ITEA 2

INFORMATION TECHNOLOGY FOR EUROPEAN ADVANCEMENT

INNOVATION REPORT

Sounding out food quality and safety

EUREKA

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One of the world's main challenges is global food production, and especially cereal production. According to the UN Food and Agriculture Organisation, production needs to double by 2050 to meet basic nutritional needs. It is a challenge compounded by inefficient agricultural practices, population growth, the conversion of grain foods to animal feed and biofuel production, and climate change. Moreover, consumers expect good food quality and safety while food inspectors demand good manufacturing practices, safety, labelling and regulatory compliance.

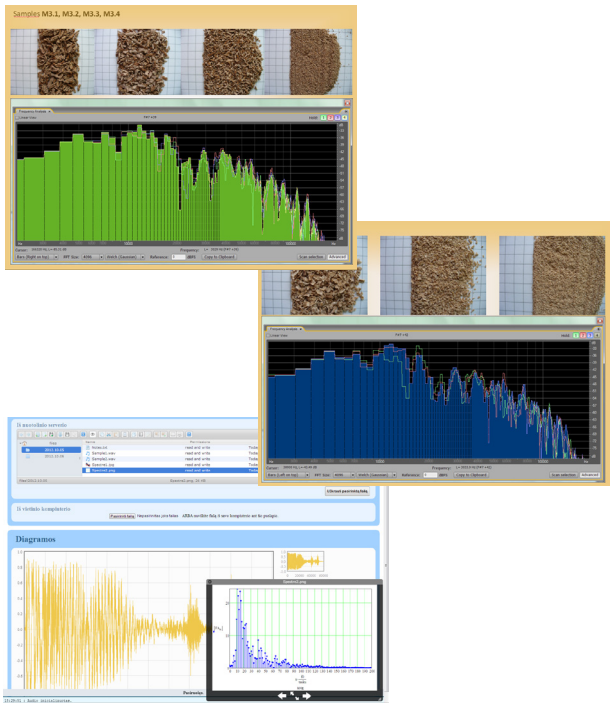
The ITEA 2 ACOUSTICS project set out to help tackle this challenge and respond to demand from food producers for in- and on-line equipment to monitor the quality and safety of food, meet regulatory requirements and reduce production costs as well as increase throughput. The solution came in the form of a non-invasive acoustic testing method for rapid food quality and safety controls, using tools and algorithms based on the propagation and reflection of acoustic waves to characterise, determine and monitor changes in microstructure through advanced acoustic spectrometers. Among the application areas were quantitative determination of certain mycotoxins in cereal grains, structural/texture changes in bakery products and extruded products and particle size in chocolate, coffee and porosity of tea and defects in non-food products such as textiles, paper and building materials.

Efficient quality and safety control

A key to the success of the ACOUSTICS project was the development of relevant processing algorithms and sampling and analysis techniques for the acoustic spectrometers that are excellent tools for different applications in food quality and safety, particularly in cereals where there is a close correlation between the texture and structure of porous and aerated products and the quality of the food produced. The main innovation was the introduction of a new non-invasive acoustic technique whereby porosity in material can be measured in order to detect certain mycotoxins in food – altogether faster and cheaper per analysis than analysis measurements to date. This approach eases the sampling and analysis of certain mycotoxins (DON, AFT) – fungal metabolites that are poisonous to man and animal – in cereal grains, estimated to be responsible for the contamination of over 25% of the world's commodity crops. Extrapolated to costs, mycotoxin contamination could run into €1 billion a year in the EU alone.

Reliable, fast and flexible

The small consortium of academic partners and SMEs from Lithuania and a University and Institute from Ukraine collaborated closely in this unique project to develop an objective tool for laboratory and on-line instrument analysis and in-line high-throughput analysis of consignments of cereal grains to quantitatively determine certain mycotoxins. The monitoring of cereals in-line increases food safety at a substantially lower cost than has been possible to date. Importantly, the speed at which the food, feed and agriculture industries are able to monitor processing streams not only boosts efficiency and effectiveness but also enables compliance with legislation and logistical and operational targets to be met. Furthermore, time and investments in complex instruments and staff qualifications can be reduced.



