Application Note 42: Analysis of Cheese Powder

Introduction:

Cheese powder is made from block cheese that is ground and mixed with water to form a homogenous blend. The blend is dried either in a spray dryer or evaporative dryer. The resultant powder is used as a flavouring ingredient in the snack food and biscuit industry. The NIT-38 Dairy Analyser was set-up to scan samples of powdered cheese and to develop a calibration for fat, protein, lactose and moisture. The following application note presents the results of the calibration procedure.

Procedure:

26 samples of powdered cheese were scanned using a 4mm pathlength Powder Cell and the NIT-38 Dairy Analyser. The powdered cheese was spooned into the lower half of the powder cell, smoothed across the face of the cell and scrapped clean. The top half of the cell was closed and the cell sealed and cleaned off with a brush.

The cell was placed into the NIT-38 Dairy Analyser and 5 scans were collected as the cell moved passed the light beam. Several samples were scanned in duplicate by repacking the cell and rescanning. The spectra were stored in the analyser's memory and then uploaded to a PC. The spectral data was combined with the laboratory data for each scan, ie, fat, protein, lactose and moisture, using Microsoft Excel Spreadsheet. The resulting file was saved as Lactoscancheese.csv formatted file.

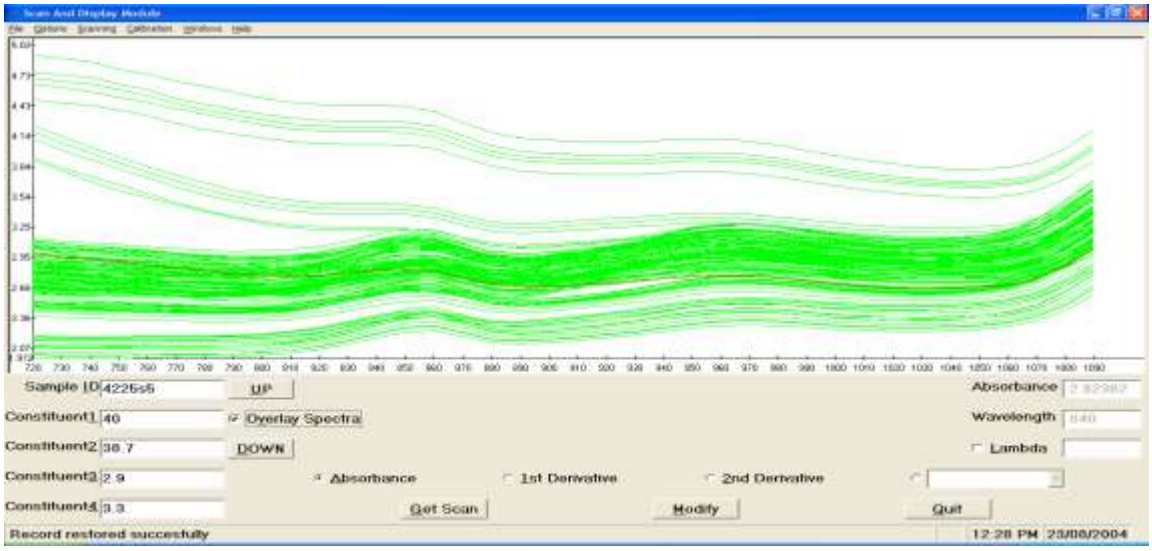

Figure 1. NIT Spectra of Cheese Powder

The Lactosancheese.csv file was imported into NTAS (NIR Technology Australia Software) and the spectral data inspected. Figure 1. shows the spectral plot of the 145 scans collected in the NIT-38 Dairy Analyser. Figure 2. shows the Second Derivative of the spectra. The second derivative algorithm is simply the slope of the slope of the spectra and it is useful in reducing spectra with high degree of scatter, to a single baseline and to accentuate the spectral bands for protein, fat, lactose and moisture. It can be see that in figure 2, the spectral bands at 830, 900 and 950nm are better identified as compared to the spectral bands in figure 1.

