

# Quality Trait Analysis of Multiple Grains Using Internet-enabled FT-NIR

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## Introduction

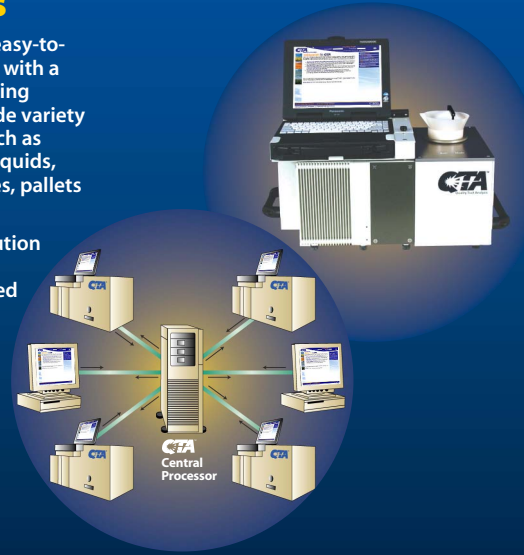
- Increased specialty and value added grains are developed and produced
- The coexistence of commodity grains with specialty grains requires simple, fast, non-destructive, on-site trait analysis methods that preserve the quality and segregation of the grain
- NIR is rapid and non-destructive. But its use in the field and/or processing facilities has many challenges

## Challenges

- A ruggedized instrument is needed
- On-site technical resources are required for calibration model building, maintaining and updating
- The reliability of test results and instrument performance
- Analytical capability expansion
- The storage, retrieval and sharing of test results and sample tracking

## Solutions

- A rugged and easy-to-operate FT-NIR with a versatile sampling device for a wide variety of materials such as whole grains, liquids, powders, pastes, pallets and granules
- The FT-NIR solution is used in an Internet-enabled system



## Why Internet-enabled FT-NIR system?

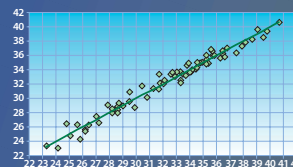
- The calibration models are built, and maintained at a central location
- No technical background or laboratory experience is required from the operator(s)
- No on-site technical resource is needed for instrument maintenance, calibration updates or new application developments
- Test results and sample information are stored at a central location and can be retrieved and shared from anywhere around the world
- Real-time remote performance and instrument monitoring

## Selected Results

Table 1. Statistical Analysis of NIR Results for Wheat and Barley

Grain	Trait	R <sup>2</sup>	RMSEP	Range
Wheat	Protein	0.990	0.284%	7 - 19%
	Moisture	0.998	0.128%	7 - 22%
	Hardness	0.923	8	-15 - 91
	Falling Number	0.745	42.1 sec	62 - 580 sec
Barley	Protein	0.927	0.27%	10.4 - 15.7%
	Moisture	0.996	0.166%	7.4 - 21.5%

Prediction vs True / Wet Gluten / Test Set Validation

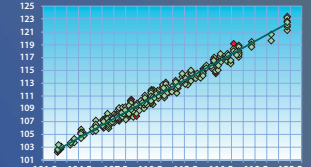


Wheat Wet Gluten: R<sup>2</sup> = 0.990, RMSEP = 0.71%, Range: 23-41%

Table 2. Statistical Analysis of NIR Results for whole Canola Seeds

Trait	R <sup>2</sup>	RMSEP	Range
Oil	0.984	0.45%	34 - 54%
Protein	0.989	0.302%	18 - 32%
Oleic	0.970	0.50%	61.3 - 78.6%
Linolenic	0.929	0.25%	1.58 - 7.82%
Glucosinolates	0.877	2.6 μmol/g	6 - 34.2 μmol/g
Chlorophyll	0.959	3.85 ppm	0.1 - 107 ppm

Prediction vs True / LV. / Test Set Validation

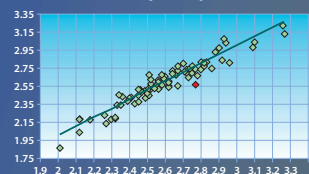


Canola IV: R<sup>2</sup> = 0.984, RMSEP = 0.54, Range: 102 - 122.2

Table 3. Statistical Analysis of NIR Results for Soybean and Soy Flour

Sample Type	Traits	R <sup>2</sup>	RMSEP	Range
Soybean	Moisture	0.982	0.27%	6.5 - 15.2%
	Oil	0.989	0.3%	15.5 - 24.5%
	Protein	0.990	0.42%	36.2 - 51.5%
	Total Isoflavone	0.780	240 ppm	920 - 2912 ppm
Soy Flour	Moisture	0.988	0.17%	3.6 - 10.7%
	Protein	0.992	0.31%	40.4 - 55.4%
	Oil	0.994	0.51%	8.1 - 28.2%

Prediction vs True / ARG (% 13 MB) / Test Set Validation

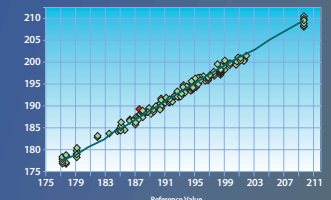


Soybean Arginine: R<sup>2</sup> = 0.901, RMSEP = 0.0728%, Range: 2.0 - 3.3%

Table 4. Statistical Analysis of NIR Results for Intact Flax Seeds

Traits	R <sup>2</sup>	RMSEP	Range
Protein	0.994	0.24%	18.2 - 29.3%
Oil	0.987	0.33%	37.6 - 50.0%
Oleic	0.972	0.54%	12.9 - 25.8%
Linolenic	0.993	0.41%	47.5 - 68.4%
Stearic	0.902	0.22%	2.5 - 4.9%
Total Saturates	0.948	0.21%	7.1 - 11.3%

Prediction vs True / IODINE VAL / Test Set Validation



Flax IV: R<sup>2</sup> = 0.994, RMSEP = 0.61, Range: 177.1 - 209.7

Table 5. Statistical Analysis of NIR Results for Whole Corn Samples

Traits	R <sup>2</sup>	RMSEP	Range
Oil	0.947	0.42%	2.3 - 9.3%
Protein	0.977	0.33%	5.2 - 13.3%
Moisture	0.994	0.27%	7.2 - 24.9%
Starch	0.982	0.65%	52.2 - 72.4%
Alanine	0.921	0.05%	0.4 - 2.2%
Glutamate	0.906	0.16%	1.1 - 7.8%
Leucine	0.937	0.10%	0.7 - 5.3%
Phenylalanine	0.913	0.03%	0.3 - 1.8%
Serine	0.910	0.03%	0.3 - 1.8%
Threonine	0.910	0.02%	0.3 - 1.1%
Tyrosine	0.933	0.02%	0.2 - 1.5%
Valine	0.933	0.03%	0.3 - 1.8%

## Conclusions

- An Internet-enabled FT-NIR system can be used for rapid multiple grain and trait analyses
- It is easy to use and flexible as to grain types, sample forms and quality traits
- Methods for many other grains and traits such as NSI, fiber and variety ID have also been developed
- It is easily expandable to many other applications for future analytical needs

