1. Introduction.

The following report outlines the procedure used by NIR Technology Australia (NIRTech) to develop a calibration for the determination of fat and moisture in potato chips using a Near Infrared Transmission (NIT) analyser. The results obtained will be discussed on a statistical basis and suggestions for further improvement are also discussed.

1.1. Instrumentation.

The instrument chosen for this application is the NIT-38 Near Infrared Transmission analyser equipped with an automatic sample transport. This instrument scans the wavelength region 720-1100nm at a resolution of 10nm. The instrument scans each sample 5 times and the average of these sub-scans is taken as the final result.

Previous applications have shown that this region is suitable for the determination of fat and moisture, the quality of results being determined by the reproducibility of the sampling technique.

1.2. Sampling Technique.

The technique employed for this initial study was to place the samples, delivered in sealed foil bags, into a domestic food processor (Black and Decker Model BMC100), and grind the samples for a period of 30-60 seconds. The material presentation usually varied from a fine mixture to a relatively coarse mat
erial, but still small particle mixture.

The sample was loaded into an elongated sample cell of 18mm pathlength. Once placed into the cell, the mixture was tapped until no visible movement of the sample was observed. If the sample window became exposed during this tapping, more sample was added.

Samples were measured in duplicates. The procedure required that the sample cell be packed and measured on the instrument. The same sample was readjusted in the cell and measured again. A second repack with a new sample was performed and the above procedure repeated.

The data were saved on the internal memory of the instrument for later regression analysis and calibration development.

1.3. Samples.

Table 1 provides details of the samples provided by Freer Foods Pty Ltd with the corresponding laboratory data for Oil and Moisture, along with a qualitative description of the sample itself (i.e. plain, chicken etc.)

Table 1: Calibration set laboratory data and qualitative description.

Sample ID	Description	Moisture*	Oil**
S1	Plain	2.8	4.2
S2	Plain	3	1.9
S3	Plain	2.8	1.6
S4	Plain	2.8	3
S5	Plain	2.6	3.1
S6	Plain	2.8	2.8
S7	Plain	3.1	2.8
S8	Plain	2.4	2.4
S9	Chicken	2.5	4.5
S10	Chicken	2.3	3.7
S11	Chicken	2.2	3.1
S12	Chicken	2.4	3.2
S13	Chicken	2.4	2.8
S14	Chicken	2.6	3.5
S15	Chicken	2.5	3.5
S16	Salt and Vinegar	4.1	3.5
S17	Salt and Vinegar	3.9	4.3
S18	Salt and Vinegar	3.9	3.5
S19	BBQ	3.1	2.4
S20	BBQ	3.4	2.6
S21	BBQ	3.3	2.8
S22	BBQ	3.2	2.5
S23	Plain	2.9	3.8
S24	BBQ	3.2	2.4
S25	Plain	2.9	3.4
	Min	2.2	1.6
	Max	4.1	4.5
	Range	1.9	2.9
	Std Dev	0.5	0.7

* Symbio Alliance Method No.: CF5.1

** Symbio Alliance Method No.: CF4.2

2. Results.

2.1. Calibration.

Table 2 provides a summary of the calibration statistics obtained from the development of two models. Model 1 contains all the data and Model 2 was developed using the average of the 5 sub-scans per replicate. Figures 1 and 2 are the predicted vs. measured results obtained from the calibration data of Model 2 for oil and moisture respectively.

Table 2: Calibration statistics for Models 1 and 2.

Model	Constituent	*n*	Outliers	Range (%)	PC's	Calibration	
						R	SEC (%)
1	Oil	500	10	1.6-4.5	11	0.85	0.28
	Moisture	500	20	2.2-4.1	10	0.83	0.24
2	Oil	100	1	1.6-4.5	10	0.86	0.26
	Moisture	100	1	2.2-4.1	9	0.85	0.20

It is apparent from the data in table 1 that model 2 is the best one to used for the prediction study.

