Application Note 151: Skim Milk Powder analysis for Fat, Moisture and Protein using the Series 3000 Food Analyser

Introduction:

Skim milk powder is a major raw material produced by the milk industry. The quality parameters are fat, moisture and protein. This study demonstrates the ability of the MultiScan Series 3000 Food Analyser to analyse these components in skim milk powder.

Procedure:

104 sample of skim milk powder were used to develop calibrations for fat, moisture and protein. Not all samples were provided with fat and protein values so that calibrations for fat and protein were based on 74 and 71 samples respectively. The samples were scanned using a 5mm powder cell in the MultiScan Series 3000 Food Analyser, NIR Technology Systems, Sydney, Australia. 10 scans for each sample were collected and imported into NTAS(NIR Technology Analysis Software) where the spectra were averaged and a Partial Least Squares (PLS) regression analysis was performed for each component. To test the calibrations, sets of 5 samples were analysed 5 times using these calibrations to test for reproducibility and accuracy.

Results:

Figure 1. shows the Near infrared Transmission spectra of the Skim Milk powder samples.

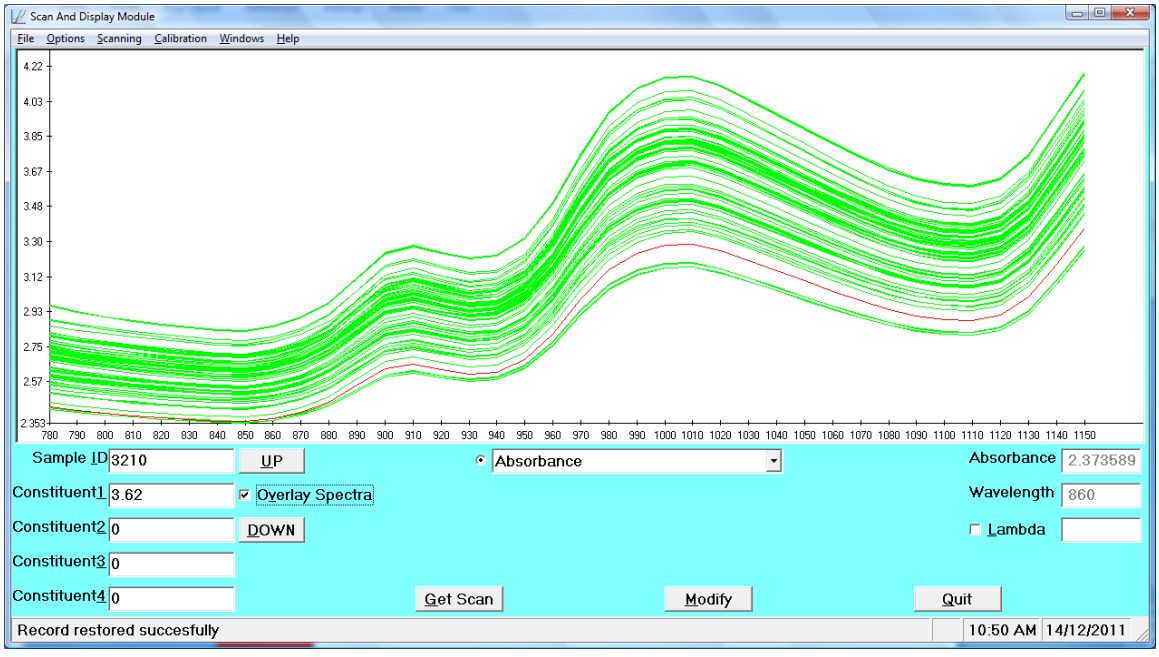

Figure 1. Averaged NIT Spectra of Skim Milk Powder

Figure 2. shows the calibration plot of the S3000 Moisture vs Ref Moisture for the skim milk samples. The SEC = 0.11% and R2 = .863.

