Appl Note 133. Measurement of Chemical Lean in Beef, Pork and Lamb

1. Introduction.

Meat is sold based on the amount of fat in the meat. The inverse to the fat content is termed Chemical Lean. Fat can be determined by various fat extraction methods including Soxhlet, Babcock or Majonier. The CSIRO developed a Microwave method for determining the moisture content of a meat sample and applying a factor to calculate the Chemical Lean. The microwave method has been a relatively quick method however it is labour intensive and the repeatability between tests and analyst can be large. The use of a Near Infrared Analyser would not only save time but minimize training required for multiple testers as well as provide the ability to save and transfer data. This study was undertaken to show the accuracy of the MultiScan Series 3000 Food Analyser against the Microwave method for measuring CL in Beef, Pork and Lamb.

1.1 Instrumentation.

The MultiScan S3000 Food Analyser is a Near Infrared Transmission spectrometer equipped with a rotating sample cup. 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 computes the average of the sub scans to give the predicted result in 60 seconds.

1.2 Sampling Technique.

1000 Beef, Lamb and Pork Samples were collected over an eight week period from the Bunbury Meat Centre in WA and measured for Moisture using the approved AusMeat Microwave method as described in the Meat Technology Information Sheet dated January 2006. The Chemical Lean was calculated for each sample using the following equations;

Beef	> 80% moisture	CL = 1.21 x Moisture +5.44
	<80% moisture	CL = 1.35 x Moisture – 3.2

Lamb	CL = 1.25 x Moisture +2.7
Pork	CL = 1.27 x Moisture + 1.1

Each sample was then weighed (89-91grams) into a 10mm S3000 sample dish. A flat plastic disk was placed over the top and pushed down to spread the sample out into the dish leaving a flat surface, the top surface was then scraped across using a Perspex scraper to give a level smooth surface. The sample were then placed into the Series 3000 Food Analyser and scanned from 720-1100nm. 10 scans were collected for each sample and saved in the instruments PC. The spectra were uploaded into NTAS (NIR Technology Analysis Software) and Partial Least Squares Regression (PLS) was used to develop calibrations for CL and Moisture.

2. Results

2.1 Calibration

Figure 2.1, below, shows the NIT spectra for the 80 through to 97 CL for beef.

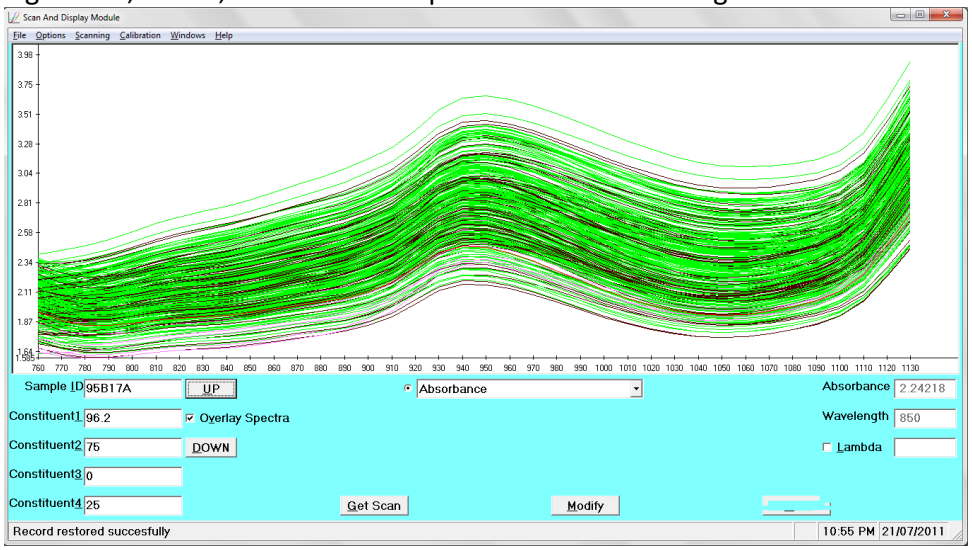


Figure 2.1: Plot of NIR Spectra for 85, 90 95 Beef.

Figure 2.2, below, shows the NIT spectra for the 65 through to 80 CL for beef.

