Fourier Transform Mid Infrared Spectroscopy Models & Associated Software for Protein, Fat, and Carbohydrate Quantifications in food and other plant materials (2023-030)

Software program and associated models to analyze nutrient compositionin real-time, nondestructively, and under any lab, industrial, and field conditions.

Market Overview

Rapid, inexpensive, and nondestructive technologies to measure nutrient compositions in biological (organic) materials are essential for their use in industrial utilization for human/animal health, energy generation, and nutrient-recycling. However, the currently available methods are expensive, take weeks to a month to generate results, and are highly destructive. For example, protein analysis uses the Kjeldahl method or nitrogen analyzer, which typically takes days to get results costing up to $100 per sample. Similarly, starch and fat analysis are time-consuming and require expensive instrumentation. This newly developed model and associated software takes 30 seconds or less to analyze a sample, is non-destructive, and costs less than a dollar per sample (when included with the instrument, operator costs, and 20 % margin). In addition to protein, the same scan will provide carbohydrate and fat results, requiring no additional scanning or operating time—up to nine nutrient composition results for less than a minute and dollar per sample.

Technical Summary

Partial least squares (PLS) models were developed inside MicroLab Expert to predict several seed composition traits (protein, sulfur-containing amino acids, starch, resistant starch, saturated and unstaturated fatty acids etc.). These models require MicroLab Expert for application but can be exported/imported into MicroLab PC for easier use. Export also allows distribution. Although the end-user cannot easily modify the models, model specifications can be made available for end-user model reconstruction/alteration. Models will be periodically updated and improved as model training sets improve and as MicroLab software is updated. The model source code is housed with the local MicroLab software; however, instrument and model settings/specifications could be available upon request.

Applications

Food processing, food quality control, nutrition, bioenergy generation, plant breeding, agricultural operations, biomaterials

Development Stage

Beta Test

Advantages

- Shorter time (<1 minute) and low cost (<$1) for nutrient type and composition data
- Accurate quantification method for solid and liquid samples
- Non destructive; hence same sample is available for other analysis
- User-friendly software, allowing methods to be created and spectra collected with relatively little technical knowledge

About the Inventors

Dil Thavarajah, PhD.

Professor of Pulse Quality and Nutritional Breeding at Clemson University

Dr. Dil Thavarajah is a Professor in the Department of Plant and Environmental Sciences and co-leader of the Phenomics component of the Feed the Future Innovation Lab for Crop Improvement at Cornell University. Dil is internationally recognized as a leader in pulse biofortification. Her research focuses developing rapid and inexpensive analytical chemistry tools and finding whole-food-based-solutions to combat global "hidden hunger."

Nathan Johnson

Postdoctoral Research Fellow at Clemson University

Nathan Johnson is a Postdoctoral Research Fellow invested in furthering the holistic health of individuals and communities through developing molecular breeding resources and high-throughput phenotyping tools for nutritional traits in pulse crops. His graduate studies focused on determining genetic markers that can be used to breed new varieties of lentils.

Amod Madurapperumage

PhD. student at Clemson University

Amod Madurapperumage is a Ph.D. student at the Plant and Environmental Sciences department conducting plant phenomics research. Amod studies on small molecular behavior in plant matrices using variety of spectroscopy techniques. He has designed several novel, robust, and high-throughput tools to analyze plant nutrient.

Leung Tang, PhD.

Applications Scientist at Agilent Technologies

Leung Tang received his PhD. in Pure and Applied Chemistry from the University of Stracthclyde in 2003. After his post-doc, he worked at A2 Technolgies and Agilent Technologies. His current role at Agilent Technolgies includes the design, implementation, and collection of experimental data, analysis and dissemination of data to create robust models, and testing chemometric models.

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