Application Note 149: Calibration for Fata, Moisture and Protein in Milk Powder using the Series 1000 Fat and Moisture Analyser.

Introduction:

Milk Powder is a food commodity used throughout the world as a means of transporting milk less the water. Milk power has high levels of protein and is widely used in food as a protein supplement. Whole milk powder contains a high level of fat. Skim milk powder contains almost no fat but higher levels of protein and lactose. Typically the moisture content of milk powder is between 2 and 6 %. Obviously the dryer the powder the less water being shipped but also the more stable the powder against microbiological degradation and also break down of the fat.

Near Infrared spectroscopy provides a rapid and accurate means of measuring fat, moisture, protein and lactose in skim and whole milk powder. Since milk powders are homogeneously mixed, the Series 1000 Fat and Moisture Analyser can be used to measure these powders.

This study shows the calibrations for fat, moisture and protein in whole milk powder.

Procedure:

10 samples of whole milk powder were provided by a food manufacturer who was interested in using NIR for milk power analyses. The samples were analysed for fat, protein and moisture using the Babcock method for fat, oven drying for moisture and Kjeldahl Digestion for protein.

These samples were scanned using a Series 1000 Fat and Moisture Analyser, NIR Technology Systems, Sydney, Australia. The samples were scanned from 720-1100nm in a 5mm pathlength sample cell as shown below.

Approximately 2gram of powder was placed into the cell and the excess scrapped away. The cell was closed so that the window in the top of the cell squeezed the powered into the 25mm diameter by 5mm cavity. The sample cell was locked and then placed into the

Series 1000 analyser where the Near Infrared Transmission spectra were collected using NTAS (NIR Technology Analysis Software). Six spectra for each sample by repacking the cell three times and scanning each packing twice.

A Partial Least Squares regression analysis was performed on the spectra data and the corresponding fat, moisture and protein reference data.

A calibration for each component was developed, however only a calibration for fat and moisture was downloaded back into Series 1000, since this instrument only supports two constituent analyses, ie, fat and moisture.

To test the calibration, 5 samples were analysed in prediction. To test the calibration for precision, 1 sample was analysed 10 times, ie, 5 repacks analysed twice.

Results:

Figure 2, shows the NIT spectral plots.

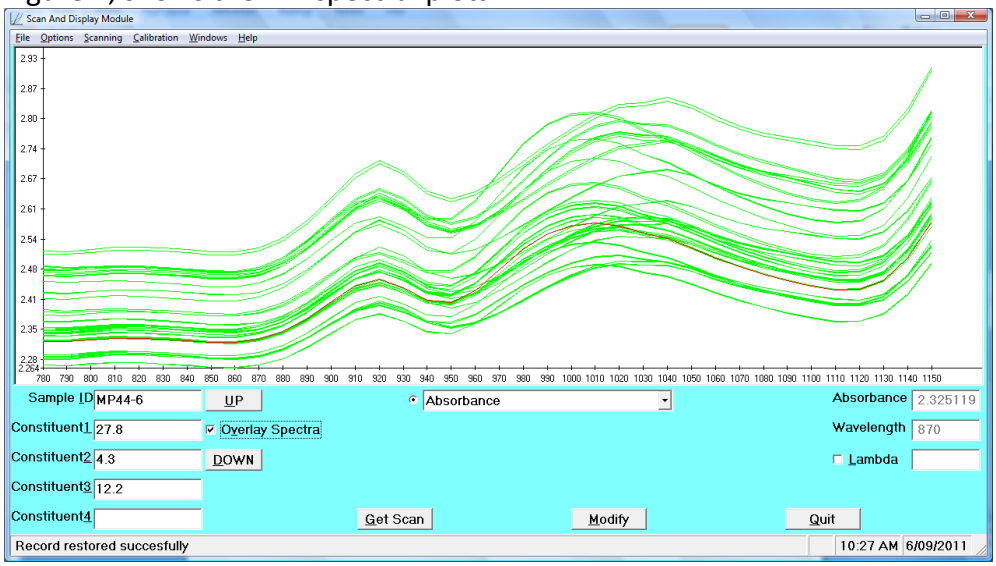

Figure 3, 4 and 5 show the calibration plots for fat, moisture and protein respectively.

