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Vibrational Spectroscopy Instruments in Tandem with Data Science can be used to Serve Food Safety

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Abstract

The DiTECT project utilizes advanced digital technologies and non-invasive sensors to enhance food safety in the EU and China. By monitoring microbiological hazards in maize, poultry, cattle, and fish, it enables early detection through rapid assessment methods. A cloud-based platform, SorfML, applies machine learning to interpret contamination data, improving real-time food safety management. This approach strengthens consumer confidence and reduces risks in the food supply chain.

Keywords:

machine learning; Internet of things; edge software development; food safety; sensors

1. Main text

Food business operators (FBOs), along with regulatory authorities and consumers, share the responsibility of ensuring food security, integrity and safety in an environmentally sustainable manner, while at the same time taking into account the increasing lack of natural resources as well as the continuous evolution of consumers' life-styles and contemporary consumption habits. These facts, realized in the context of tremendous recent technological advancements, are of global significance, with particular relevance and importance for the EU and China. In this framework, and also taking into account that the agri-food supply chain is the weakest link across the food chain in both regions, the EU-CHINA project titled "Digital TEChnologies as an enabler for a continuous food waste management systems" aims to provide quantifiable evidence for the effective detection, assessment and mitigation of biological hazards, chemical hazards and environmental contaminants, using the latest advances in software technologies and high throughput, rapid, non-invasive sensors.

In the DiTECT four pilots have been designed i.e., PILOTS; P1- maize (corn and infant foods) P2- poultry; P3 – Cattle and P4 Fish (as food), where selected microbiological hazards were monitored across food chain, using rapid, non-invasive sensors for their detection and monitoring.

Ensuring top quality and maximum safety to maintain the consumer's confidence is one of the main challenges facing the food industry nowadays. As conventional laboratory and microbiological tests cannot provide a 100% inspection, non-invasive approaches based on vibrational spectroscopy, hyper- and multi-spectral imagining started gaining popularity as rapid and efficient methods for assessing food quality, safety and authentication

To achieve this a database is created, that concerns the entire food chain covering not only the primary production but also the remaining stages of the food chain.

The contents of this database are contamination maps (prevalence, biogeography and metagenomics) of biological and chemical hazards as well as environmental contaminants on selected foods (animal origin and infant foods) and routes at retail level.

A wide range of data was collected as follows (i) Data derived from instruments based on vibrational spectroscopy e.g., FTIR/NIR/ Fluorescence/ RAMAN as well as from UV/VIS (ii) Data from convectional microbiological analyses (iii) Product characteristics/processing, distribution and storage conditions (e.g., pH, aw, atmosphere etc.).

Due to the multi-dimensional nature of the data generated from such analyses, the output needs to be coupled with a suitable statistical approach or machine-learning algorithms before the results can be interpreted. In order to overcome this challenge, the cloud-enabled platform SorfML (www.sorfml.com) was developed to provide a framework for interpreting the output from such platforms into a freshness, safety or authentication profile; allowing therefore such platforms to be applied on-line or at-line throughout the food production chain. In this talk, the main functionalities of sorfML will be outlined; as well as a short live demo highlighting the potential uses of this application.

The successful implementation of the above – mentioned database build within DiTECT project is expected to significantly reduce microbiological hazards, through means of early detection before they make their way to the final product.

Moreover, the collaboration between the EU-China food businesses and research partners will result in enhancing consumers' confidence in the safety of food traded between the two regions, throughout the farm-to-fork continuum.

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