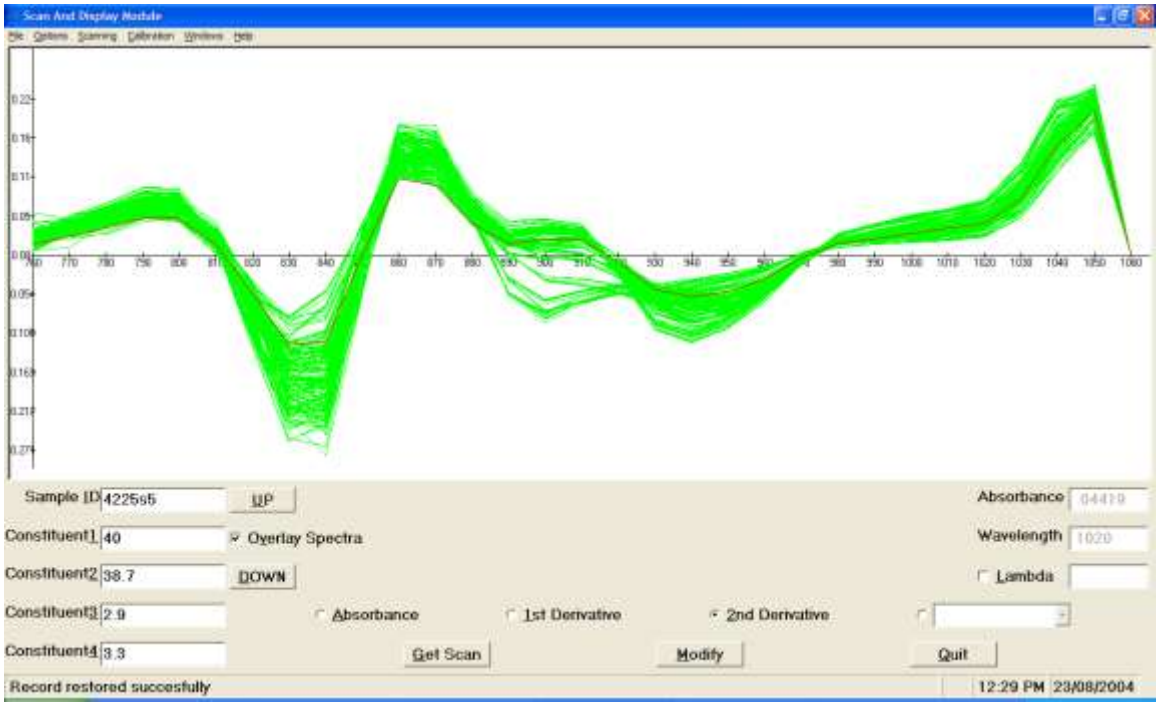

Figure 2. Second Derivative Spectra of Powdered Cheese

Results:

Table 1. presents the results of the calibration statistics for fat, protein, lactose and moisture.

Table 1.

Constituent	# Samples	Range%	#PC	SEC	R^2
Fat	145	12 - 65.5	10	0.83	0.99
Protein	145	14.4 - 44.3	12	0.79	0.99
Lactose	145	0.7 – 26.7	12	1.27	0.97
Moisture	145	2.2 – 4.7	6	0.27	0.72

Figures 3 thru 7 present the plots for the calibrations.