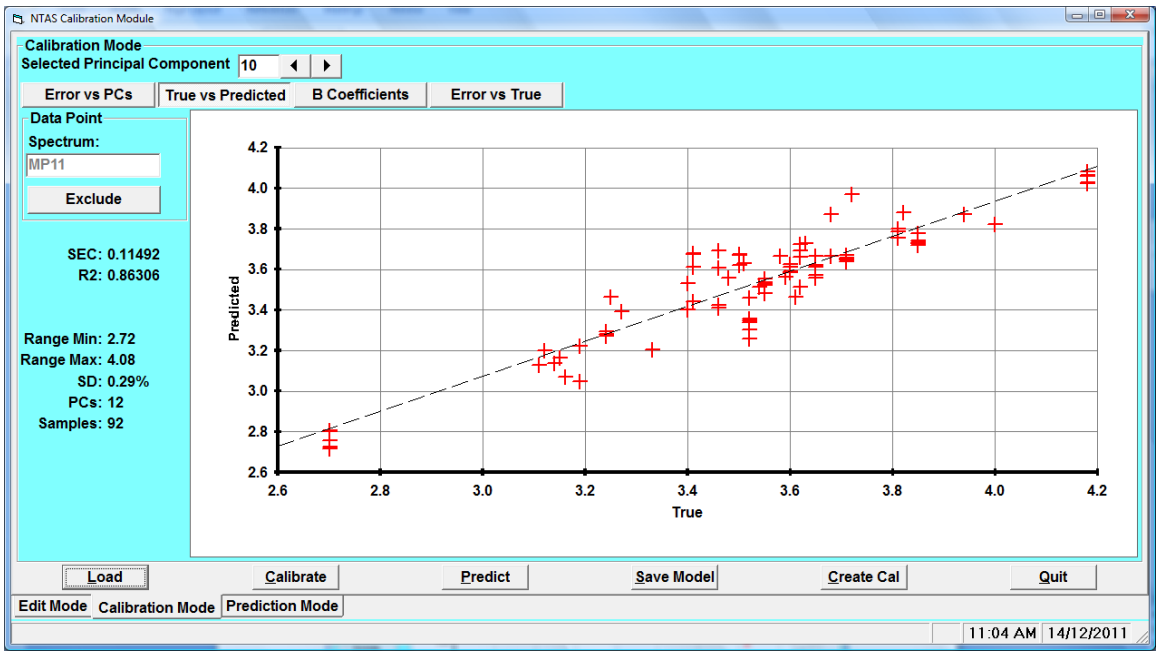

Figure 2. Moisture Calibration data

Figure 3. shows the calibration plot of the S3000 Fat vs Ref Fat for the skim milk samples. The SEC = 0.06% and R2 = .75.