ACOUSTICS Analyses of calibrated chocolate granules and GUI

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This ITEA 2 project built one acoustic prototype spectrometer that forms the basis and knowhow to construct an integrated automatic in-line model with a sound penetration/reflection acquisition system. In addition, a portable acoustic system was developed for use at point of harvest by farmers and breeders to inform the farmer about certain mycotoxin contamination of his cereal crop. Two prototypes of acoustic measurement equipment were delivered and demonstrated. After the development of analysis software and the presentation of initial results, many samples were gathered from different sources for analysis. Food and non-food samples were analysed using both traditional and acoustics methods of analysis to calculate the correlation characteristics and assess the precision and validation of the acoustics method.

The validation of the acoustic measurement system application for food safety and quality control using a model system of cereal grains damaged with Fusarium spp revealed that there were high correlations between the DON concentration in wheat samples and the different amounts of shrivelled grains in mixtures. It was also evident that this acoustic method provides reliable results in the quantitative determination of shrivelled grains and DON in wheat, and is sufficiently precise. Good performance characteristics for repeatability were also found.

This resulted in the development of new systems: a prototype acoustic measurement system for penetration designed and assembled by the Ultrasound Institute of Kaunas University of Technology and a prototype acoustic measurement system for penetration and reflection designed and assembled by Vilnius University. The software that was developed included algorithms for spectral analysis and evaluation of product quality level based on a comparison of measured parameters with values stored in the databases designed by both Universities in Lithuania.

Briefly, the food applications include the evaluation of the texture of porous products like bread, wafers and crackers, tea extraction, the whipping process of different fresh raw materials such as eggs, particle size and distribution during chocolate mixing. In terms of non-food, applications include the evaluation of the homogeneity of polypropylene films used in water filters for the desalination of contaminated water.

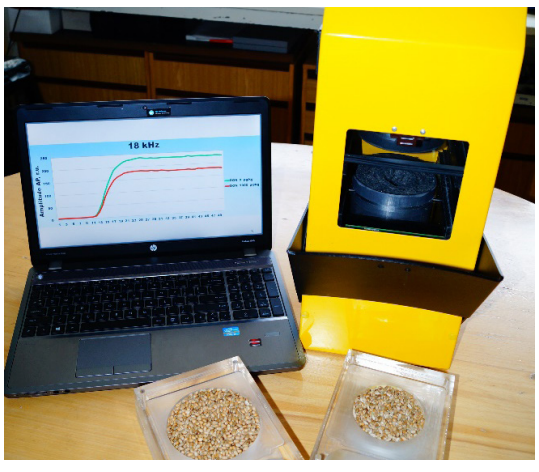
A wider context of application

While the results of this project are primarily intended for use in industrial applications in the food industry, where quality and food safety are required, and in food product development, the potential impact of implementing the physical principles of non-destructive testing for the quality and safety of porous food with fast, non-invasive acoustics is enormous. This is a powerful versatile tool in product development, sensory sciences, material characterisation in the non-food sector and in- and on-line control and monitoring of specific mycotoxins (DON, AFT) in cereal grains. This technique can easily be extended into the qualitative structural and textural aspects of food such as the shelf-life of bread, the infusion/extraction speed of tea, extruded and foam products and in the non-food area such as the building, textile and paper industries.

At the threshold of market impact

Commercialisation of the equipment still has to take root; there is interest from Dutch and French SMEs. Of the consortium partners, the results of the project have already been put to good use with the Ultrasound Institute of Kaunas University of Technology and Vilnius University along with the Ukrainian Scientific-Research Control Institute of Veterinary Medical Products and Feed Additives from L'viv among those that have developed a new acoustic spectrometer methodology for use in the food and non-food industry.

The impact of the project on the market can be tremendous because there is a huge potential of the sound/acoustic generator to be used as a new 'unit operation' in the food, feed and non-food market. The cost per mycotoxin DON analysis using this acoustic method is lower compared with the traditional chemical methods (HPLC ~ 60 EUR, ELISA ~ 25 EUR, ACOUSTIC < 5 EUR/analysis) and competing systems such as NIR and ACURUM are expensive and low-capacity. The future could see iPad-size, hand-held units. While much may depend on the outcome of acquiring a patent, the unique selling points of the equipment are that it is not only the fastest in the market and extremely flexible, especially in the portable version, but it is also the cheapest in terms of analysis costs.



Acoustic spectrometer