

Organic Application Note

NIR Analysis of Whey Powders

Sample Preparation and Procedures

Samples of powdered whey were used to develop calibrations for ash, fat, moisture, lactose, protein and salt on the LECO NIR Quik Check 20S.

Wavelength Selection and Chemical Identification

Three filters were used to develop the calibration of each constituent. All primary filters correspond to a particular region in the NIR spectrum relative to each constituent. All secondary filters were used to provide a more robust calibration.

Percent Ash

The measurement for ash is an indirect correlation of mineral content within the cellulose region of 1982 nm.

Table 1. Percent Ash in Whey Powder

Secondary Filter	1722 nm	C-H (fat)
Secondary Filter	1759 nm	C-H (fat)
Primary Filter	1982 nm	O-H (cellulose)

Percent Fat

The structures associated with the primary filters represent the long chain fatty acid groups in the sample.

Table 2. Percent Fat in Whey Powder

Primary Filter	1680 nm	C-H (fat)
Primary Filter	1722 nm	C-H (fat)
Secondary Filter	2230 nm	N-H (amino acids)

Percent Moisture

The filter that best describes moisture is 1940 nm. This represents the H-O-H groups for water.

Table 3. Percent Moisture in Whey Powder

Secondary Filter	1722 nm	C-H (fat)
Secondary Filter	1734 nm	C-H (fat)
Primary Filter	1940 nm	H-O-H(water)

Percent Lactose

A similar approach was used for the characterization of lactose (milk sugars). The calibration is based upon a direct correlation to total sugars region via the primary filter at 1778 nm.

Table 4. Percent Lactose in Whey Powder

Primary Filter	1778 nm	C-H ₂ (total sugars)
Secondary Filter	1940 nm	H-O-H (water)
Secondary Filter	2208 nm	C-H + C=O



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Percent Protein

The filter that best characterizes protein is 2180 nm. This filter represents the amino acid region of the NIR spectrum, and is typically used to detect total protein content.

Table 5. Percent Protein in Whey Powder

Secondary Filter	1680 nm	C-H (Fats)
Secondary Filter	1734 nm	C-H (fat)
Primary Filter	2180 nm	N-H (amino acids)

Percent Salt

The calibration is based upon an indirect correlation to the water band 1445 nm. For example, as the concentration of salt increases, the water intensity in the NIR region decreases; therefore, allowing an indirect quantitation of salt based on moisture content.

Table 6. Percent Salt in Whey Powder

Primary Filter	1445 nm	H-O-H (water)
Secondary Filter	2100 nm	O-H + C-O (starch)
Secondary Filter	2310 nm	C-H (fat)

Statistical Calculation and Results

The calibration equations for all parameters were calculated using the aforementioned filters and lab-analyzed samples.

The primary parameter for determining the accuracy of the NIR method is the Standard Error of Estimate (SEE). This parameter calculates the standard deviation of the differences between the NIR predicted values and the reported lab values.

Table 7. Statistical Summary for the Calibrations

Constituents	S.E.E.	Correlation	Range
Ash	0.37	0.90	6.95% to 9.90%
Fat	0.16	0.76	1.24% to 1.97%
Moisture	0.31	0.82	4.09% to 5.85%
Lactose	2.47	0.84	64.60% to 77.50%
Protein	0.40	0.91	10.68% to 13.58%
Salt	0.24	0.79	2.46% to 3.60%

Summary

In summary, the LECO NIR Quik Check 20S may be used to accurately detect ash, fat, moisture, lactose, protein, and salt in whey powders.



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