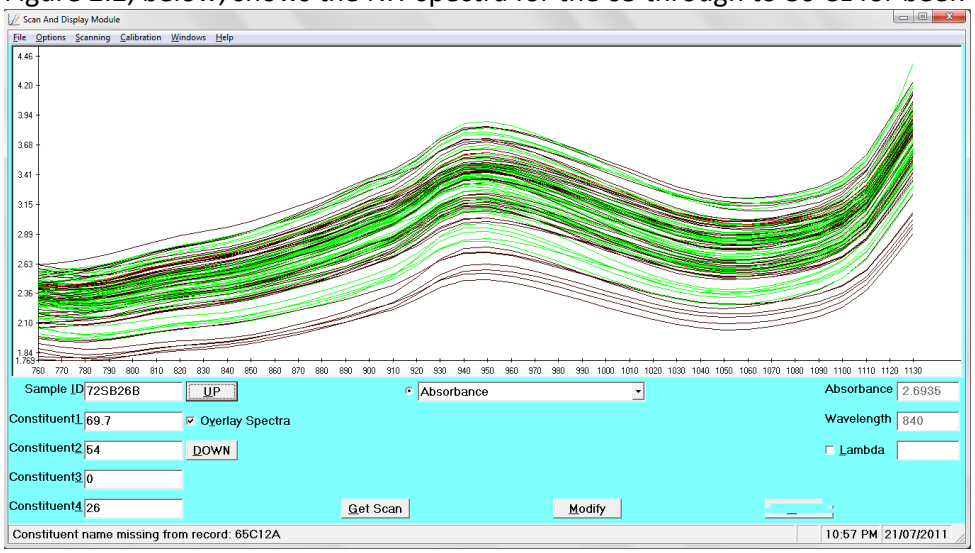


Figure 2.2: Plot of NIR Spectra for72 Beef.

Figure 2.3, below, shows the NIT spectra for the 65 through to 80 CL for beef.

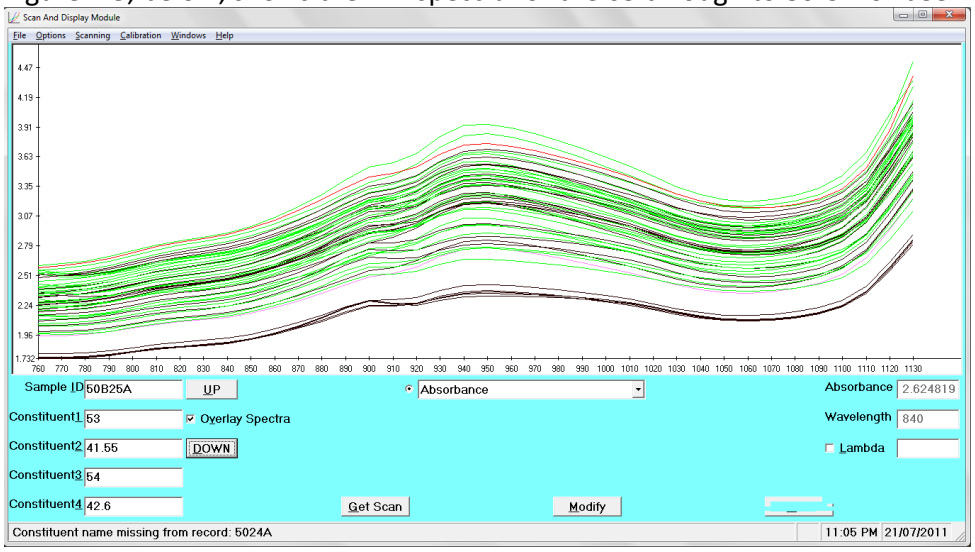


Figure 2.3: Plot of NIR Spectra for 50 Beef

Figure 2.4, below, shows the NIT spectra for 85 through to 95 CL for pork.

