NIR Technology in Grain and Cereals analysis

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- Spectroscopy
- Spectral Regions
- NIR principle of analysis
- Calibration and prediction
- NIR installation points
- Application of NIR
- NIR as a tool

Spectroscopy

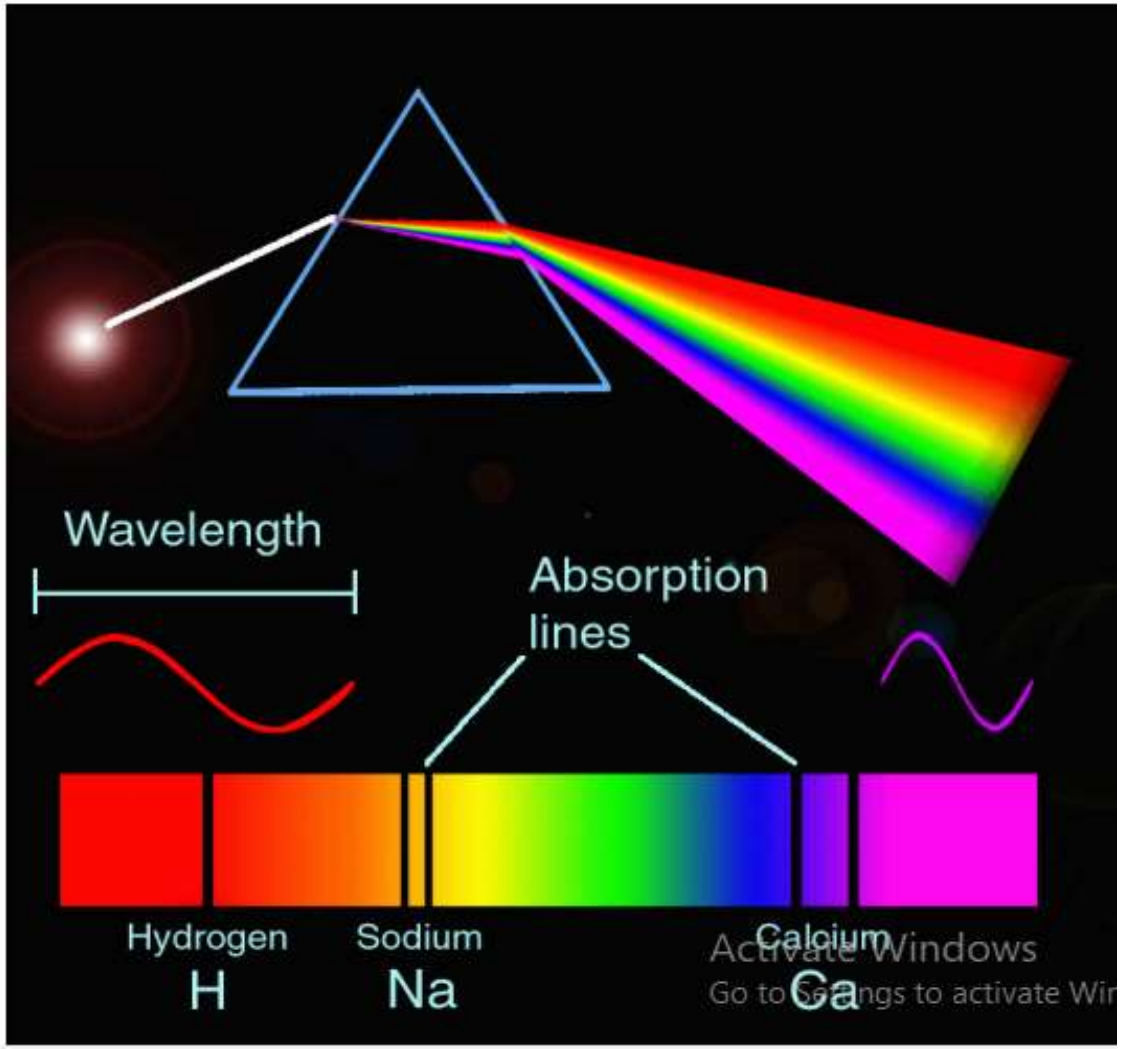
Chemical analysis using near Infrared: How?

