Application Note 159. Analysis of Whole Milk using the Series 2000 Near Infrared Transmission Analyser

Introduction:

Whole Milk is used is the manufacture of yoghurt, cheese, cream, butter and other dairy based products. Whole cow milk has approximately 3-5% fat, 3-5% protein and 3-5% lactose. The solids can be adjusted by removing the cream and then blended back the cream to get the correct fat content and the skim milk to get the correct protein and lactose levels. This is referred to Standardisation of the milk to suit the end product. As such the analyses of fat, protein, lactose and water in the incoming milk is the first step in making any dairy based product.

Milk is commonly analysed using Infrared Back Scatter technology. Although very accurate, these back scatter analysers are limited to measuring liquid milk. As such, analysis of cheese, milk powder, yogurt or cream requires solubilisation and dilution. Near Infrared Transmission analysers such as the Series 2000, are designed to measure ground cheese, milk powder, soft and cream cheese etc without dilution or solubilisation, but can also be used for liquids such as milk, skim, cream and yoghurt.

This study demonstrates the use of the Series 2000 NIT Analyser to measure whole milk quickly and accurately.

Procedure:

10 Whole milk samples were purchased from Global Proficiency Pty Ltd, a company that provide reference samples for the Australian and New Zealand milk industry. Each sample is provided with values for fat, total protein, lactose, SNF (Solid Non Fat) and TS (Total Solids). The samples were placed into a 50C water bath for 10 minutes, then removed one by one for analysis. The samples were homogenised by vigorous agitation and then poured into a 10 mm pathlength liquid cell. The cell was moved down and up in front of the light beam to collect 10 scans in the Series 2000 NIT Analyser. Light passes through the sample and is collected into a diode array spectrometer that scans from 720-1100nm. Protein (N-H), Fat(C-H), Water (O-H) and Carbohydrates(C-O-H) absorb light at specific frequencies. The amount of light absorbed at each frequency is proportional to the concentration of each component. The NIT spectra were collected for each sample and stored in the Series 2000. The spectral files were imported into NTAS (NIR Technology Analysis Software) where the reference values for protein, fat, lactose, SNF and TS were appended and a Partial Least Squares Regression analysis was performed to develop calibrations for each component.

These calibrations were downloaded into the Series 2000 and 20 samples of whole milk were analysed to assess the accuracy of the NIT methods.

Results:

Figure 2. shows the NIT spectra of the milk samples.

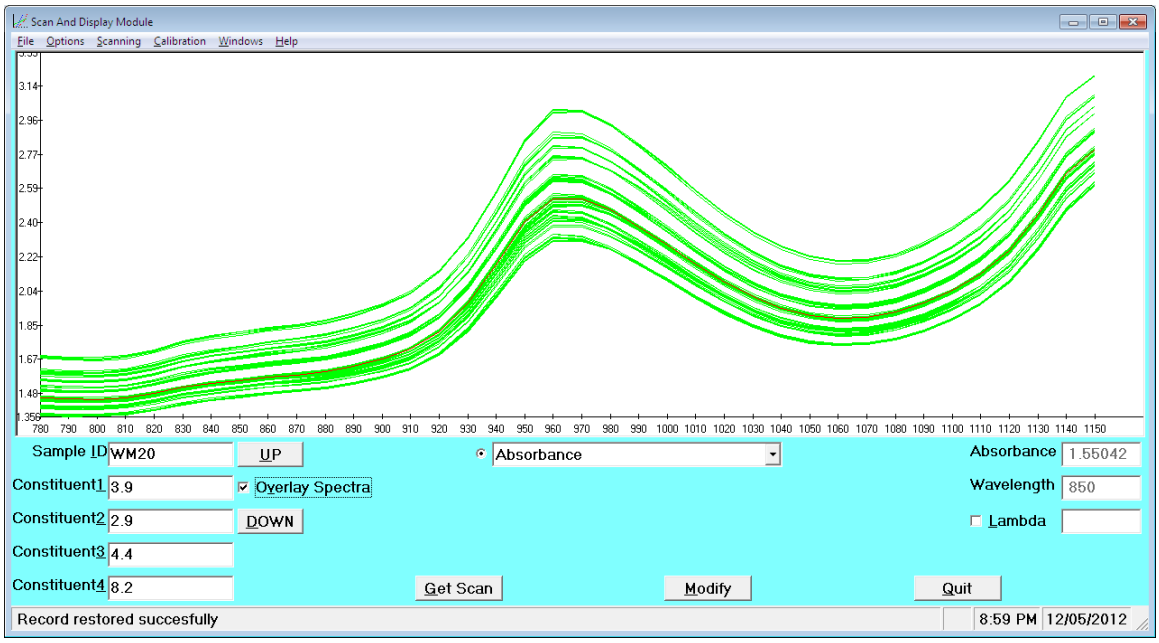

Figure 2.