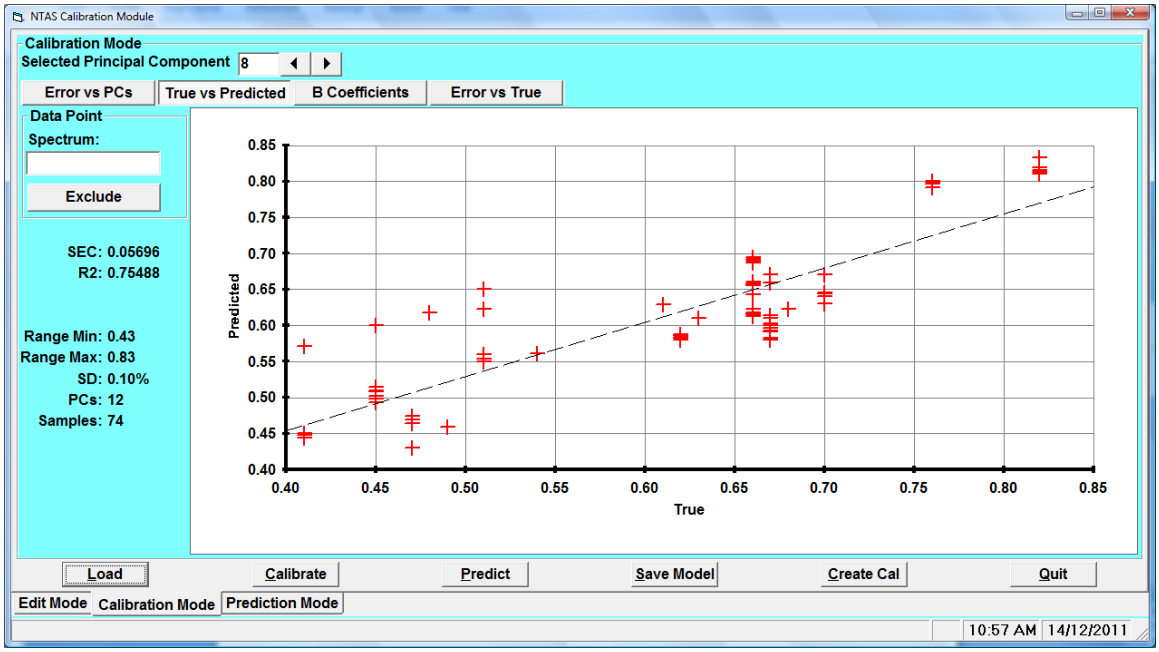

Figure 3. Fat Calibration Data

Figure 4. shows the calibration plot of the S3000 Protein vs Ref Protein for the skim milk samples. The SEC = 0.08% and R2 = .809.

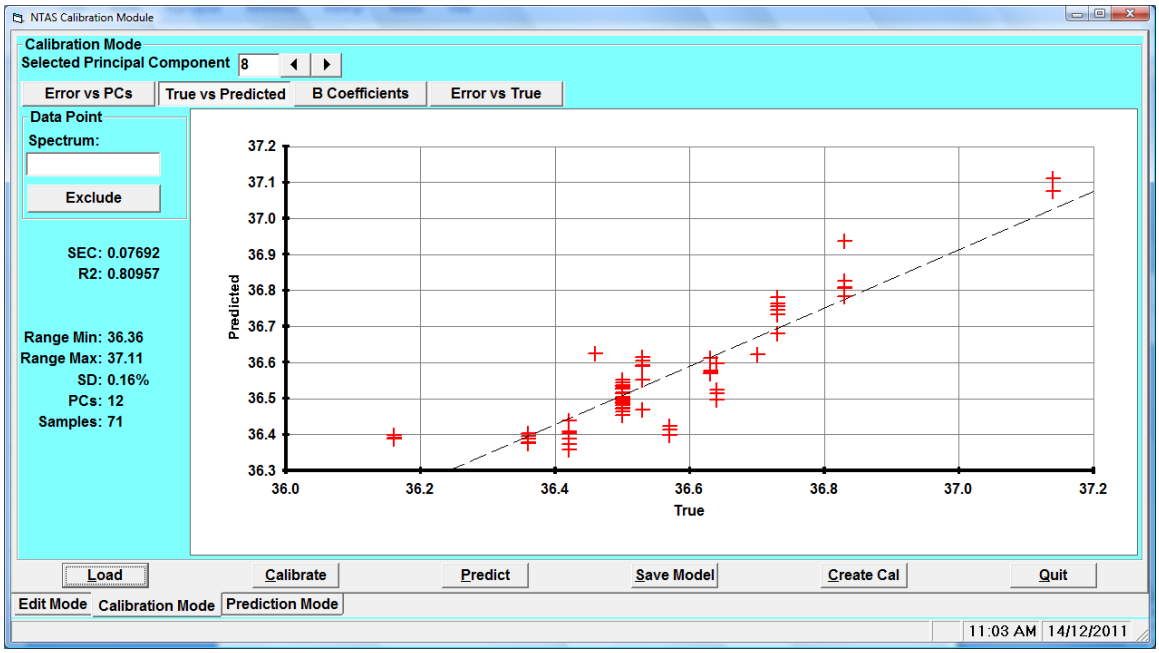

Figure 4. Protein Calibration Data

Prediction Results:

Table 1. shows the prediction of the five sample, each analysed five times. The Standard Deviation of Differences, SDD, is the estimate of the precision for the calibrations and the Standard Error of Prediciton, SEP, is the estimate of the accuracy of these calibrations.