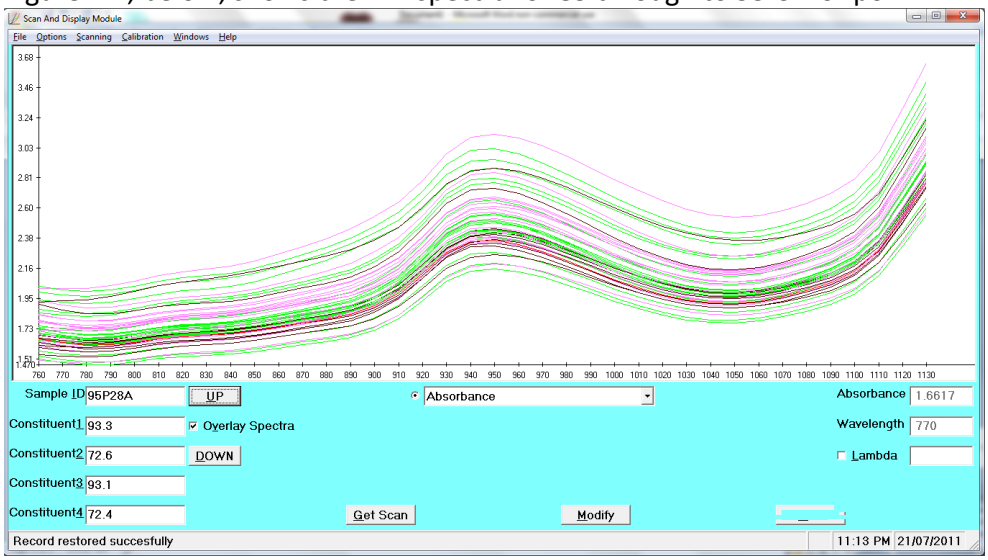


Figure 2.4: Plot of NIR Spectra for 85, 95 Pork.

Figure 2.5, below, shows the NIT spectra for 85 CL for lamb.

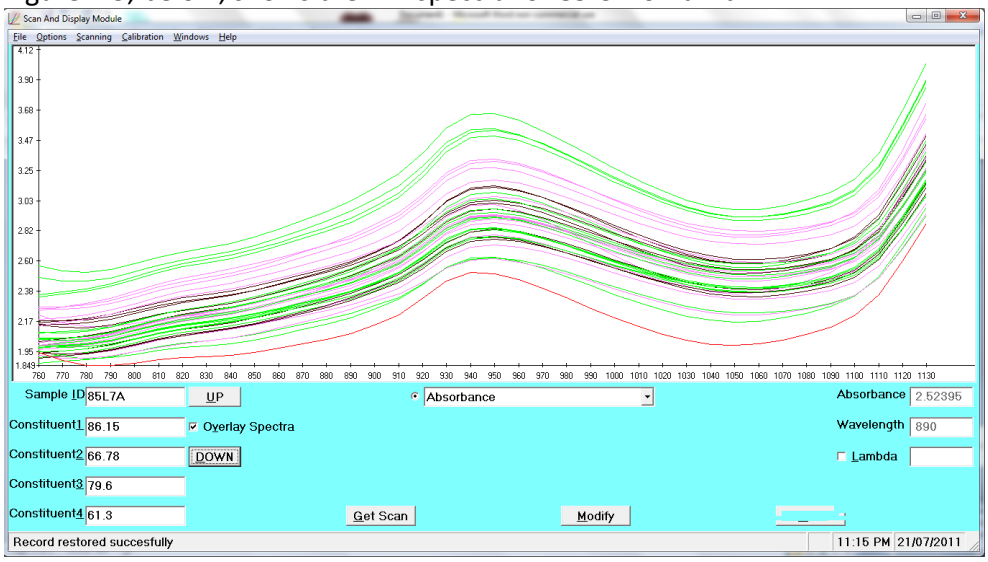


Figure 2.5: Plot of NIR Spectra for 85 Lamb.

Figure 2.6, below, shows the NIT spectra for 50 CL for lamb.

