Introduction:

This study was undertaken to demonstrate the feasibility of measuring fat and moisture in concentrated meat bone extract. The ultimate objective is to use an online system, in process, to maximise product quality and concentration levels. This study used a Series 3000 Food analyser for sample analysis.

Procedure:

Many samples were taken from the production line for the concentrated meat bone extract. The samples were divided in to two sets, this finished product ready for packaging and an in process product still undergoing production. The samples were presented to the analyser at temperature of 70 degrees Celsius. The samples were in a liquid state at this temperature, as the samples cool they congeal to become a solid. 50ml of each sample was placed in a petrii dish and scanned over the wavelength range of 720nm to 1100nm. A total of 10 scans were collected and each sample was repeated and presented to the instrument twice. The spectra was collected and then uploaded into NTAS (NIR Technology Analysis Software) and Partial Least Squares Regression (PLS) was used to develop a calibration for fat and moisture.

Results:

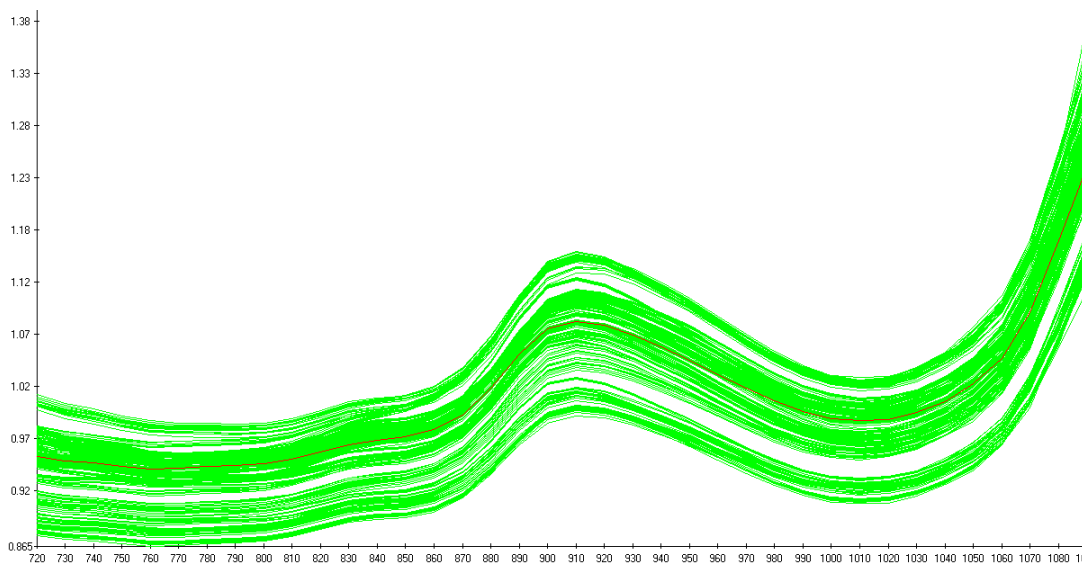Figure 1, below, shows the NIR spectra of the samples of in process MBC solutions.

Figure 1: Plot of NIR Spectra for scanned in process MBC solutions.

Figure 2, below, shows the NIR spectra of the samples of finished MBC solutions.
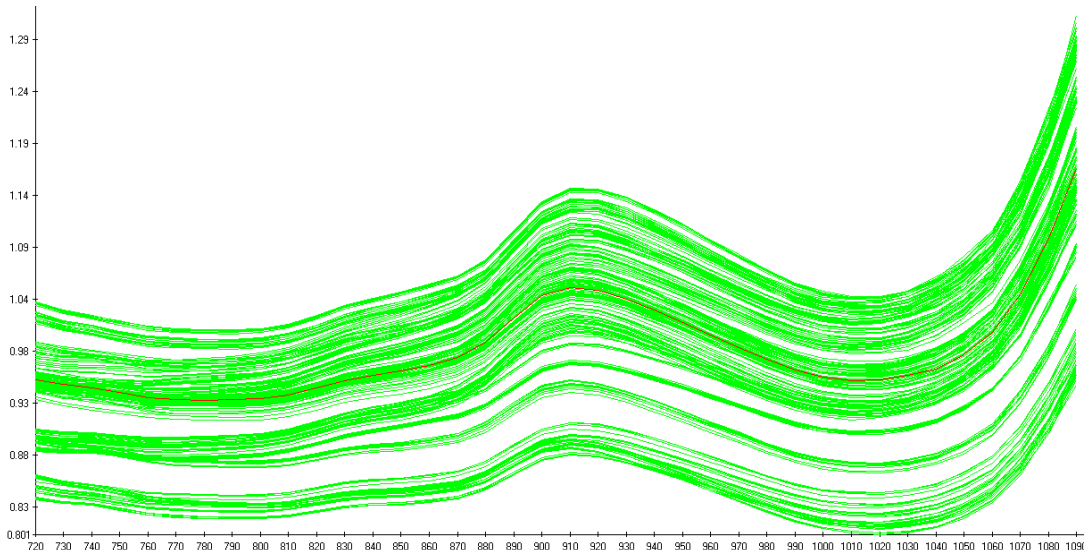