Spectroscopy

Spectroscopy is the study of absorption of near infrared light (energy) by molecules

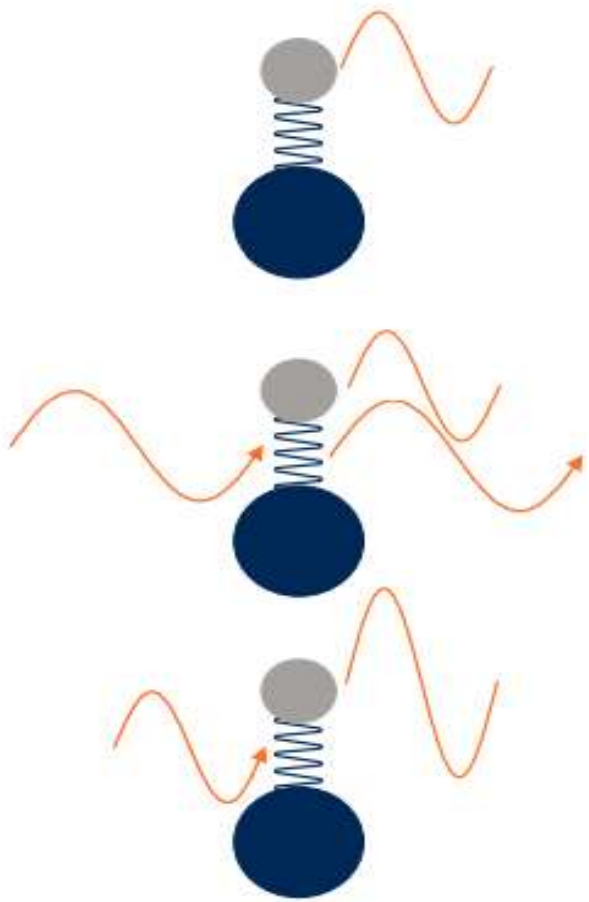
Near infrared ranges from 780 – 2500 nm

It is a part of molecular spectroscopy where interaction between light (energy) and matter (molecules).



Spectroscopy

- Atoms vibrate with a frequency specific to the molecular bond
- When light hits the vibrating bond, it is just passing through when it does not match the frequency
- When light hits the bond with a matching frequency, the light is absorbed and the vibration intensifies
- Organic bonds absorb NIR light.