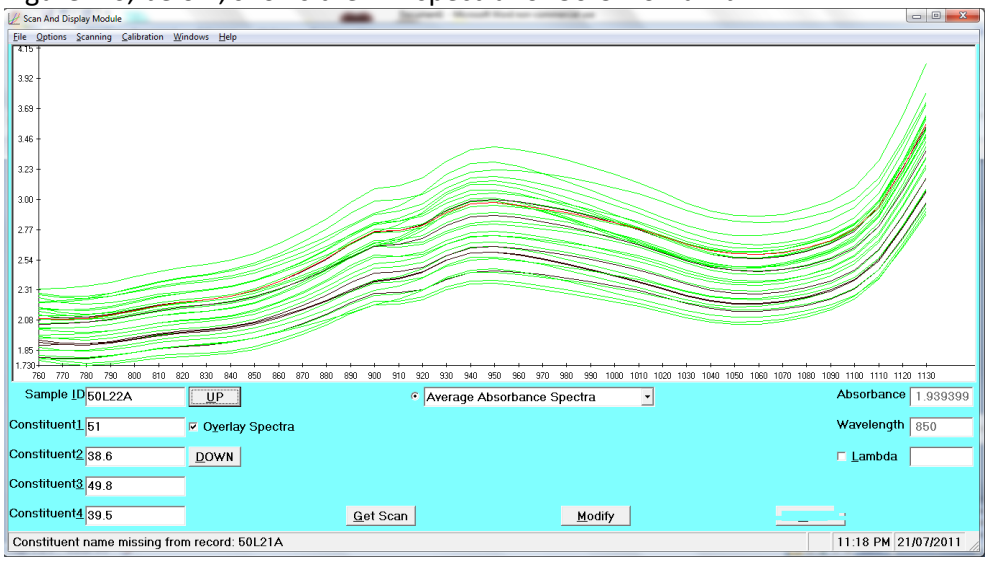


Figure 2.6: Plot of NIR Spectra for 50 Lamb.

Figure 2.7 shows the calibration plot for the NIR 95 Beef CL values versus the Microwave values.

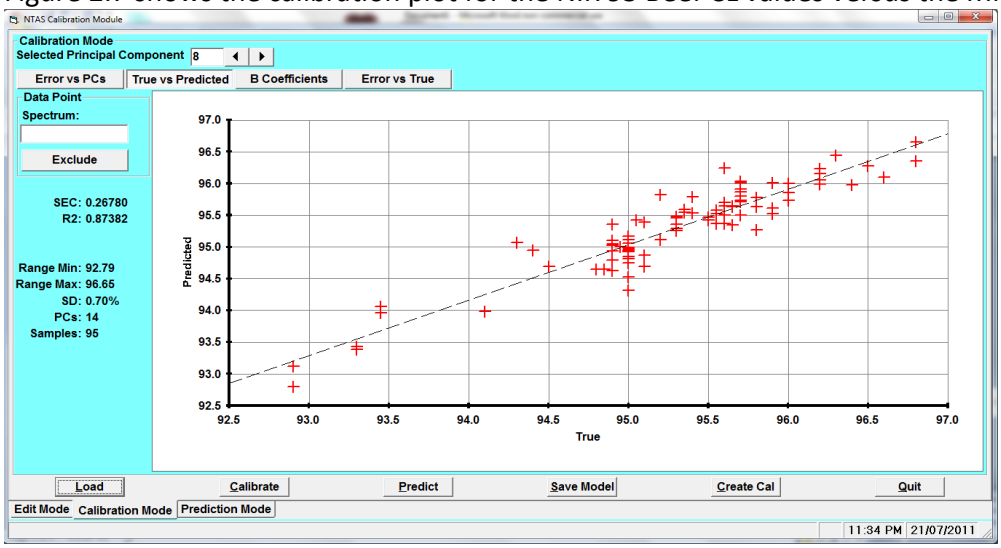


Figure 2.7: The Standard Error of calibration is 0.27% with a correlation (R2) of 0.87.

Figure 2.8 shows the calibration plot for the NIR 90 Beef CL values versus the Microwave values.

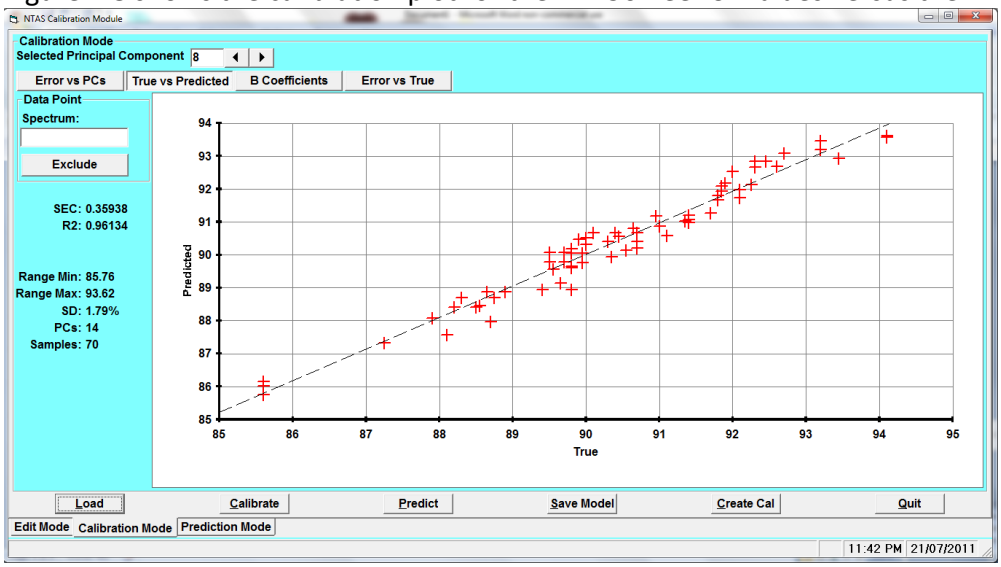


Figure 2.8: The Standard Error of calibration is 0.37% with a correlation (R2) of 0.96.