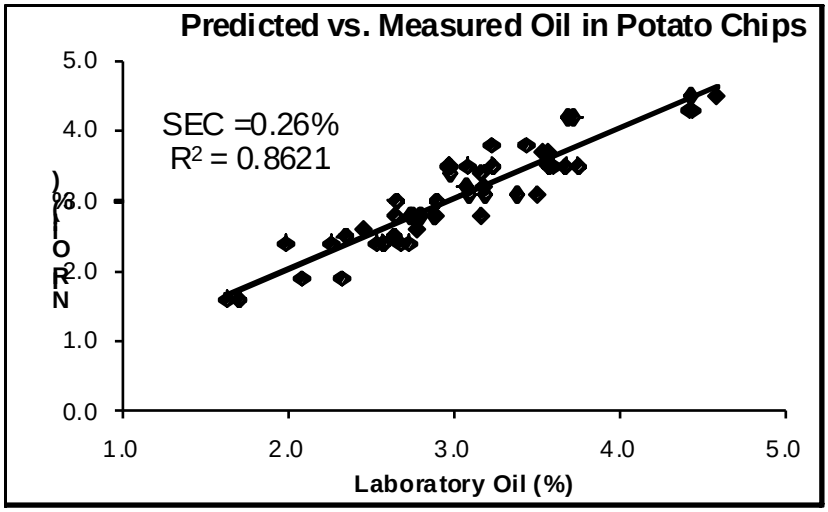

Figure 1: Predicted vs. Measured Oil in Potato Chips using NIR.

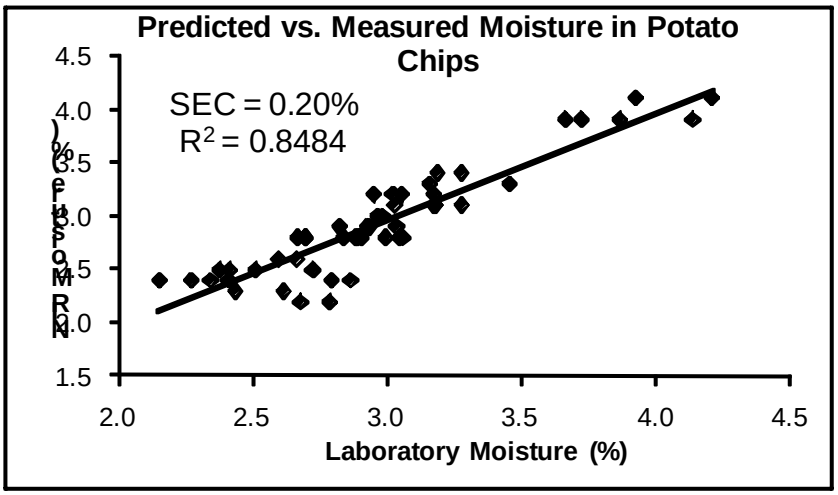

Figure 2: Predicted vs. Measured Moisture in Potato Chips using NIR.

2.2. Prediction.

Table 3 provides a summary of the statistics obtained from model 2, for the prediction of the oil and moisture content of the different varieties of potato chips provided. Figures 3 and 4 shows this data graphically.

Table 3: Prediction statistics for the determination of oil and moisture in potato chips.

Sample	Description	Oil (%)		Moisture (%)	
		Actual	Predicted	Actual	Predicted
1	Plain	4.2	4.1	2.8	3.0
3	Plain	1.6	1.5	2.8	3.0
9	Chicken	4.5	4.3	2.5	2.2
14	Chicken	3.5	3.7	2.6	2.6
17	Salt and Vinegar	4.3	4.6	3.9	3.7
18	Salt and Vinegar	3.5	3.5	3.9	4.0
20	BBQ	2.6	2.9	3.4	3.2
21	BBQ	2.8	2.8	3.3	3.3
		Bias	-0.02	**Bias**	0.05
		SDD	0.21	**SDD**	0.20