Sample ID	Ref Moist	S3000 Mois	Diff	SDD	Ref Fat	S3000 Fat	Diff	SDD	Ref Prot	S3000 Prot	Diff	SDD
MPA1	3.60	3.62	-0.02		0.66	0.67	-0.01		36.5	36.5	0.00	
MPA2	3.60	3.61	-0.01		0.66	0.68	-0.02		36.5	36.5	0.00	
MPA3	3.60	3.59	0.01		0.66	0.67	-0.01		36.5	36.5	-0.01	
MPA4	3.60	3.58	0.02		0.66	0.68	-0.02		36.5	36.5	-0.03	
MPA5	3.60	3.59	0.01	0.018	0.66	0.66	0.00	0.006	36.5	36.5	-0.04	0.016
MPB1	3.85	3.74	0.11		0.66	0.66	0.00		36.5	36.5	-0.03	
MPB2	3.85	3.72	0.13		0.66	0.66	0.00		36.5	36.5	-0.04	
MPB3	3.85	3.78	0.07		0.66	0.64	0.02		36.5	36.5	-0.03	
MPB4	3.85	3.73	0.12		0.66	0.65	0.01		36.5	36.5	-0.04	
MPB5	3.85	3.73	0.12	0.023	0.66	0.65	0.01	0.010	36.5	36.6	-0.05	0.010
MPC1	2.70	2.81	-0.11		0.66	0.67	-0.01		36.5	36.5	0.02	
MPC2	2.70	2.80	-0.10		0.66	0.67	-0.01		36.5	36.5	0.01	
MPC3	2.70	2.73	-0.03		0.66	0.68	-0.02		36.5	36.5	0.01	
MPC4	2.70	2.76	-0.06		0.66	0.70	-0.04		36.5	36.5	0.01	
MPC5	2.70	2.72	-0.02	0.041	0.66	0.70	-0.04	0.013	36.5	36.5	-0.02	0.013
MPD1	3.65	3.62	0.03		0.82	0.79	0.03		36.5	36.5	0.04	

MPD2	3.65	3.66	-0.01		0.82	0.79	0.03		36.5	36.5	0.02	
MPD3	3.65	3.61	0.04		0.82	0.77	0.05		36.5	36.5	0.00	
MPD4	3.65	3.57	0.08		0.82	0.79	0.03		36.5	36.5	-0.03	
MPD5	3.65	3.56	0.09	0.043	0.82	0.77	0.05	0.012	36.5	36.5	-0.01	0.026
MPE1	3.50	3.68	-0.18		0.76	0.80	-0.04		36.5	36.5	0.05	
MPE2	3.50	3.67	-0.17		0.76	0.80	-0.04		36.5	36.5	0.03	
MPE3	3.50	3.67	-0.17		0.76	0.79	-0.03		36.5	36.5	0.03	
MPE4	3.50	3.67	-0.17		0.76	0.81	-0.05		36.5	36.5	0.02	
MPE5	3.50	3.62	-0.12	0.023	0.76	0.79	-0.03	0.008	36.5	36.5	0.01	0.012
SEP			0.10				0.03					0.03

Discussion:

The calibration statistics, Standard Error of Calibration, SEC, and Correlation, R^2, are often misleading or misunderstood. It is normal to expect that the correlation will be in the high 0.9 range, eg, 0.999, for a moisture and protein calibration. However correlation is related to the range of values in the calibration set and the scatter of the predicted results around the line of best fit.

In this study the range of moisture, fat and protein are extremely narrow and as such, the R^2 values for each calibration are very low. However the SEC values are very good, ie, less than 0.1%.

Far better statistics are the SEP and the SDD as they indicate the precision and accuracy for analysing future samples.

Conclusion:

The data presented above shows that the Series 3000 can provide an accurate and precise method for determining fat, moisture and protein in skim milk powder.

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