Figure 2: Plot of NIR Spectra for scanned finished MBC solutions.

Figure 3, shows the calibration plot for the NIR Fat values versus the reference Fat values for the in process product. The Standard Error of Prediction (SEP) is 0.5 with a correlation (R^2) of 0.89.
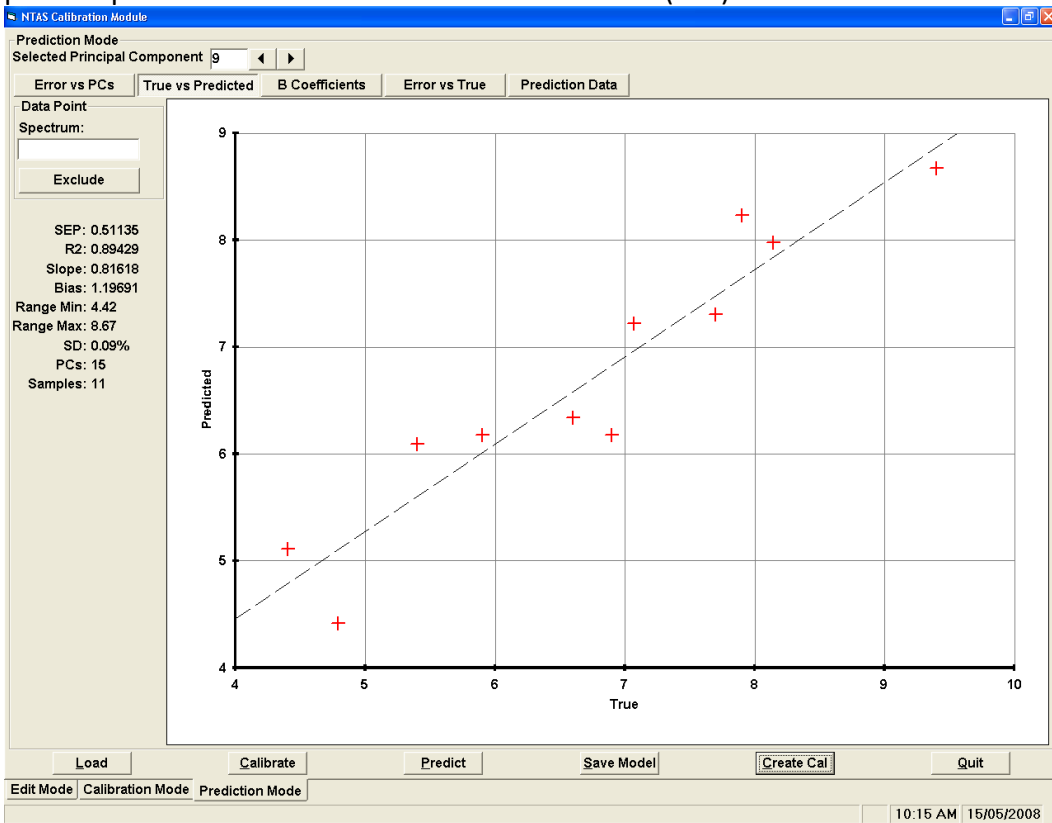

Figure 3: Plot NIR Predicted Fat value vs. Reference Fat value for in process product.

