Introduction.

Meat and bone meal (MBM) is a bi-product of the rendering industry. It is used as a source of high protein material for making stock feed pellets. The composition of MBM is typically about 48 - 52% protein, 33-35% ash, 8-12% fat, and 4-7% moisture and is sold based on the protein and fat content. As such the rendering plant needs to measure the protein and fat content to ensure that their product meets the customers' specifications.

Instrumentation.

The MultiScan Series 3000 Near Infrared Transmission spectrometer uses a rotating sample drawer to analyse a wide range of materials. The instrument uses a diode array spectrometer to scan the wavelength region 720-1100nm at a resolution of 10nm. The instrument scans the sample ten times and then gives the average of the sub scans in the final predicted result.

Sampling Technique.

30 samples of ground MBM were supplied with % moisture values. The sample were spooned out of the sample container and spread into the Series 3000 lexan sample dish and smoothed level with a plastic slide. As the dish is rotated in the light beam the instrument collects the Near Infrared Transmission (NIT) spectra, 720-1100nm, from 10 portions of each sample. Each samples was repacked and scanned in duplicate to produce 30 x 2 x 10 = 600 spectra which was stored in the instrument's memory. The spectra were uploaded into NTAS (NIR Technology Analysis Software) and Partial Least Squares Regression (PLS) was used to develop calibrations for moisture.

Results
Calibration Models

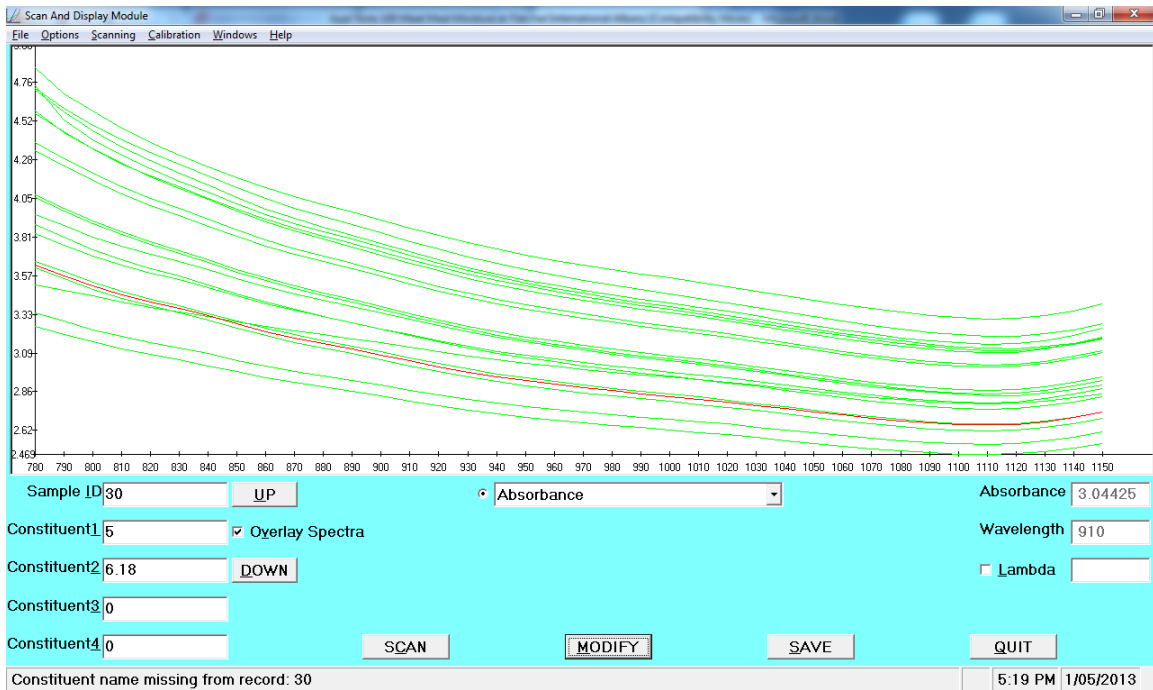Figure 2.1, below, shows the NIT spectra for the Meat & Bone Meal samples.