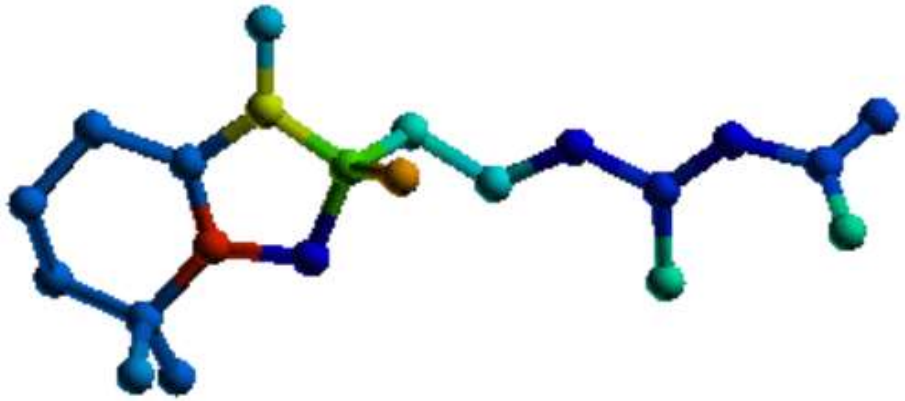
Spectroscopy

Color & chemical composition including

-OH

-NH

-CH



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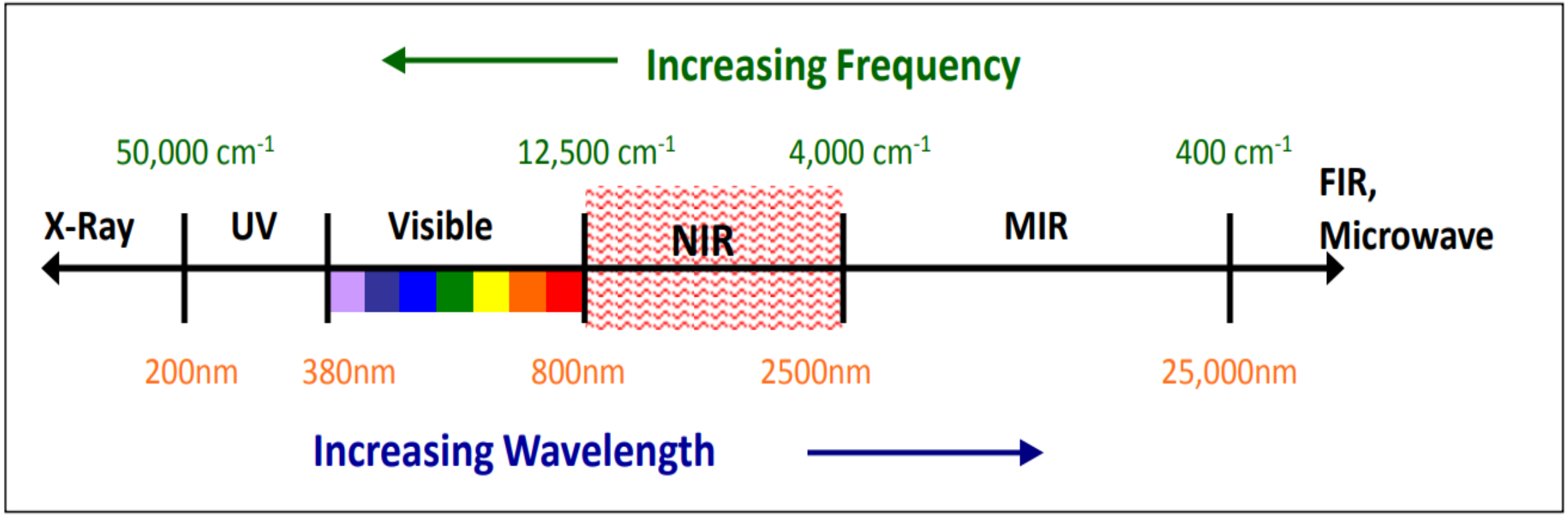
