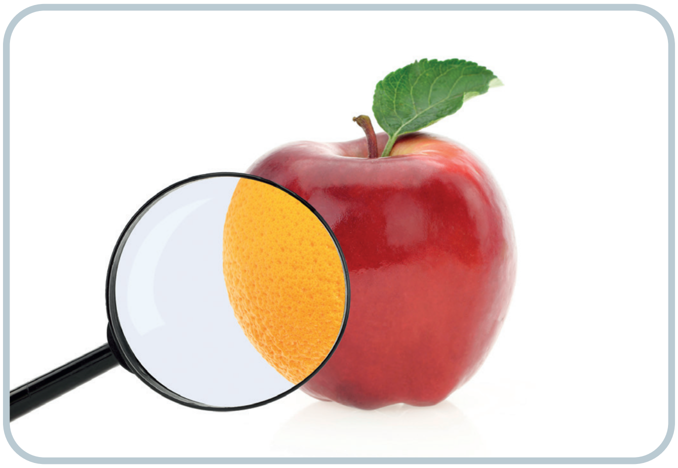

Application Note AN N300

Fighting Food Fraud: FT-NIR for Targeted/Non-Targeted Adulterant Screening

Maintaining brand reputation and product quality has led to increased focus on qualifying raw materials and ingredients used in food production. In addition to traditional quality parameters like moisture, fat, and protein, detection of adulterants plays a critical role in ensuring food safety and quality. The USP (US Pharmacopeial Convention) Food Fraud Database currently lists hundreds of incidents of economically motivated adulteration (EMA), substitution, counterfeiting or mislabeling of food products, such as olive oil and milk powder and some prominent adulterants e.g. melamine.

FT-NIR offers a valuable tool for screening almost any raw material with an excellent cost-benefit ratio and unrivaled ease-of-use. The high information content of NIR spectra provides a finger print of the complete sample. Comparing the spectra of the incoming raw materials with those measured using samples of known quality permits a non-targeted screening of adulterants or contaminants within the detection limits. If a material is tested positive on adulteration by FT-NIR, further investigations with complementary analytical methods can be carried out to determine the exact identity of the adulterant.

Bruker FT-NIR spectrometers offer a fast and effective tool for quality control of raw materials, intermediate products and final products. As a non-destructive method without any sample preparation it is already extensively used in the food industry for analyzing main constituents such as protein, moisture, fat, lactose, ash, and fiber.
With the measurement of a single spectrum the sample can be evaluated in a three-step process. This enables verification of the sample identity and targeted screening for known contaminants as well as non-targeted screening for adulteration with unknown materials, followed by traditional quantification of the main constituents:

1. Identification
Identification of a sample is carried out to determine if the spectrum of an incoming raw material fits within the statistical population of authentic and previously accepted batches. With this first step it can be checked if the correct raw material was delivered and properly labeled to avoid usage of the wrong ingredient in production.

2. Conformity
In the next step the sample is further qualified using conformity test, which is a more specific evaluation of the spectrum. Each data point of the NIR spectrum is subject to a dedicated test with an individual threshold. This check for conformity at each data point allows a real fingerprinting of the material with adjustable sensitivity.

3. Quantification

During the quantification of the different constituents an outlier test based on the Mahalanobis Distance is performed. Again the analysis spectrum is compared to the sample population in the individual quantification models.

Bruker Optics comprehensive spectroscopy software OPUS provides powerful tools for identification, qualification by conformity test and quantification of raw materials and finished products. The powerful MultiEvaluation package combines these individual evaluation tools to a single routine. This allows the hierarchical evaluation of spectra using different methods, like identification of a product in a list of hundreds of products, followed by a dedicated conformity test and/or quantification of the identified product.

The software user interface links measurement and evaluation methods to a single raw material or product. The operator only needs to select the product to be analyzed and the correct measurement and evaluation methods are performed automatically. Green checkmarks are used for passing evaluations, whereas a red cross indicates the sample has failed the test.