Figure 4, shows the calibration plot for the NIR moisture values versus the reference moisture values for the in process product. The Standard Error of Prediction(SEP) is 0.3 with a correlation (R^2) of 0.97.
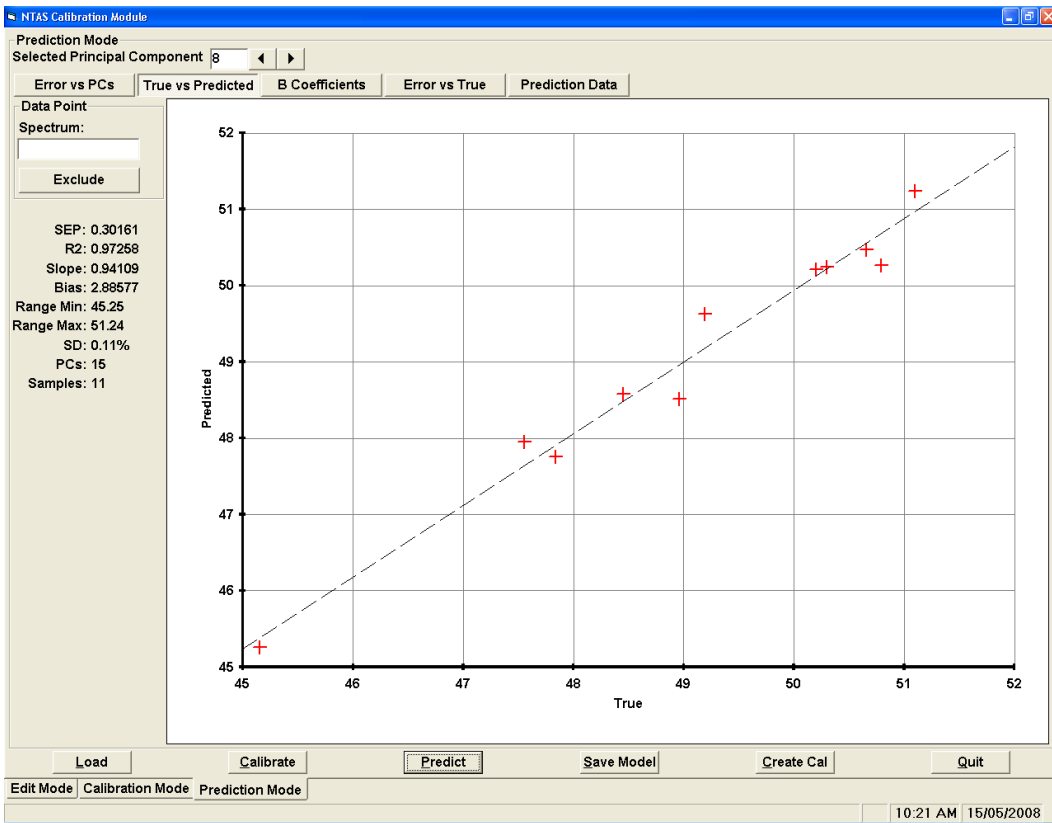
Figure 4: Plot NIR Predicted moisture value vs. Reference moisture value for in process product.