Spectral Regions



Frequency = 1 / wavelength

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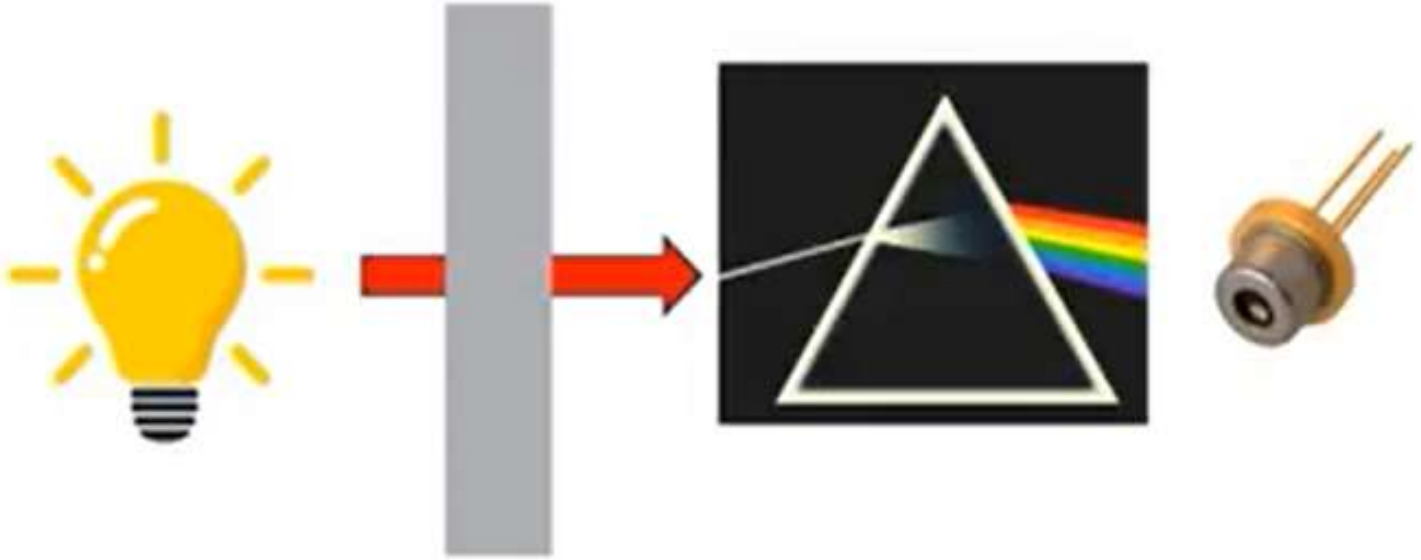
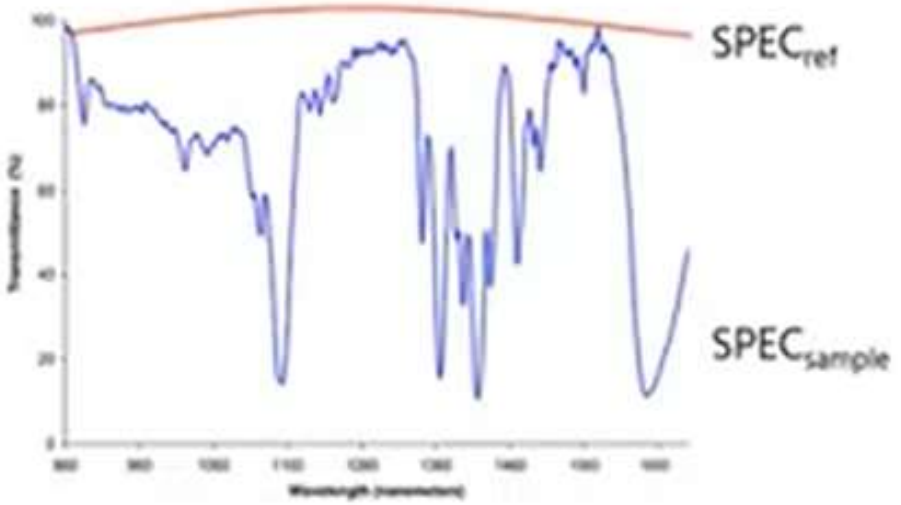
NIR principle of analysis