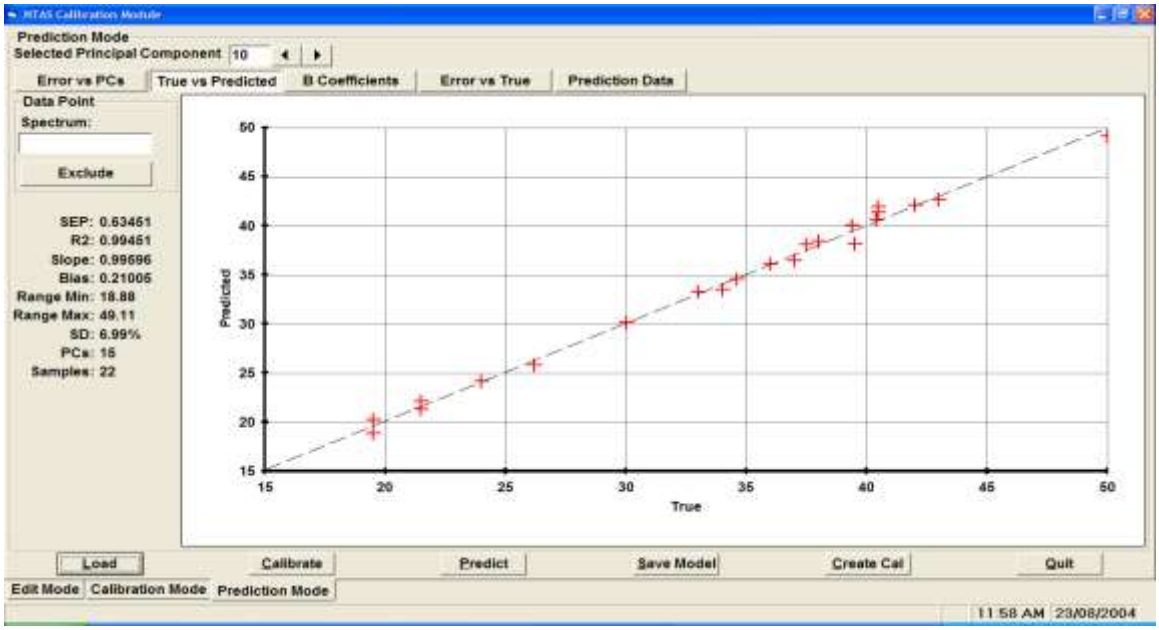

Figure 4. Calibration Plot of NIR Fat vs Ref Fat.

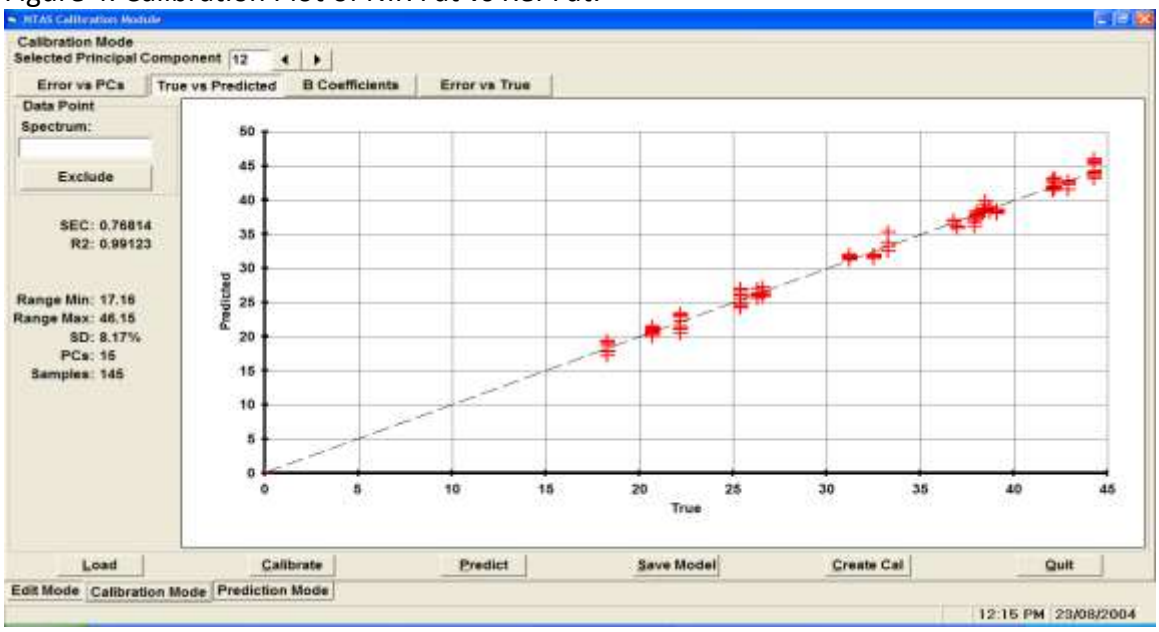

Figure 5. Calibration Plot of NIR Protein vs Ref Protein.