Figure 5, shows the calibration plot for the NIR Fat values versus the reference Fat values for the finished product. The Standard Error of Prediction (SEP) is 0.24 with a correlation (R^2) of 0.98.
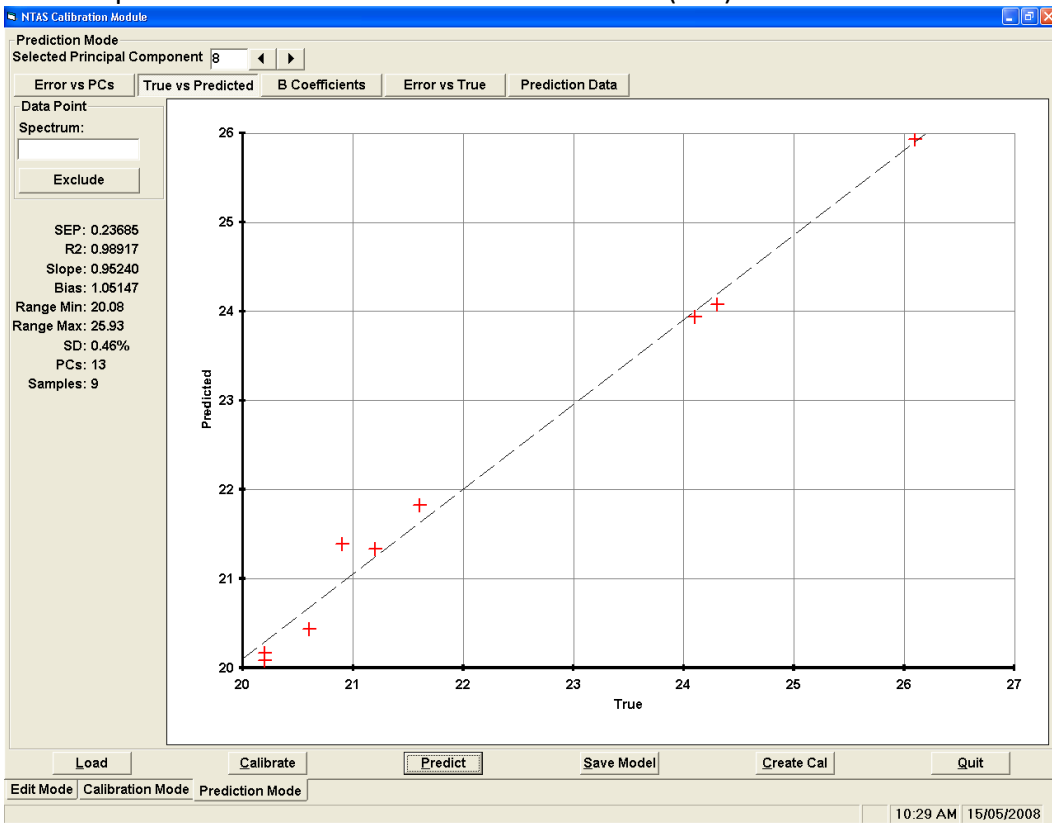

Figure 5: Plot NIR Predicted Fat value vs. Reference Fat value for finished product.

Figure 6, shows the calibration plot for the NIR moisture versus the reference moisture for the finished product. The SEP is 0.3 with a correlation (R^2) of 0.97.
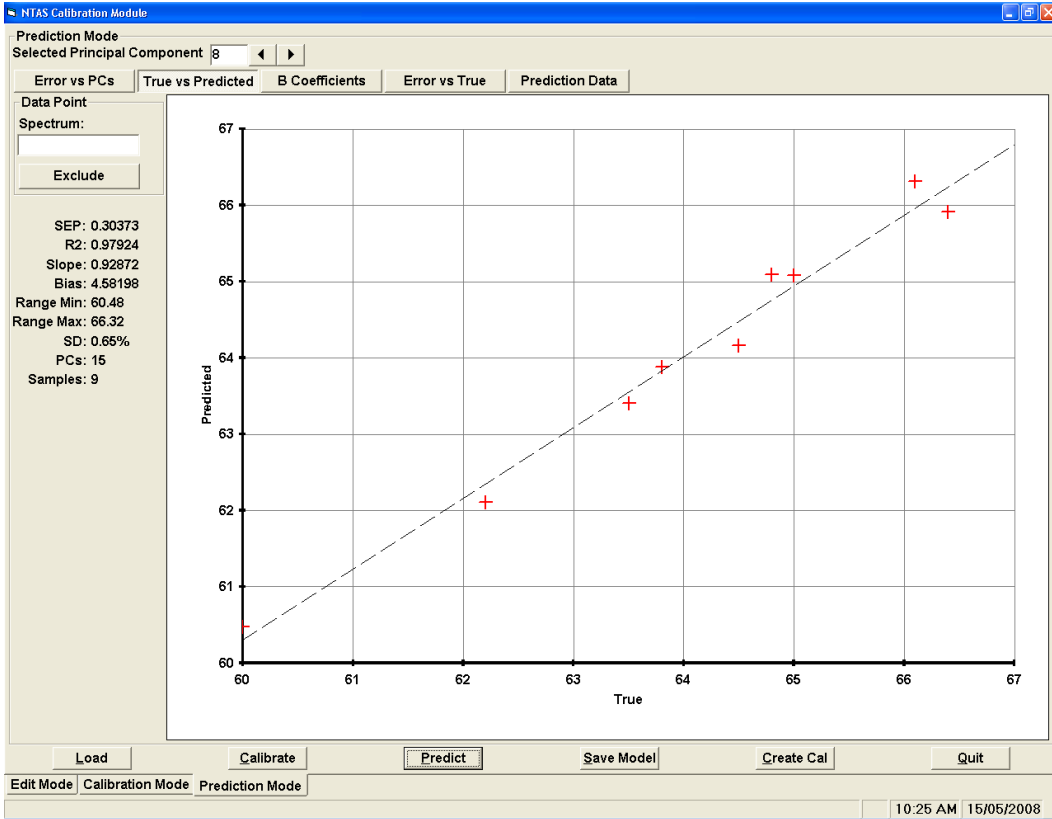

