Metagenomics and Big-Data approaches for monitoring food quality and safety

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State-of-the-Art

Food quality and food safety are critical components to maintain a safe and economically sustainable food supply and are important for the improvement of food security across the globe (Cook and Nightingale, 2018). Utilization of omics-based techniques can broaden the scope of sampling programs and can increase detection of a broad range of issues, including spoilage and pathogenic organisms identification, foodborne illness outbreak detection, microbial source tracking investigations, niche adaptation, antimicrobial resistance and product shelf-life monitoring (Miller et al., 2013; Zhou et al., 2016; Forbes et al., 2017).

This PhD project develops within the frame of the EU granted project **H2020-DiTECT** – "*Digital Technologies as an enabler for a continuous transformation of food safety system*", whose main objective is to develop a map of the microbiome involved in each food chain and identifying the possible contamination routes using advanced techniques based on shotgun metagenomics. These data will be integrated with metadata about product composition, soluble and volatile organic compounds, technological process and storage conditions to develop a specific database for each food chain. Models integrating metagenomics data with available variables will be developed, allowing to predict the functional potential of the microbiome by collecting on-line data across the food chain. A platform collecting and integrating different Big-Data generated within the project will be developed, to predict the presence of risks for the safety or freshness (microbial spoilage) of different food products based on data acquired by on-line and nondestructive sensors. **This approach will be tested across 4 food chains in pilot systems** (bovine fresh meat and milk production, poultry, cereal-based baby foods, aquaculture).

"Digital Technologies as an enabler for a continuous transformation of food safety system"

Objectives and Milestones

This PhD thesis project will integrate multidisciplinary skills and can be subdivided into the following activities:

A1) **Analysis of the scientific literature** concerning the identification of the main microbial contaminants to be considered across each food chain, in particular for the four food chains considered.

A2) **Assessment of laboratory protocols:** definition and standardization of protocols for microbiome sampling and analysis in each food chain.

A3) **Shotgun metagenomics analysis** of food and environmental samples from the different food chains.

A4) **Data integration and development of the next-generation monitoring platforms:** microbiome data will be integrated with those collected by on-line, not-destructive technologies (microbial metabolites, cytometry) for the development of a simple, "smart", big data-driven tool, that enables real time predictions for safety and freshness profiles for a given food product.

References

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