How does NIR measure parameters?

What is calibration mdel ?

NIR Principle of Analysis



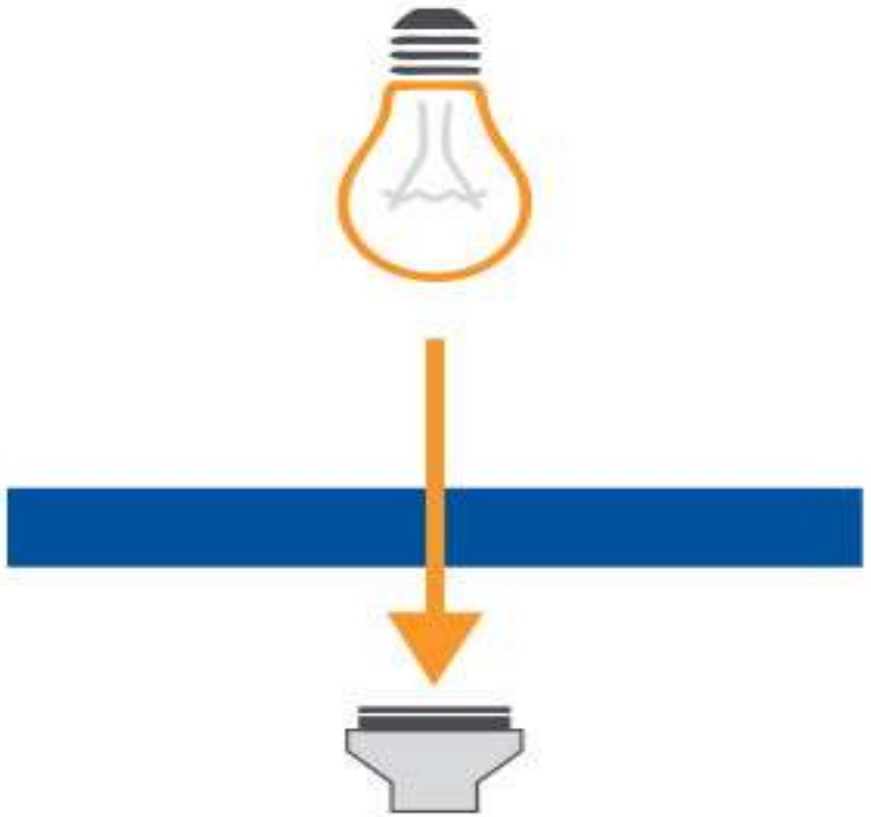


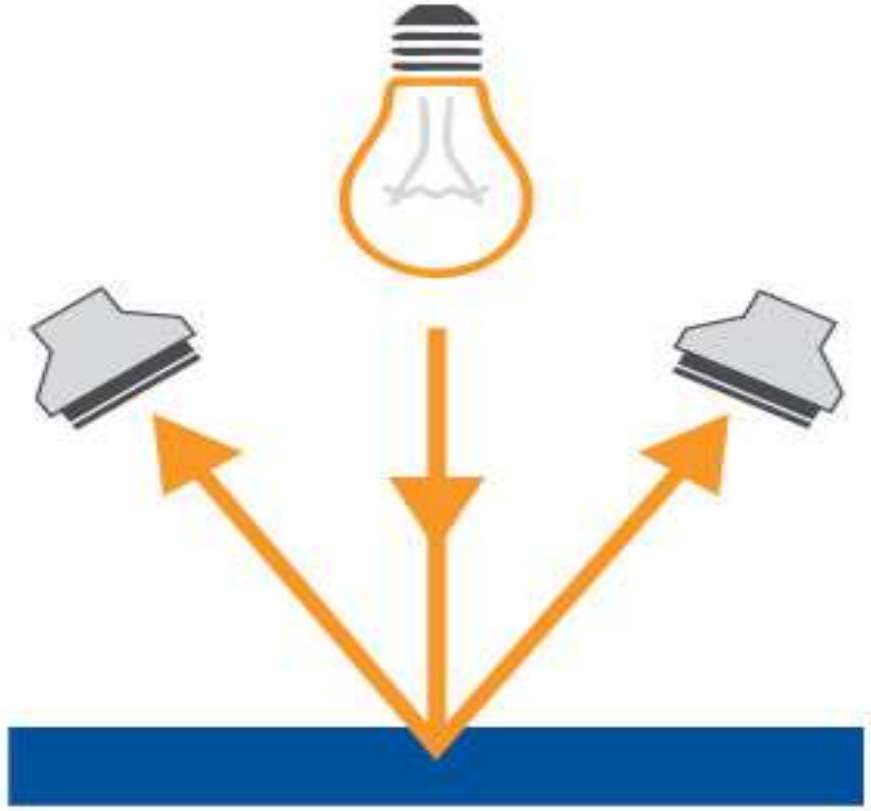
Light source | Sample | Spectrometer | Detector

$$A = -\log\left(\frac{SPEC_{sample}}{SPEC_{ref}}\right) = \log(SPEC_{ref}) - \log(SPEC_{sample})$$