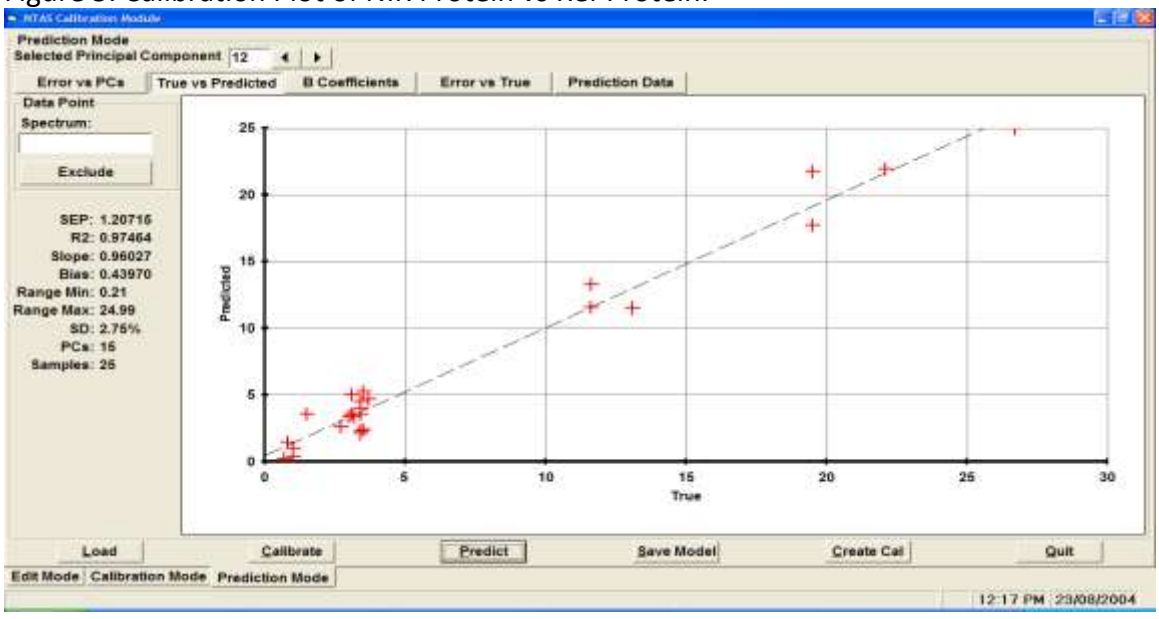

Figure 6. Calibration Plot of NIR Lactose vs Ref Lactose

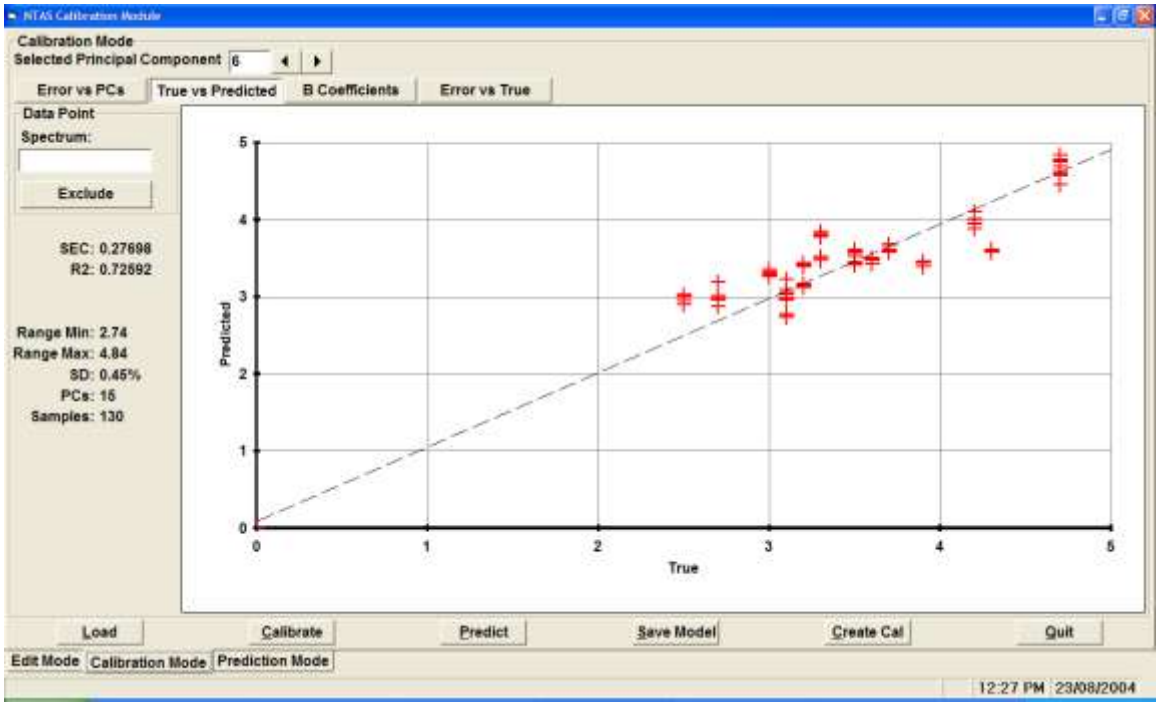

Figure 7. Calibration Plot of NIR Moisture vs Ref Moisture

Discussion:

The powdered cheese samples provided represented a very broad range of concentrations of fat, protein and lactose, yet a small range for moisture. The linearity of the NIR appears excellent for fat and protein with R2 = 0.99, however errors (SEC) are higher than expected. It is considered that a few samples are very different to the others and as such could not fit within a calibration that suited the rest of the samples. Specifically, sample 4297 had a fat content of 