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Food Pro.tec.ts: Implementing new sensor technologies in meat supply chains (#488)

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Introduction

The project Food Pro.tec.ts (Food production technologies for trans-boundary systems) is part of the "INTERREG V-A Deutschland-Nederland" program, which supports cross-border cooperation with partners from industry and research. The project consists of five subprojects, which are focussing on the development of new technologies and innovations for the agricultural and food sector. The aim of subproject 1 is the development of new real time sensors for the meat industry in order to control critical process parameters and to predict important quality and safety attributes, as well as the shelf life of meat products throughout the entire chain.

Methods

In the first stage of the project, different spectroscopic technologies (fluorescence, Raman, surface-enhanced Raman and infrared) are investigated in order to control process parameters (hygienic conditions), product parameters (total bacterial count on the meat surface) and safety parameters (pathogenic bacteria). Therefore, laboratory investigations with different food contact surfaces from the meat industry and different types of meat are conducted. Spectroscopic measurements are carried out in parallel to classical cultural microbial analysis and evaluations of further quality attributes. Appropriate processing methods and chemometric analysis are used to examine the correlations between the spectral data and the critical parameters. A variety of well-established and advanced machine learning systems are investigated for the development of accurate predictive models. In addition, storage test with meat samples are carried out to characterize the spoilage and to develop shelf life models based on predictive microbiology. The accuracy and reliability of sensor and model predictions are validated in further trials and pilot studies.

Results

The first results show promising potential for correlation of spectroscopic data and microbial counts on meat surfaces and for monitoring of contaminations on processing equipment. In case of the monitoring of hygienic conditions on processing equipment, the results indicate that conventional and convolutional neural network models are well suited for the classification of the actual microbial load on different surfaces. For the determination of the total bacterial count on meat surfaces, fluorescence spectroscopy shows promising results. Although, the accuracy and robustness of the method depends on the type, processing level and cut of the meat, there is the potential for application as a tool for real-time determination of the microbial load. The results delivered by the sensors in combination with the predictive models show the ability for the calculation of remaining shelf life in real-time at all steps of the chain. Regarding the detection of different microbial species, like pathogenic bacteria, surface-enhanced Raman spectroscopy shows the potential for the differentiation on species level.

Conclusion

The overall concept for the implementation of the new sensor technologies is presented in The sensors offer the potential for the non-invasive real time determination of process and product specific parameters. The information delivered by the sensors and the predictive models will be integrated into an early warning tool by using process analytical technology (PAT). This offers an on-line feedback for process adjustment and it supports the decision making during production. Furthermore, it allows companies to optimize processes and their storage management. This leads to an overall reduction of food waste in meat chains and contributes to improve the product quality and safety.

Notes