figure 7 shows the calibration statistics for the NIR moisture values versus the reference moisture values. The Standard Error of Calibration is 0.16% with a correlation (R^2) of 0.89.

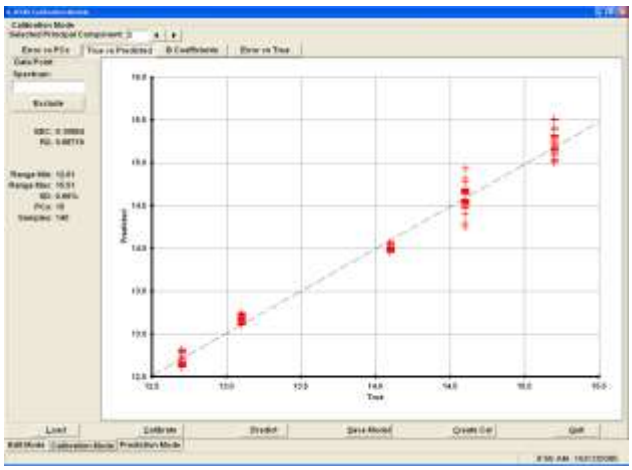

Figure 6: Plot NIR Predicted Fat vs. Reference Fat values.

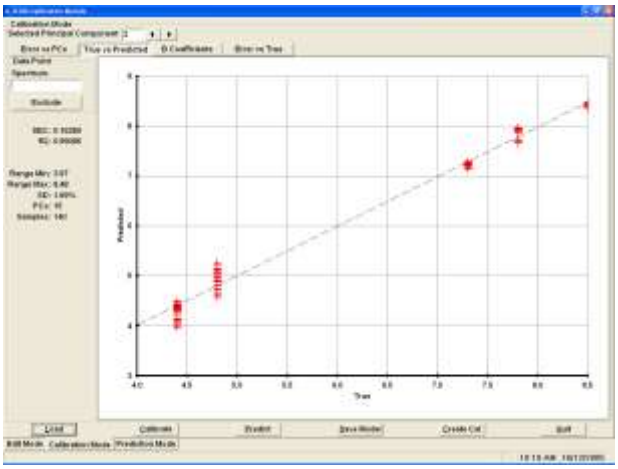

Figure 7: Plot NIR Predicted Moisture vs. Reference Moisture values

Conclusion:

As can be seen from the product spectra in Figure 1 there are clearly two separate groups of spectra. The higher group consists of very dark pellets for marine feed. The spectra for these pellets are somewhat featureless and any variation may be due to the product density and not it's physical make up. Whilst the standard errors of calibration and the correlation levels maybe acceptable, it is possible that this is directly as a result of the affects that the protein, fat and moisture may have on the density of the product.

Further testing of these products will be required before it can be conclusively determined that the spectra is a true representation of the product make up.

The second set of spectra show distinct feature changes across the measured wavelengths indicating that the results are a good indication of the product make-up. As a result of this the improved standard errors of calibration and the correlations are a clear indication that the Cropscan 2000B is capable of measuring the protein, fat and moisture in these samples.

However, current sampling methods for all of these products currently required a two step process, the first to reduce pellets size and the second to grind the product to a powdered consistency. A one step process would be required for this to function on a quantitative level. The use of a hammermill may be feasible but is a potentially expensive option. Also, neither set of spectra is sufficient independently to construct an acceptable calibration.

NIR Technology Systems
366 Edgar Street, Condell Park, NSW, 2200, Australia
Tel: 612 9708 5068, Fax: 612 9708 5537
Email: nirtech@nirtech.net, Web: www.nirtech.net