Figure 6: Plot NIR Predicted moisture value vs. Reference moisture value for finished product.

For the finished product additional reference data was available for the constituents of Salt and Protein for some of the tested samples. Figures 7 and 8 below show the plots for the two new constituents respectively. The SEP for salt is 0.1 with a correlation (R^2) of 0.99 and the SEP for protein is 0.1 with a correlation (R^2) of 0.99.
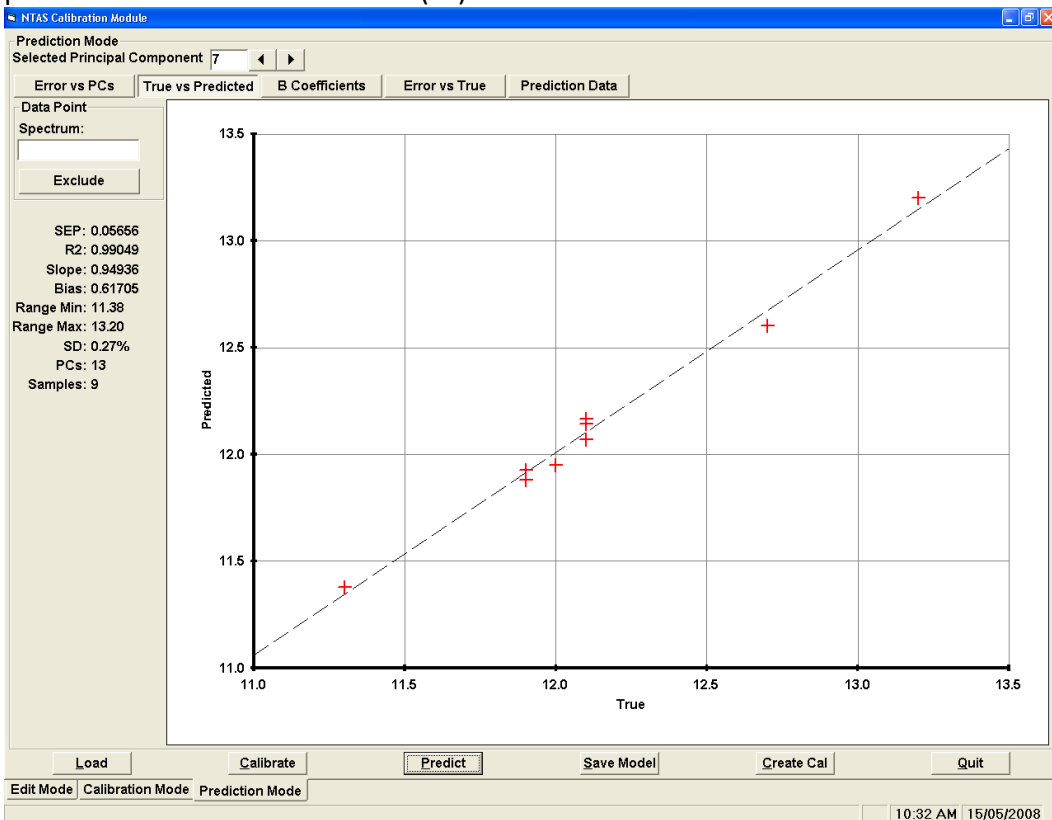
Figure 7: Plot NIR Predicted salt value vs. Reference salt value for finished product.
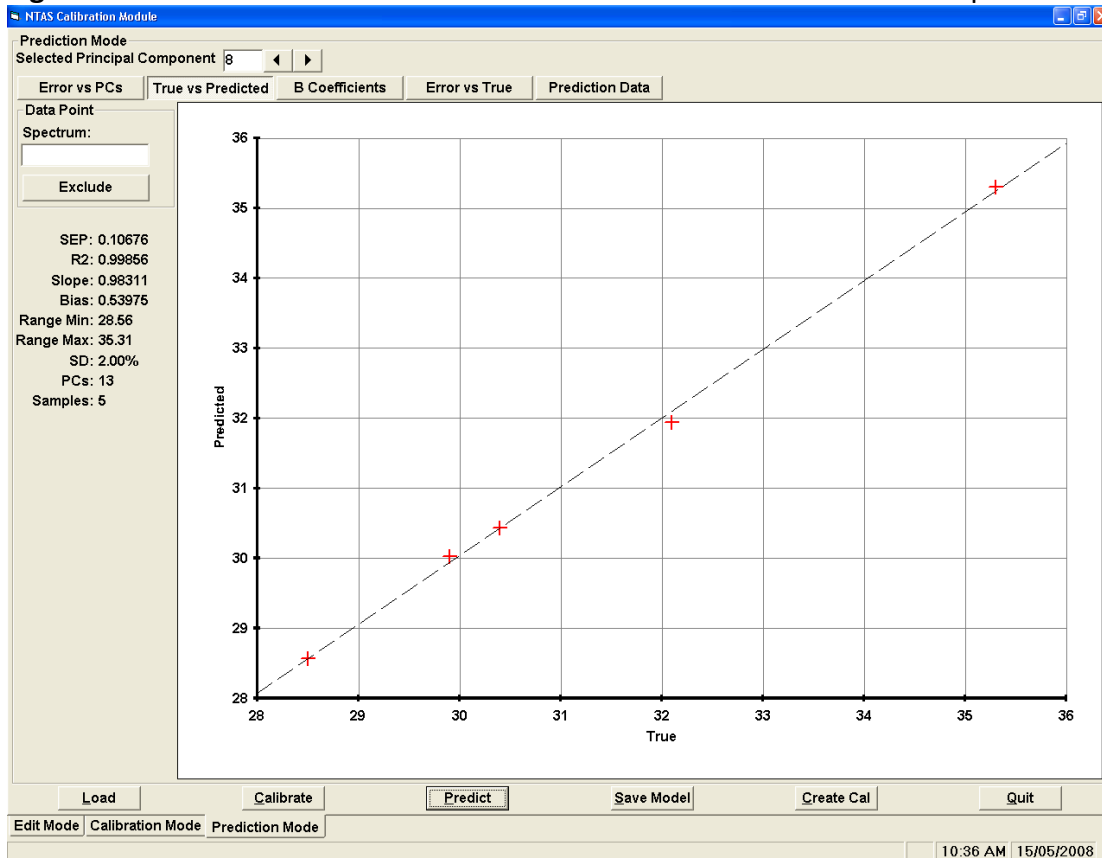

Figure 7: Plot NIR Predicted protein value vs. Reference protein value for finished product.

Conclusion:

It can be seen in the above calibration plots that the Series 3000 food analyser can be calibrated to detect the desired constituent at acceptable levels. However, by implementing an online analysis system it is likely that Standard Errors of predictions could be notably improved.

As the samples were taken at 70 degrees Celsius and placed in the analyser they began to cool rapidly. This resulted in a spectral shift for each sample based on its falling temperature. Averaging the samples across all ten of the scans taken helped to alleviate this issue. A small number of the in process samples actually formed skins on their surfaces due to the rapid cooling of the samples. These samples were excluded from the above study.

Implementing an online sampling and analysis system for these products, would totally remove any cooling of the sample, and thereby, any potential errors introduced by the resultant spectral shift.

Additional sampling and analysis would be needed with the online system to enhance and improve the above calibrations to make them more robust and accurate.