Chemometrics

Transmission and Reflectance





Calibration and prediction

NIR Spectra

Refrence analysis

15.2
20.1
30.2
.
.
.
30.8

Calibration

Calibration model

NIR Spectra

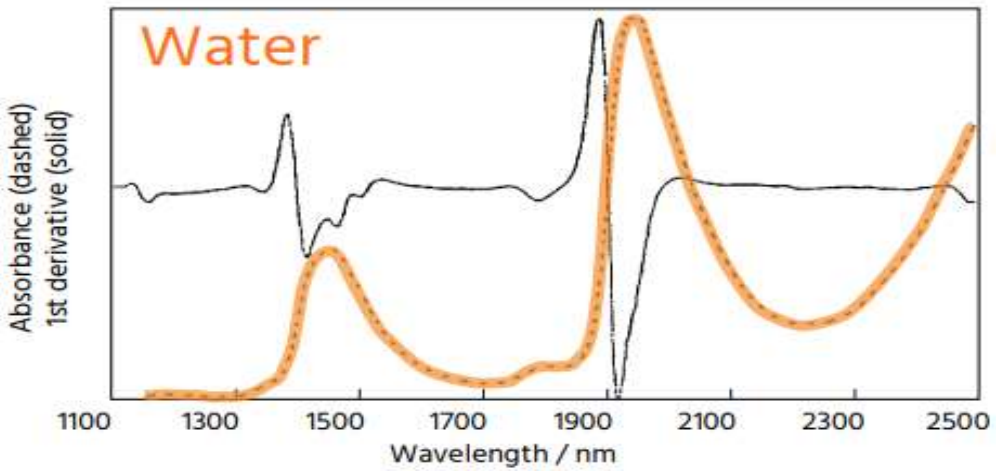
Calibration model

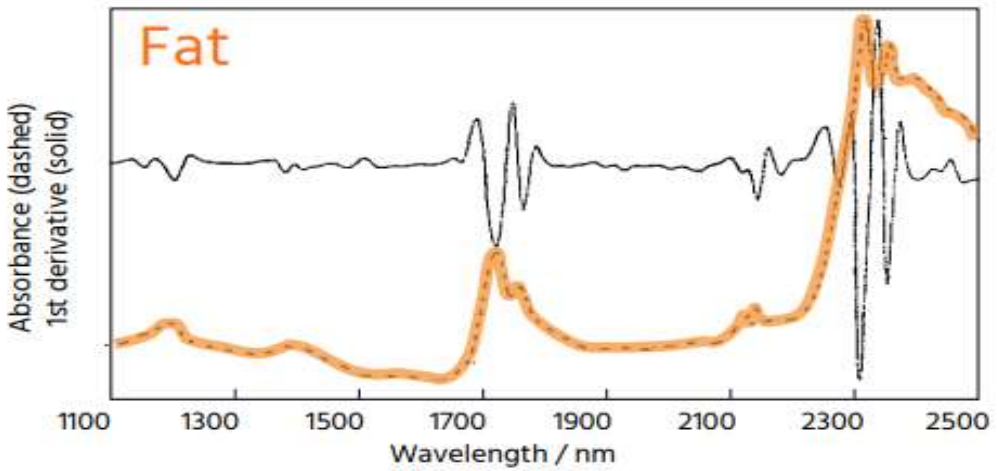
Prediction

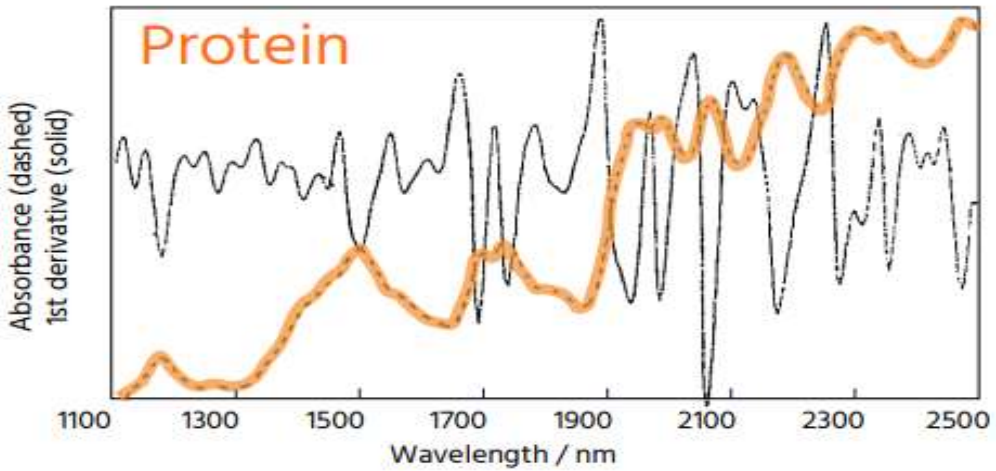
Result of NIR

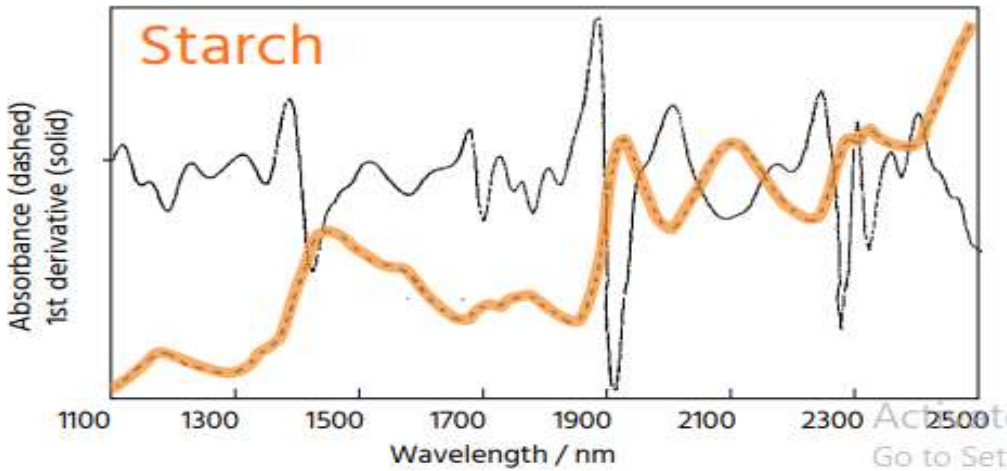
15.8
20.9
30.7
.
.
.
312

Constituent Spectra









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NIR installation points

Where and how can NIR help ?