65.5%. This seems to be at complete odds with the rest of the samples and as such was excluded from the set. There was also some question about sample 980209 and 980209 026 as we had two samples with the same ID number. This may indicate a typing error since these samples did not fit the calibration well.

The lactose calibration showed a large error at the low end of the range, ie, <5%. By excluding all samples above 5%, and recalibrating, the SEC was reduced to 0.47%, as shown below, figure 8. The correlation drops to 0.77 as compared with 0.97 with all samples included.

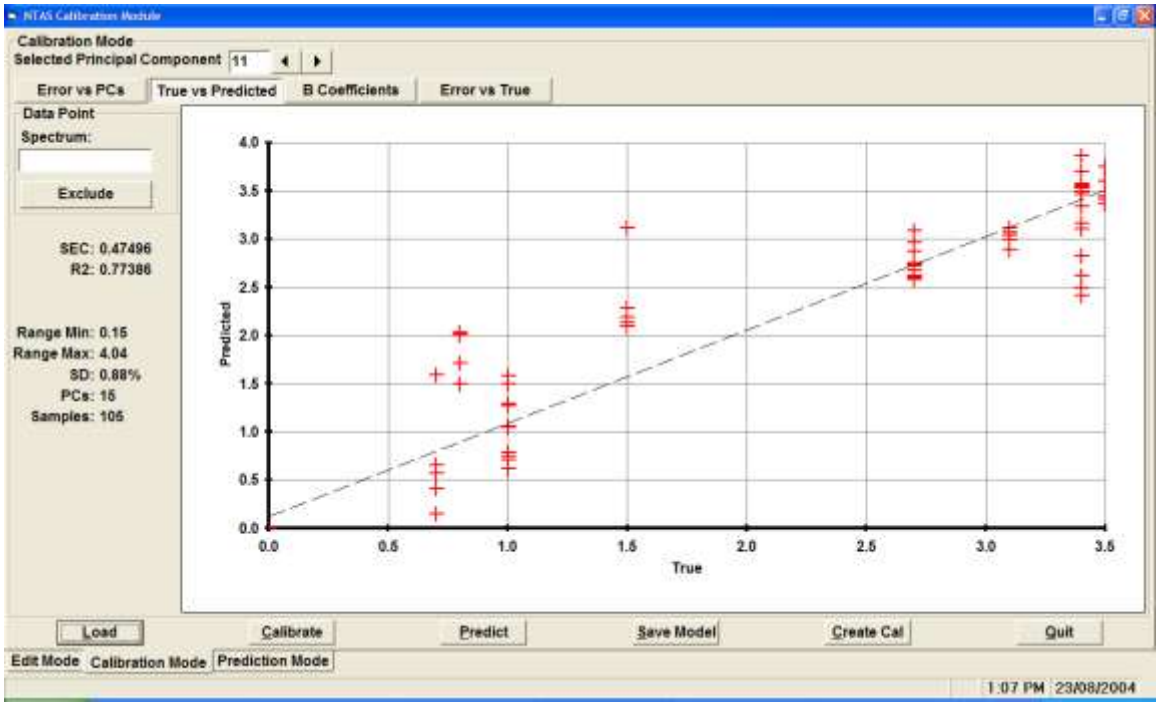

Figure 8. Calibration plot of NIR Lactose vs Ref Lactose, <5%.