Figures 3 through 5 show the calibration plots for fat, protein, lactose, SNF and total solids

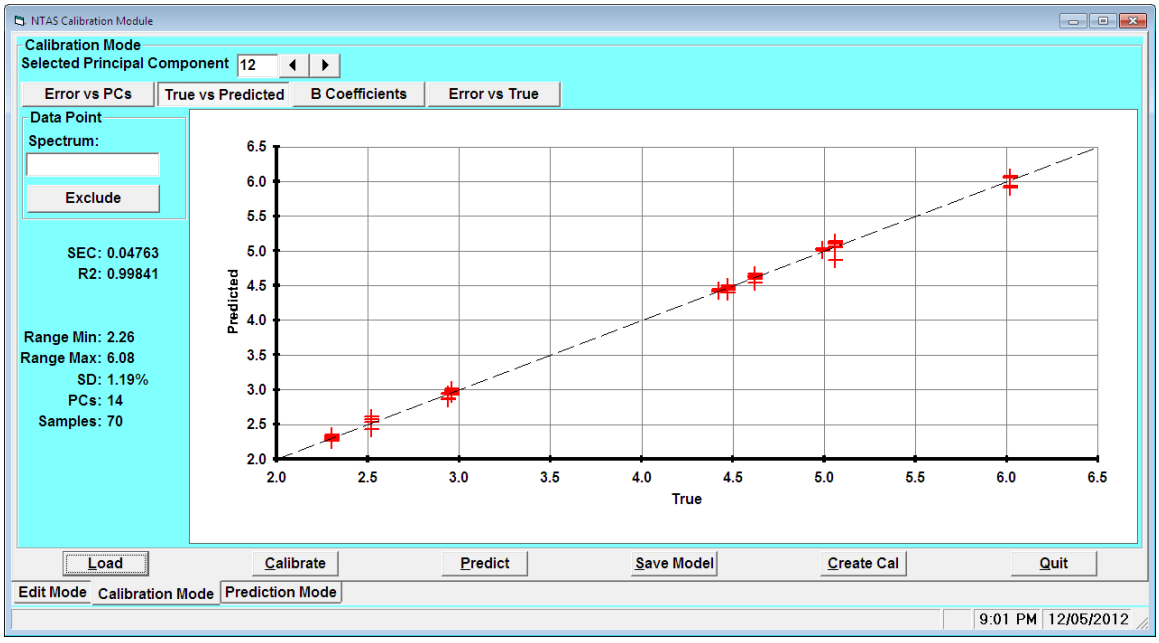

Figure 3. Fat Calibration Plot

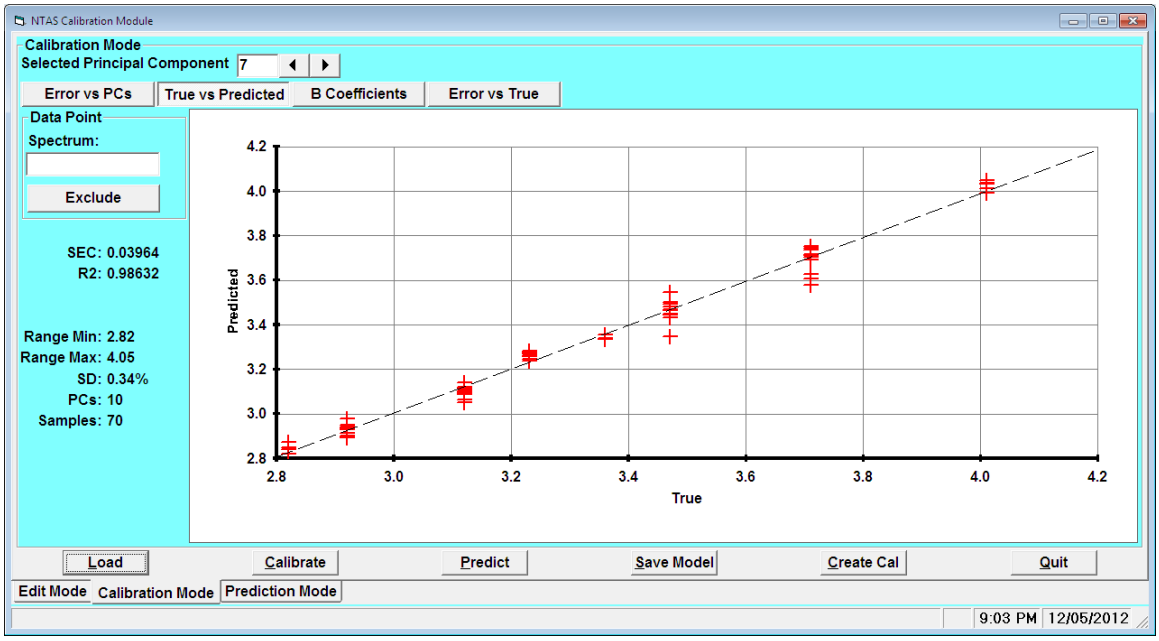

Figure 4. Protein Calibration Plot

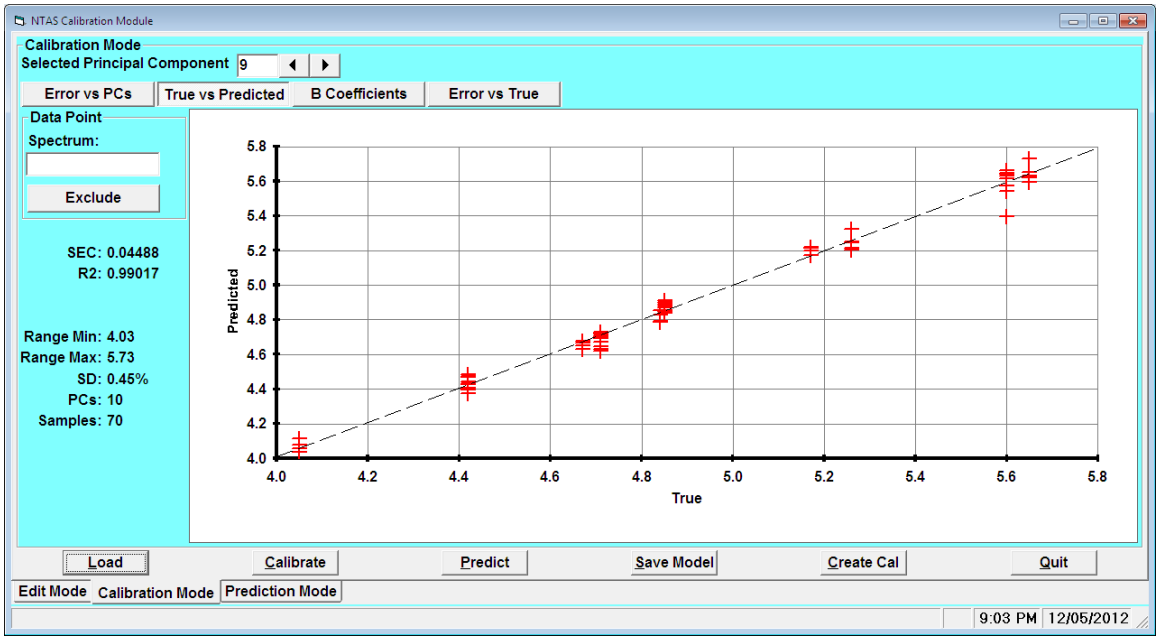

Figure 5. Lactose Calibration

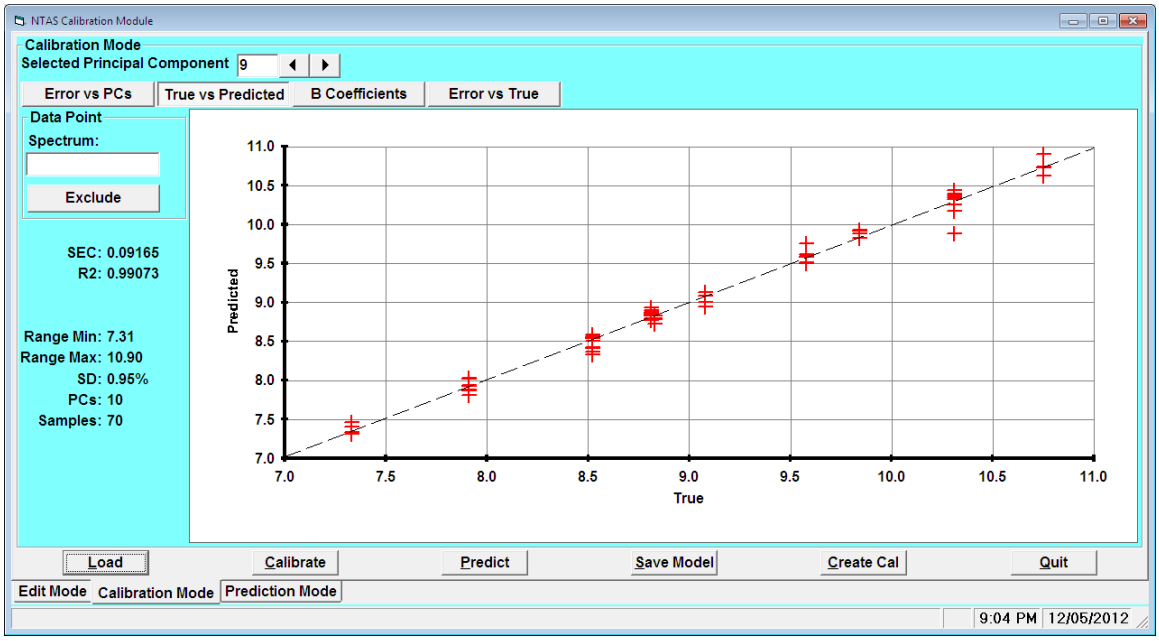

Figure 6. SNF Calibration

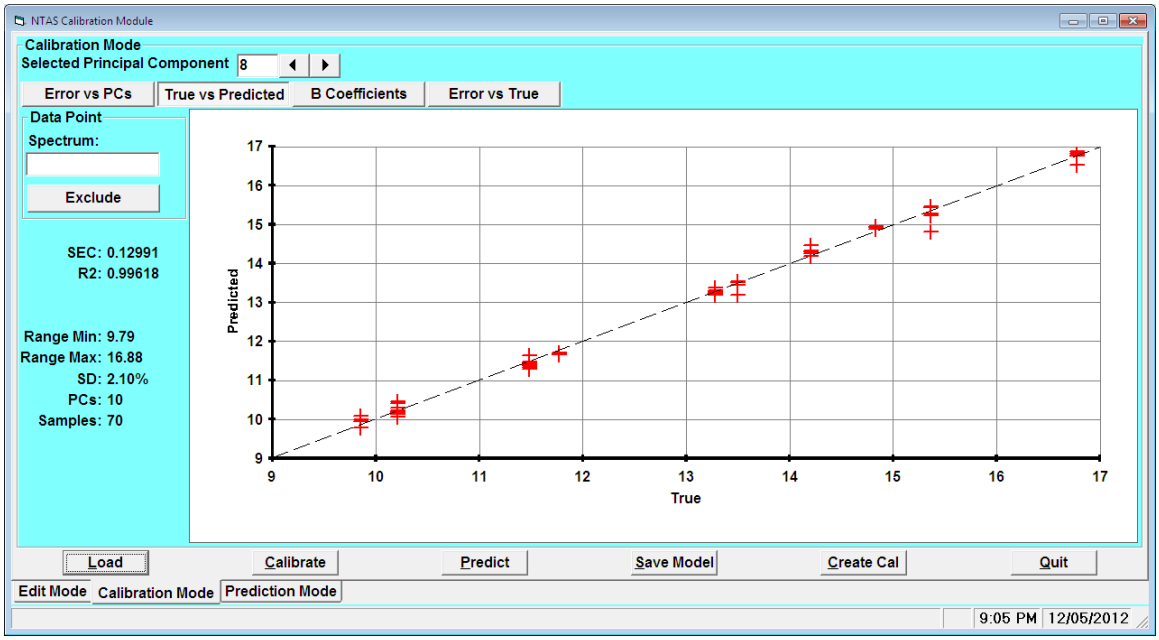

Figure 7. Total Solids Calibration Plot

5 samples of whole milk were analysed 2 times using the above calibration models.