Raw material reception

Quality control laboratories

Production

Finished products

Speed! Allows for many improvements:

- Check incoming ingredients
- Rejection of out of spec incoming material
- Measurement of in-process products
  - ❖helps for process control
  - ❖ reduces re-work or scrap product
- Used for end product testing
  - ❖quality control
  - ❖packaging

Purpose

- Speed = Increased efficiency
  - Greater sample throughput
- Reduced costs
  - No consumables
  - No chemical disposal costs
  - Lower labor costs
- Increased safety
- Better process control
  - Greater product knowledge

Application of NIR

Applications in the Food Industry

- Flour Milling
- Bakers
- Pasta Manufacturing
- Oilseed Processors
- Ice Cream Makers
- Snack Foods
- Meat Processors
- Wet Corn Milling
- Grain Handlers
- Dry Corn Milling
- Fruit
- Edible Oils
- Dairies
- Feed Producers
- Breweries
- Spices
- Food Additives
- Modified Starches

Example: NIR at a Flour Mill

Wheat

Wheat : Protein, Moisture, Starch, Wet Gluten, Zeleny,

Wheat flour

Wheat Flour II - Moisture, Ash, Protein, Water Abs, Wet Gluten

Example: NIR at oilseed industries

Cereals/Grains

- Corn/Maize
- Wheat
- Barely
- Rye
- Oat
- Triticale

Vegetal Protein Meals

- Rapseed/ Canola, Seed, Cake
- Rapseed/ Canola, Meal
- Soybeans /Meal, Cake, Short
- Roasted Soybean Meal
- Soybean Meal De-hulled
- Soybean Full-fat
- Sunflower/ Meal, Cake
- Bean Protein
- Copra Meal
- Pea Protein
- Peanut/ Meal, Cake
- Linseed
- Corn Gluten Meal

Vegetal By-Products

- CornGluten Feed
- Wheat Gluten Meal
- Corn Germ
- Linseed Wheat Blend
- Corn Germ Meal
- Beet Pulp
- Corn Flakes
- Corn Extruded
- Corn By-products
- Corn Mash
- Barely Flakes
- DDGS
- Rice Bran
- Broke Rice
- Wheat Brans
- Wheat Gluten Middling

NIR as a tool

Why choose NIR as a tool ?

- **Instruments are easy to use**

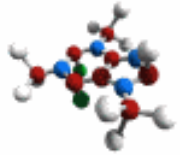
- **NIR is fast**

- **Accurate results**

- **Little sample preparation**
- **Environmentally friendly**

  - no chemicals
- **Economical**

  - no consumables
- **Capable of solid or liquid analyses**
- **Handles complex matrices**



  - simultaneous, multi-component analysis

POUR SAMPLE
START
RESULT
MEASURE
Parameter
Value
GH
NH
Protein [%]
20.62
1.42
0.87
Fat [%]
20.12
1.23
0.98
Moisture [%]
11.27
1.73
0.62
Cotton Seed Meal
Large cup

Global partners

Which companies and manufacturers are using NIR technology for advanced analysis ?

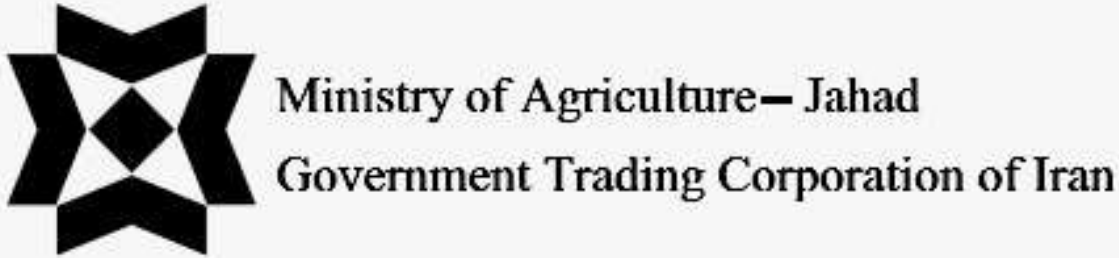
Barilla
N°1 in ITALIA

DSM
BRIGHT SCIENCE. BRIGHTER LIVING.

Cargill

Zar
Group

SGS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