Conversely, by excluding all samples below 5%, then the calibration gives a SEC = 0.32 and R^2 = 0.99 as shown in figure 9.

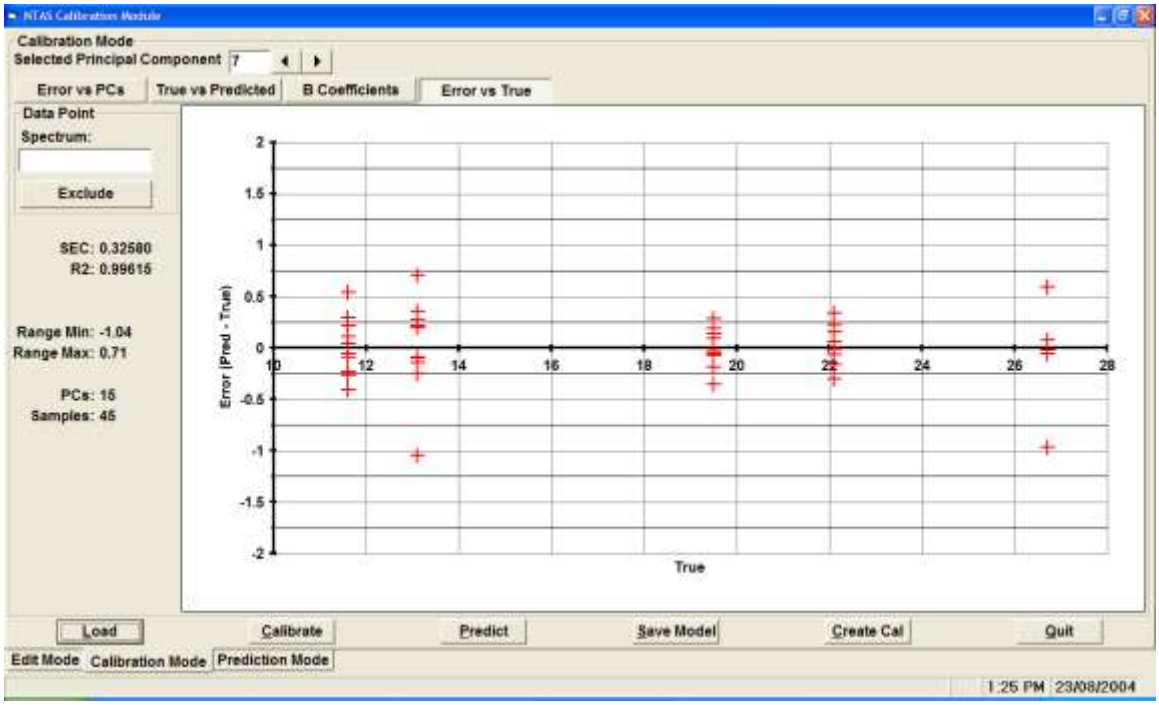

Figure 9. Calibration Plot of NIR Lactose vs Ref Lactose, >5%.

The Moisture calibration, shown in figure 7, has a low SEC = 0.27 however the R^2 = 0.72. This is due to the narrow range of moisture values. To obtain a better estimate of the moisture calibration, it is suggested that samples be selected from earlier stages of the drying process.

Conclusion:

The data presented above illustrates the ability of the NIT-38 Dairy Analyser to measure the fat and protein in powdered cheese. The data suggests that optimal calibration could be developed for all samples, independent of colour. More samples covering the full range of products would be required however the preliminary calibrations for fat and protein appear realistic. For lactose there appears to be a need for two calibrations to cover the different ranges, ie, .7-5% and 5-26%. And the moisture calibration could be improved with more samples covering a broader range.

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