Figure 2.9 shows the calibration plot for the NIR 72 Beef CL values versus the Microwave values.

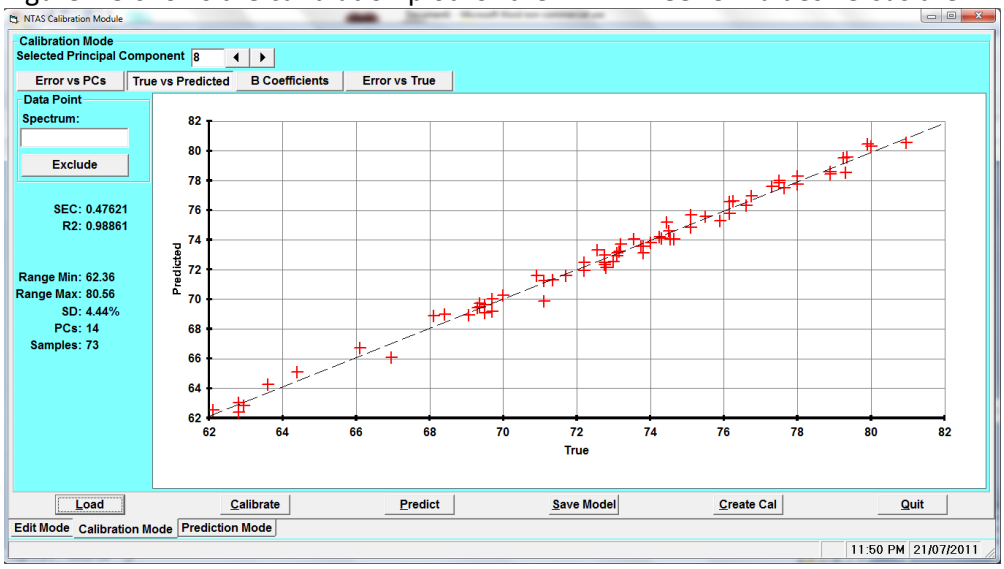


Figure 2.9: The Standard Error of calibration is 0.48% with a correlation (R2) of 0.99.

Figure 2.9 shows the calibration plot for the NIR 85 Beef CL values versus the Microwave values.

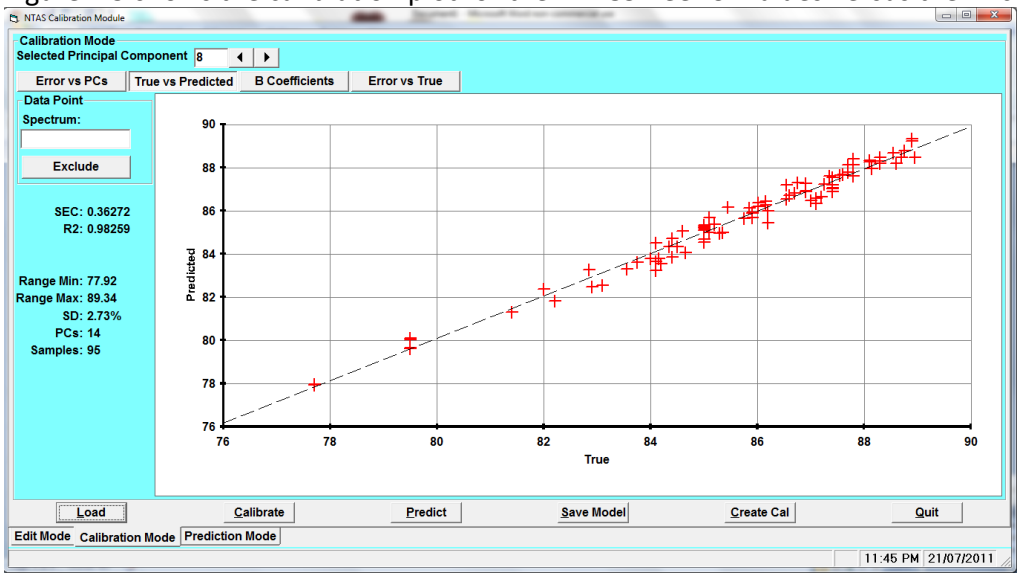


Figure 2.9: The Standard Error of calibration is 0.37% with a correlation (R2) of 0.98.