Table 1 shows the predicted results vs the laboratory tested values for each sample.

Sample ID	Ref Fat	NIT Fat	Ref Prot	NIT Prot	Ref Lactose	NIT Lactose	Ref SNF	NIT SNF	Ref TS	NIT TS
0806-1A	2.52	2.52	2.82	2.85	4.05	3.92	7.33	7.09	9.85	9.70
0806-1B	2.52	2.54	2.82	2.84	4.05	3.95	7.33	7.14	9.85	9.70
0806-2A	2.94	2.87	3.36	3.29	4.67	4.57	8.83	8.62	11.77	11.43
0806-2B	2.94	2.80	3.36	3.27	4.67	4.57	8.83	8.59	11.77	11.37
0806-3B	4.42	4.38	3.47	3.35	4.84	4.68	9.08	8.78	13.50	13.11
0806-3A	4.42	4.37	3.47	3.36	4.84	4.72	9.08	8.83	13.50	13.20
0806-4B	4.99	5.06	3.71	3.64	5.17	5.05	9.84	9.47	14.83	14.52
0806-4A	4.99	5.04	3.71	3.65	5.17	5.08	9.84	9.53	14.83	14.56
0806-5B	6.02	6.13	4.01	3.98	5.65	5.57	10.75	10.51	16.78	16.47
0806-5A	6.02	6.15	4.01	3.98	5.65	5.61	10.75	10.59	16.78	16.52

The Standard Error of Prediction (SEP) for these components in Whole Milk were calculated to be:

Fat	0.06%
Protein	0.03%
Lactose	0.03%
SNF	0.07%
TS	0.08%

Conclusion:

The Series 2000 Near Infrared Transmission Analyser has been shown to provides very accurate and precise analyses of whole milk.

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