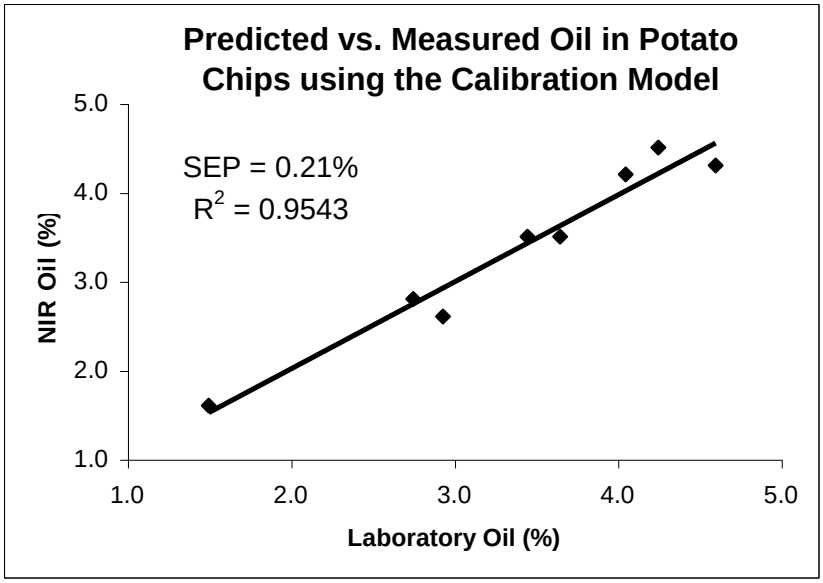

Figure 3: Prediction results for Oil content in potato chips.

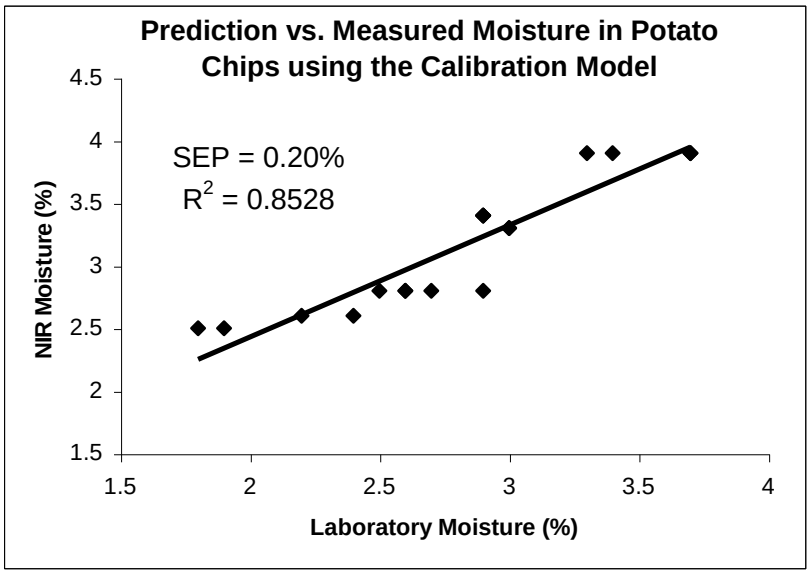

Figure 4: Prediction results for Moisture content in potato chips.

3. Conclusions.

From the calibration data obtained from the 25 samples, it was possible to calibrate the NIRTech NIT-38 Near Infrared analyser to measure the oil and moisture content of potato chips to a level of accuracy of 0.26% and 0.20% respectively. The predictive ability of this calibration, based on developing a model and using it on some of the samples provided gave accuracy results of 0.21% and 0.20% for oil and moisture respectively.

The following must be considered before this method is used on the production line.

- The calibration is based on 25 samples and although the predictive ability is very high, more samples should be added to add to the robustness.

- A domestic food processor was used and gave variable sample presentation, which has added some scatter to the model. It is anticipated that the use of a high power processor will overcome this variability.

- The calibration has not been temperature stabilised. The model should ideally contain at least 100 sample spectra, of which 5 percent should be measured when the samples and instrument are at various temperatures. NIRTech will perform this task if the instrument operates to a level acceptable by Freer Foods Pty Ltd.

- The model seems to work for all varieties of chips measured. As in all cases, variety specific calibrations are always recommended but this lies at the disgression of the user.

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