Figure 2.10 shows the calibration plot for the NIR 72 Beef CL values versus the Microwave values.

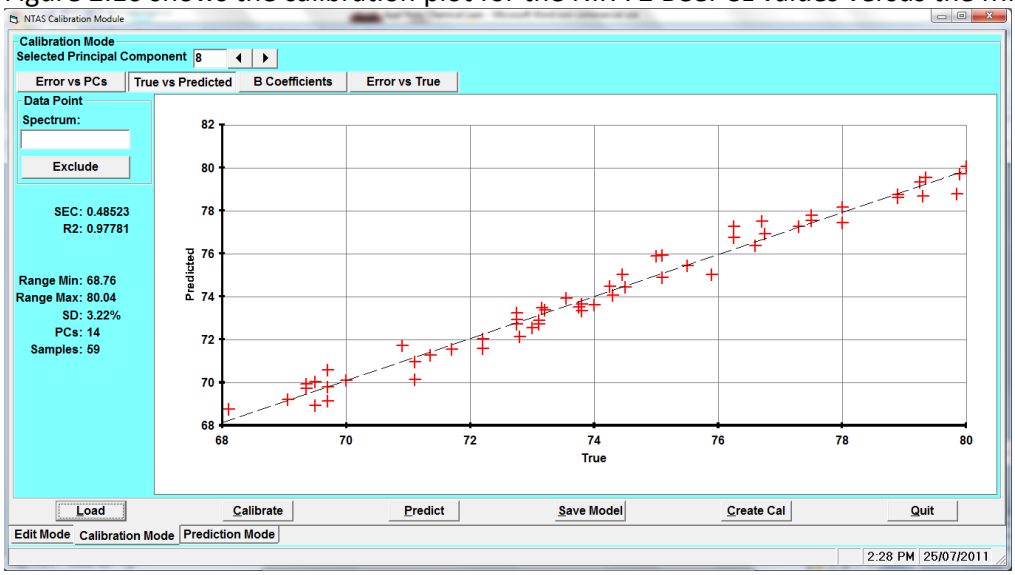


Figure 2.10: The Standard Error of calibration is 0.48% with a correlation (R2) of 0.98.

Figure 2.11 shows the calibration plot for the NIR 72 Beef CL values versus the Microwave values.

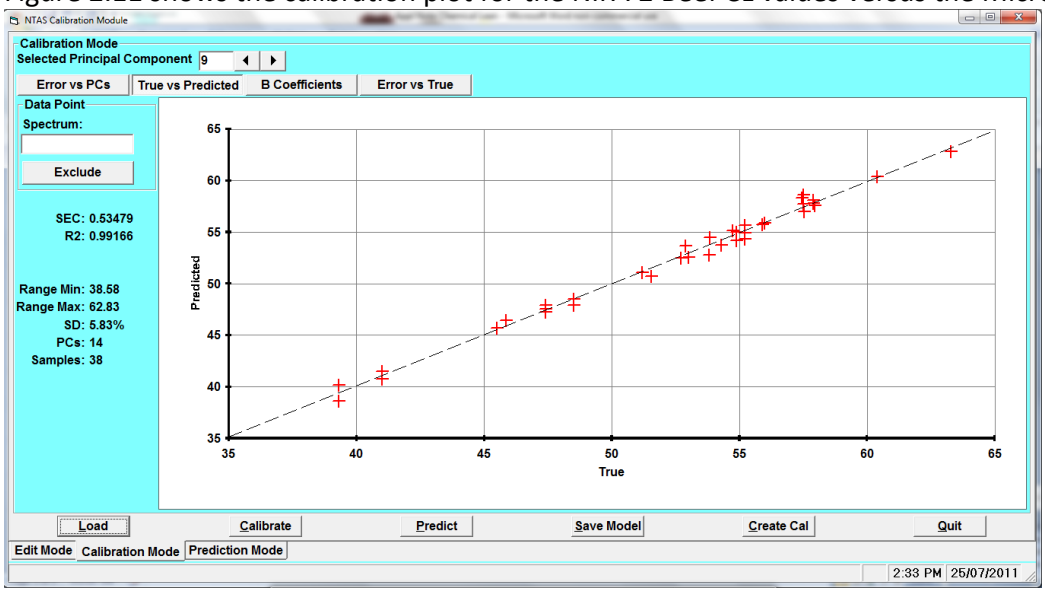


Figure 2.11: The Standard Error of calibration is 0.53% with a correlation (R2) of 0.99.