Figure 2.1: Plot of NIR Spectra for Meat & Bone Meal

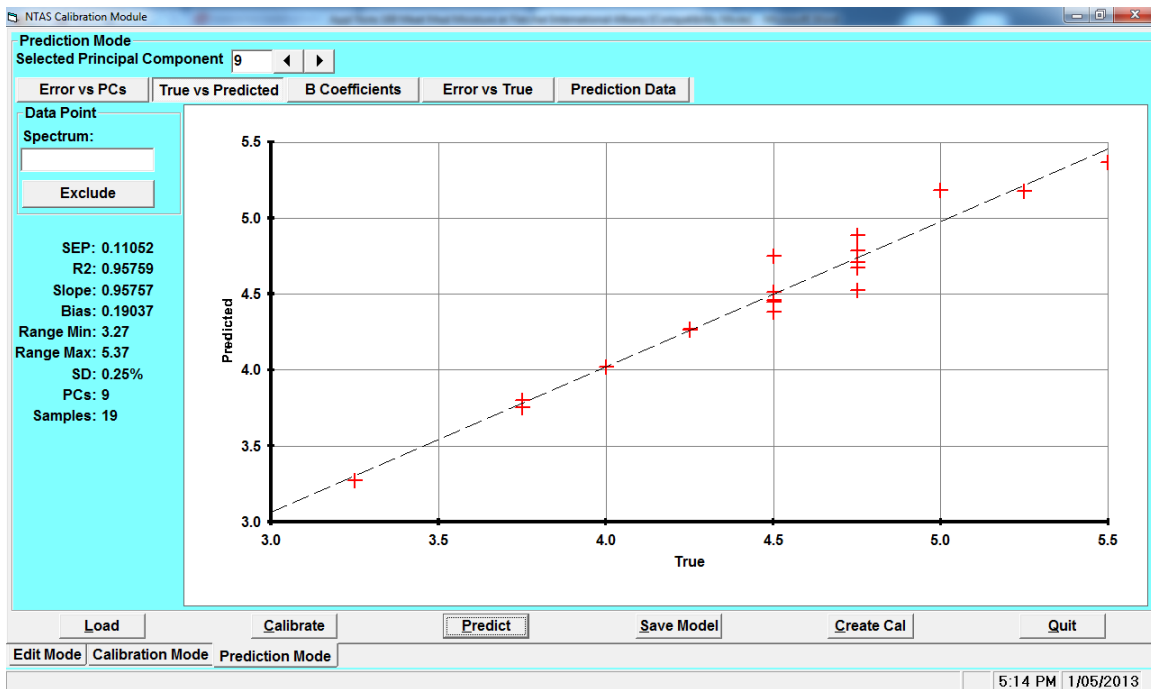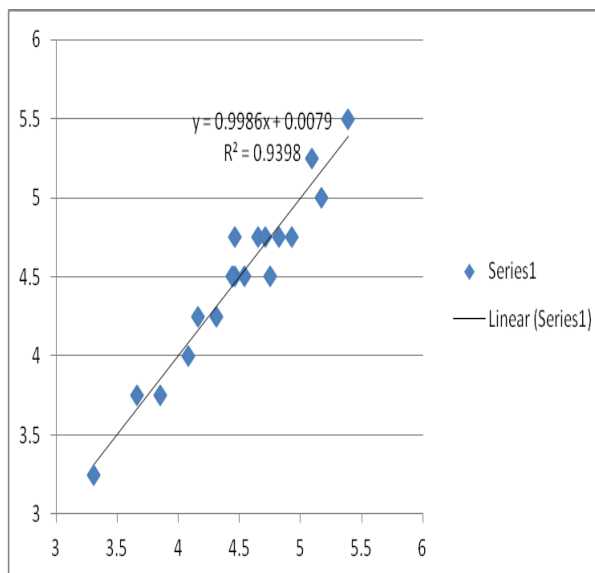Figure 2.2 shows the calibration statistics for the NIR Moisture values versus the batch reference values.

Figure 2.2: The Standard Error of prediction is 0.11% with a correlation (R2) of 0.96.

Prediction.

19 samples from the same batch were analysed to check the calibration model for moisture. Table 1 provides a summary of the predicted results comparing against the Lab values on the Meat & Bone Meal.

Table 1: Predicted results Vs MBM lab results.

SampleID	NIR	LAB	Errors		
2	4.16	4.25	0.09		
1	5.09	5.25	0.16		
3	4.31	4.25	-0.06		
4	4.93	4.75	-0.18		
5	4.44	4.5	0.06		
7	4.46	4.5	0.04		
8	3.85	3.75	-0.1		
9	3.66	3.75	0.09		
10	4.75	4.5	-0.25		
12	5.39	5.5	0.11		
13	3.31	3.25	-0.06		
14	4.82	4.75	-0.07		
18	4.54	4.5	-0.04		
22	4.65	4.75	0.1		
24	4.08	4	-0.08		
26	4.44	4.5	0.06		
28	4.46	4.75	0.29		
29	4.71	4.75	0.04	**Average**	**0.00**
30	5.17	5	-0.17	**SEP**	**0.13**

Chart: $y = 0.9986x + 0.0079$, $R^2 = 0.9398$ (Series1, Linear (Series1))

The standard error of prediction for Moisture was excellent, 0.13% against the reference method.

Conclusion.

The measurement of moisture in meals is a relatively simple test for NIR. Protein and fat measurements are more important and require a good set of calibration samples that represents the range of protein and fat to be found in normal production samples.

This study demonstrates that the MultiScan Series 3000 Food Analyser is suitable for analyzing meat and bone meal samples for moisture. Next Instruments have developed calibrations for protein, fat, moisture and ash in meal samples several times and as such, it is confident that Series 3000 will be suitable for measuring protein, fat, moisture and ash in meat and bone meal.