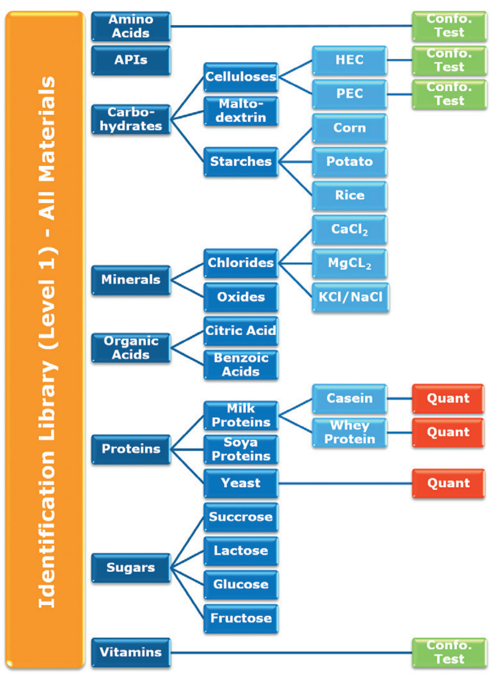

Figure 1: Example scheme of a MultiEvaluation method with hierarchical identification followed by conformity testing or quantitative evaluations.

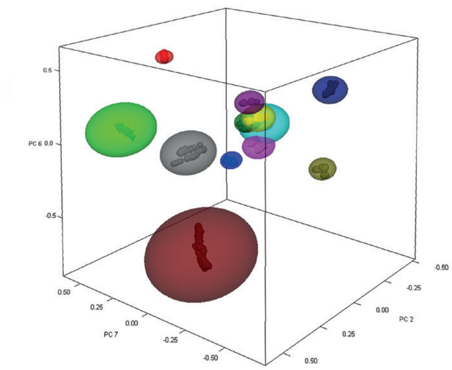

Figure 2: 3D scores plots showing different material groups in an identification library.

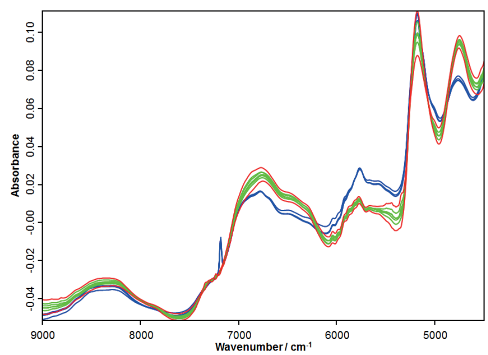

Figure 3: Display of reference spectra in a conformity test method (green) with spectra detected as outliers (blue).

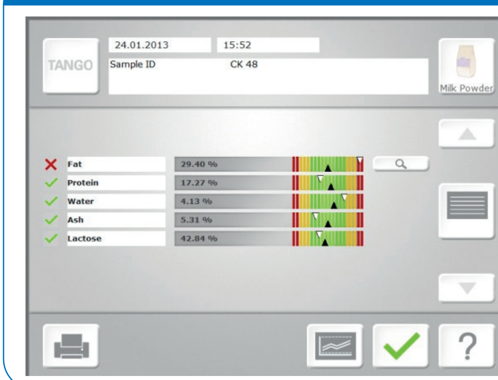

Figure 4: Result screen for a quantification showing a Mahalanobis outlier for the fat evaluation.

Bruker Scientific LLC

Billerica, MA · USA
Phone +1 (978) 439-9899
info.bopt.us@bruker.com

Bruker Optics GmbH & Co. KG

Ettlingen · Germany
Phone +49 (7243) 504-2000
info.bopt.de@bruker.com

Bruker Shanghai Ltd.

Shanghai · China
Tel.: +86 21 51720-890
info.bopt.cn@bruker.com

www.bruker.com/optics