Figure 2.12 shows the calibration plot for the NIR 72 Beef CL values versus the Microwave values.

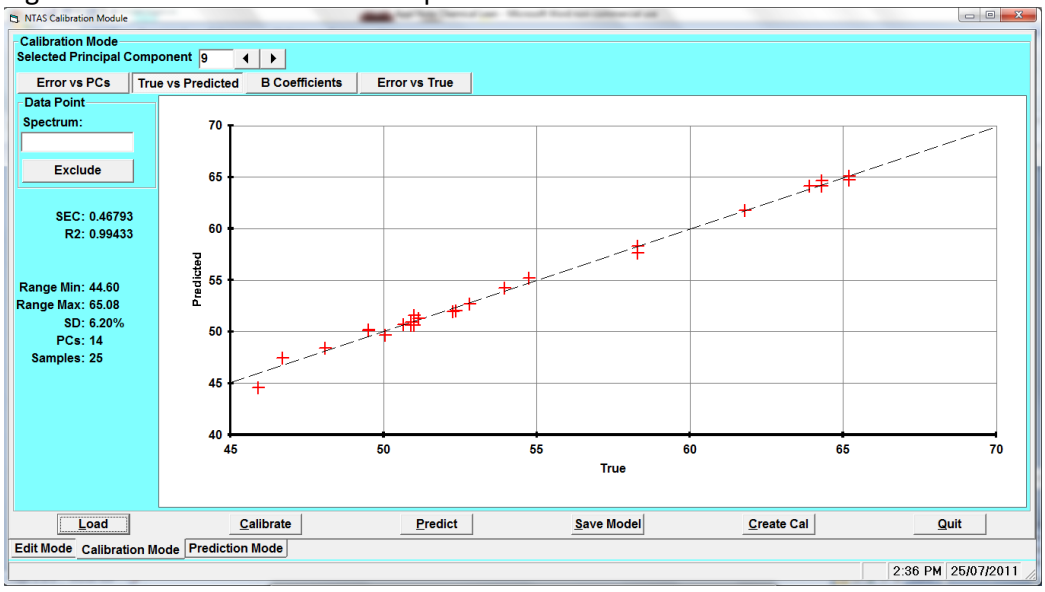


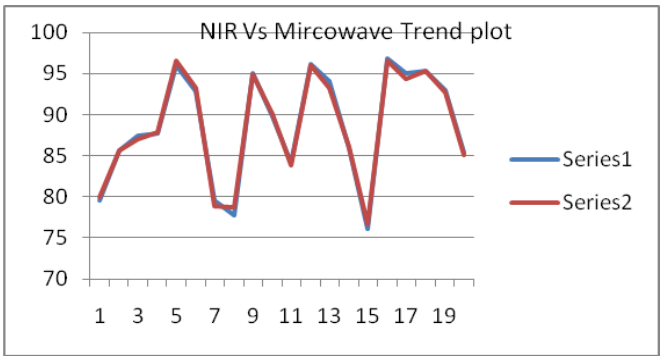
Figure 2.12: The Standard Error of calibration is 0.46% with a correlation (R2) of 0.99.

Prediction Data:

Over two days samples which were not in the calibration set were tested using the microwave method and then scanned through the MultiScan S3000 to predict CL. Table 1.0 shows the prediction results for high CL samples and Table 1.1 shows the prediction results for low CL samples over the two days against the microwave results.

Table 1.0

Sample ID	CL Ref	CL NIR		Diff
90ORG 1	79.5	80		-0.5
90PREB2	85.6	85.7		-0.1
85REGB3	87.4	87		0.4
85V5	87.7	87.8		-0.1
95HSP4	96.05	96.5		-0.45
85P6	92.85	93.2		-0.35
85L7	79.6	78.8		0.8
85M8	77.7	78.7		-1
95B10	95	94.9		0.1
90B11	89.8	90.1		-0.3
85B12	84.1	83.8		0.3
95COW16	96.2	96		0.2
90COW17	94.1	93.3		0.8
85COW18	85.9	86		-0.1
75COW19	76.15	76.6		-0.45
95HSB923	96.8	96.6		0.2
95B24	95	94.4		0.6
95B25	95.3	95.3		0
90B26	92.9	92.7		0.2
85B27	85.3	85.1		0.2
SEP				0.455803