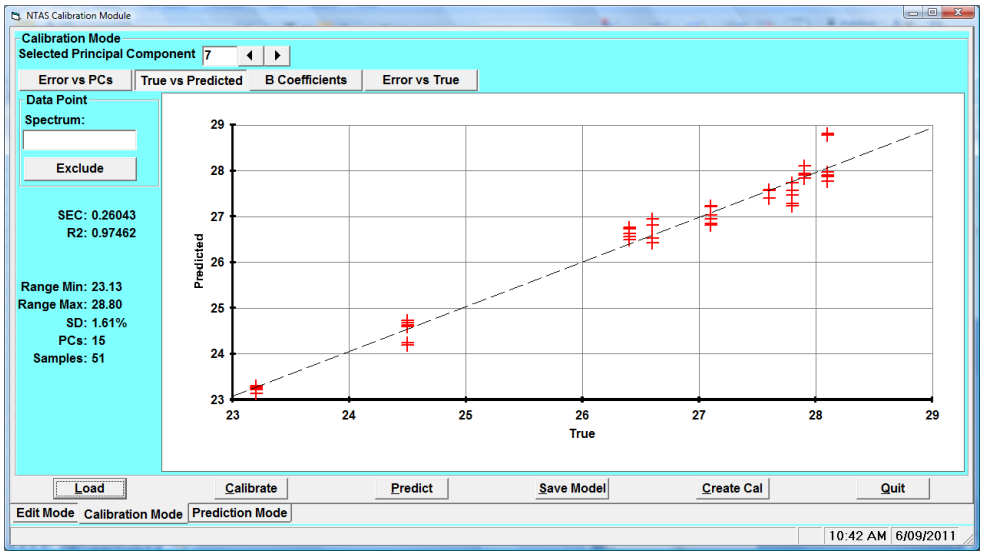

Figure 3. Fat Calibration Plot

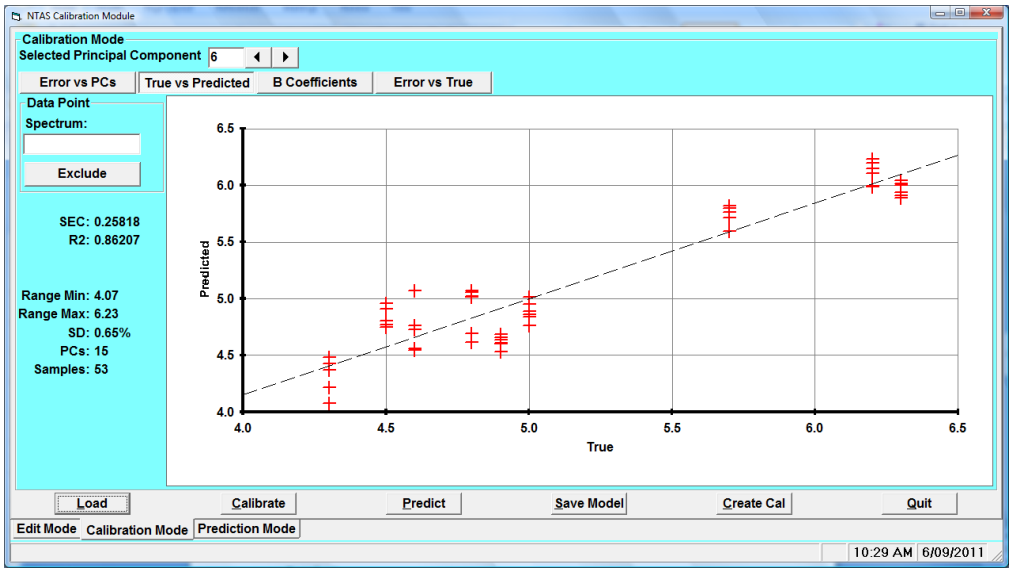

Figure 4. Moisture Calibration Plot

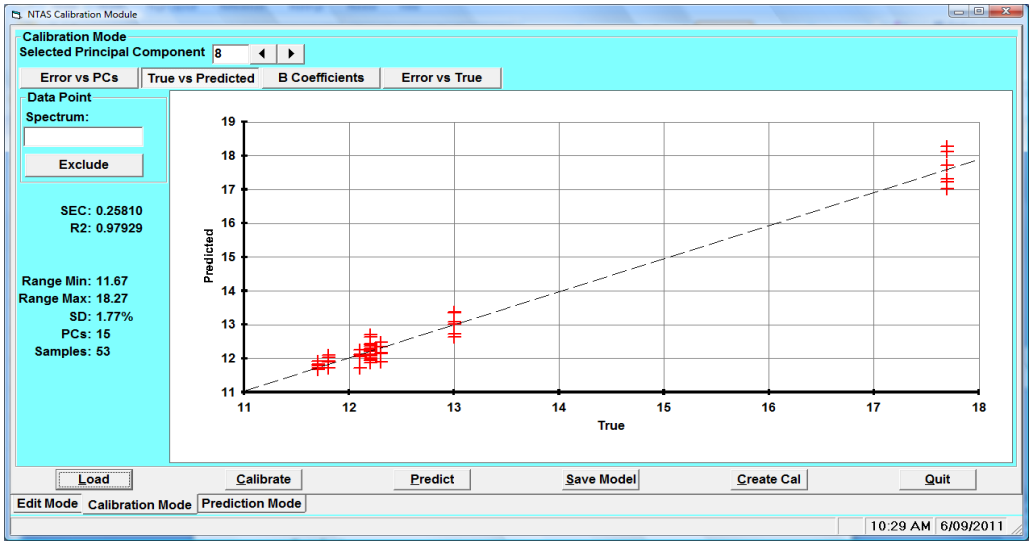

Figure 5. Protein Calibration Plot

Table 1. shows the prediction results for the 5 samples analysed in prediction.

Sample	NIR Fat	Ref Fat	Fat Diff	NIR Moist	Ref Mois	
MP1	27.93	27.9	0.03	6.39	6.3	0.09
MP1	28.11	27.9	0.21	6.37	6.3	0.07
MP3	24.24	24.5	-.26	5.08	5.0	-.08
MP3	24.19	24.5	-.31	5.00	5.0	0
MP10	27.58	27.6	-.02	5.02	4.8	0.22
MP10	27.56	27.6	-.04	5.05	4.8	0.25
MP25	27.03	27.1	-.07	6.28	6.2	0.08
MP25	26.95	27.1	-.15	6.30	6.2	0.1
MP44	27.49	27.8	-.31	4.31	4.3	0.01
MP44	27.45	27.8	-.35	4.37	4.3	0.07
Sep			0.18			0.08

Table 2. shows the results of analysing sample 2, ten times.

Sample 2	Fat	Moisture		Fat Diff	Mois Diff
1	22.5	5.9		0.2	0.2
1	22.4	6.1		0.3	0.0
2	22.2	6		0.5	0.1
2	22.2	6.2		0.5	-0.1
3	22.9	6		-0.2	0.1
3	22.9	6.2		-0.2	-0.1
4	22.9	6.1		-0.2	0.0
4	23	6.2		-0.3	-0.1
5	23	6.1		-0.3	0.0
5	23	6		-0.3	0.1
Ave	22.7	6.1	Stdev	0.34	0.10

Discussion:

The purpose of this study was to obtain an approximation of the accuracy and precision that might be achieved using the Series 1000 Fat and Moisture analyser.

The accuracy is estimated for fat = 0.2% and for moisture = 0.1%. Although protein is not normally measured using the Series 1000, the study suggests that protein can be measured with an accuracy of approximately 0.25%.

The major limitation of this measurement is the precision for fat measurement. The data shows a SDD of 0.34% for fat. However the difference between repeat scans on the same repack show very little difference. This suggests that the error is due to packing the sample.

To improve the precision of the analysis, the sample cell needs to be redesigned and the procedure for packing to be refined. Further experimentation will be undertaken to resolve this problem.

NIR Technology Systems
366 Edgar Street, Condell Park, NSW, 2200, Australia
Tel: 612 9708 5068, Fax: 612 9708 5537
Email: nirtech@nirtech.net, Web: www.nirtech.net