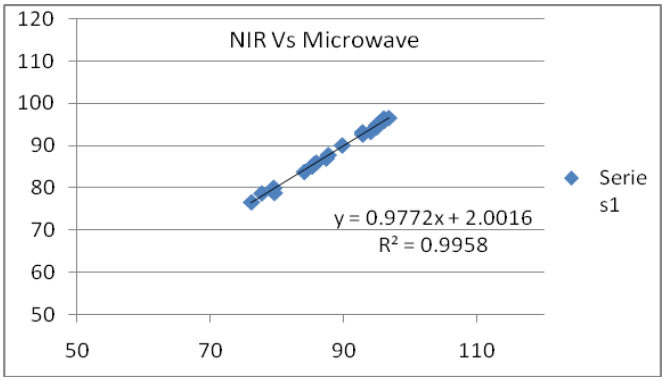
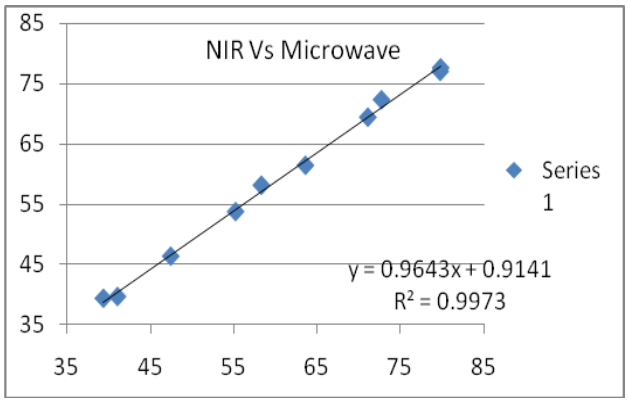
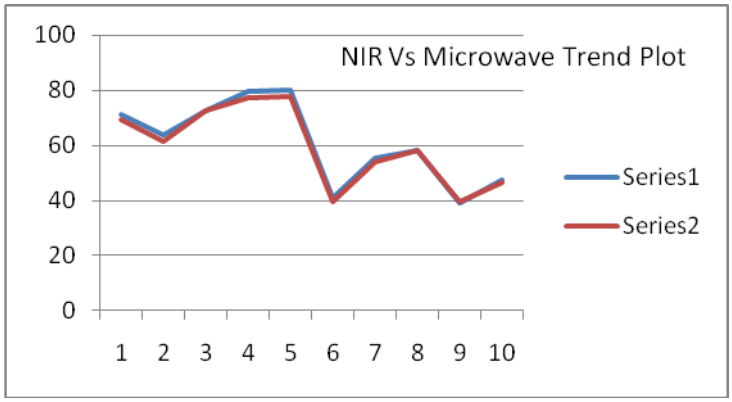


Table 1.1

Sample ID	CL Ref	CL NIR		Diff
70PACK13	71.1	69.5		1.6
70SAUS14	63.6	61.5		2.1
72BPACK28	72.75	72.4		0.35
72SAUS29	79.8	77.1		2.7
72SAUS30	79.85	77.7		2.15
50B15	41	39.7		1.3
50COW20	55.2	53.8		1.4
50LAMB22	58.3	58.2		0.1
50B31	39.3	39.4		-0.1
50B32	47.4	46.4		1
STD				0.93089





Discussion:

The objective of this study was to establish whether the Near Infrared Transmission (NIT) technology used in the MultiScan Series 3000 Food Analyser from Next Instruments could be calibrated for measuring Chemical Lean in meat, using the data from the current Microwave method. The data from tables 1.0 and 1.1 show that the calibrations developed using the Series 3000 are comparable to the data obtained from Microwave method. Figures 3.1 and 3.2 show that the Series 3000 data tracks the Microwave data extremely well. As shown in table 1.0 the high CL calibrations predicted very well given a SEP 0.45 and taking note that sample 7 and 8 were outside of the calibration range for 85 to 95 CL. Adding more samples from 77 to 82 CL would improve these results. The lower CL prediction data didn't predict as well as the high CL. This is due to having different types of product in the calibration set. Separating out the Sausage, Cow and Lamb and putting them into individual calibrations will improve this calibration and give a similar prediction result as seen in Table 1.0 for the high CL samples.
This study has shown that the MultiScan Series 3000 Food Analyser can be calibrated to measure CL and Moisture in Meat samples quickly and accurately compared with the Microwave method.

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