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FreshScan

Innovative Concepts for Food Characterisation along the Supply Chain Based on Micro-detector-systems

The ongoing reporting of foodstuff scandals underlines the necessity of product quality monitoring in the food industry. However, till now quality control has been random at most and often using methods which destroy the product. To ensure the monitoring along the entire supply chain from the producer to the consumer, highly efficient and non-invasive methods are needed. In this context micro-system-technology represents a potential novel solution for the non-invasive characterisation of foodstuff quality.

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Keywords

Quality, meat, fluorescence, UV/VIS, NIRS, non-invasive

The methods for quality analyses applied so far in the production of fresh food from horticulture and livestock farming are often time-consuming, labour- and cost-intensive. Thus it appears that quality monitoring of single products along the entire supply chain can not be realized with commonly used analysing methods. Therefore the development of specific micros-systems on optical measuring principles for the fast and non-destructive detection of product properties shall be examined within an interdisciplinary research project called "FreshScan". The ATB is one of six project partners in this research network which is founded by the Federal Ministry of Education and Research (BMBF) and coordinated by the „Fraunhofer Institut für Zuverlässigkeit und Mikrointegration (IZM)" in Berlin. Additional partners are the Institute for Chemistry and Physics of the Federal Research Centre for Nutrition and Food (BfEL) in Kulmbach, the working group of Optoelectronics of the „Ferdinand Braun Institut für Höchstfrequenztechnik (FBH)" in Berlin and the Technical University of Berlin (TUB) with the Institute of Optic and Atomic Physics and the research team of the Berlin Center of Advanced Packaging.

Objectives

The aim of the project is to continuously monitor the production process including the transport to the point of sale by establishing a two-part quality analysis system. Meat products will be examined by reflectance, fluorescence and Raman spectroscopy. For this approach an autonomic mobile detector system will be constructed, able to correlate the spectral data with additional relevant product information. At the same time a micro-system which will be attached to the product shall be developed to record relevant production and transport data (e.g. time, temperature) along the entire processing chain. Thus quality variations resulting by e.g. failure in the cooling storage can be detected in time and additionally retraced. Delivering the information of the quality state at each critical point in the supply chain to the parties concerned (e.g. producers, processors, dealers and consumers) shall improve the quality management. In a next step the micro-systems designed for the measurements of meat products shall be modified and tested on other products of the food industry (e.g. fruits/vegetables, fish).

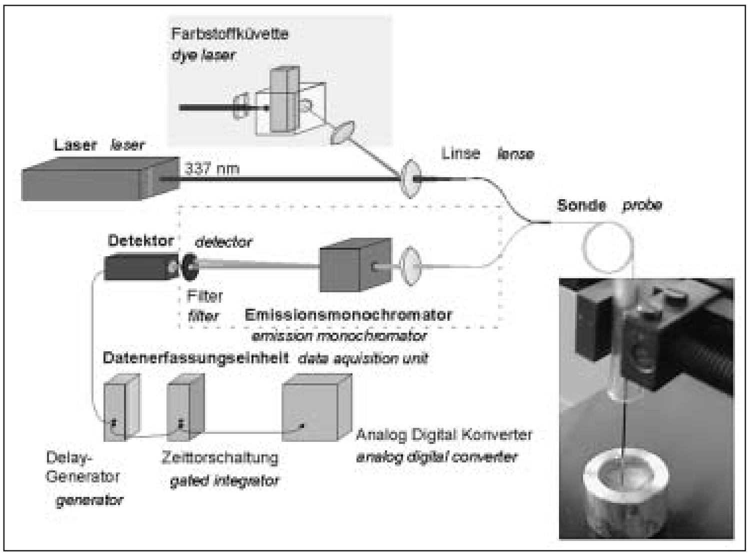

Fig. 1: Schematic view on the experimental set-up of the laser-induced fluorescence spectroscopy

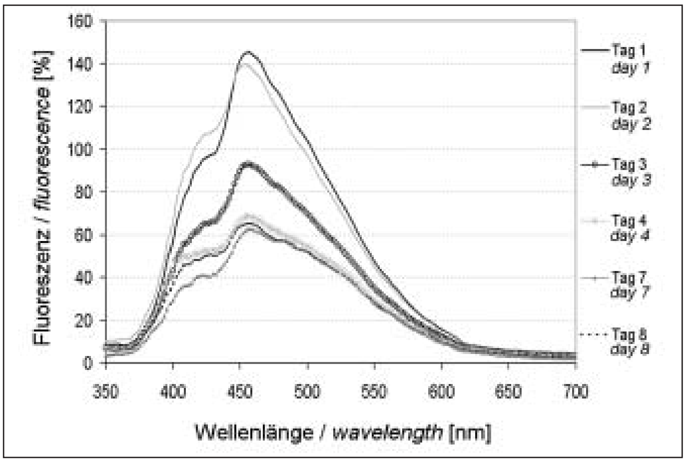

Fig. 2: Fluorescence spectra measured during eight days at the musculus longissimus dorsi of pork

Work at the ATB

Relevant parameters for the characterisation of product quality based on spectroscopic measuring methods will be developed at the Leibniz Institute for Agricultural Engineering Potsdam-Bornim (ATB). The porcine *longissimus dorsi* muscle has been chosen for the experiments because of its relative homogeneity. For the analysis of the quality parameters the reflectance spectroscopy was non-invasively applied in the ultraviolet (UV), the visible (VIS) and the near-infrared (NIR) wavelength range directly on the fresh meat, and the fluorescence spectra were recorded in a wavelength range of 350 to 700 nm. The experimental set-up is shown exemplary for the laser-induced fluorescence spectroscopy (*Fig. 1*) [1]. During the first three to four days of meat storage the fluorescence intensity decreased in a wavelength range of 400 to 500 nm (*Fig. 2*). This could be a result of the decreasing content of NADH post mortem. Furthermore, reflectance measurements were used for the detection of changes in the water, lipid, and protein content. With the help of the transmittance spectroscopy applied on meat and meat products, specific absorption areas were found at 960 to 1010 nm for water, at 930 nm for lipids, at 875 nm and 1025 nm for proteins and at 908 nm for connective tissue [2]. The porcine fat contains in particular stearic, oleic, linoleic, and linolenic acid which can be responsible for the absorption around 930 nm [3]. In the visible wavelength range haem pigments can be detected at 530 to 580 nm [4]. The haem pigments can change their spectral properties for instance during the different meat processing steps.

The spectroscopic measuring methods shall be used fort the non-destructive detection of meat quality parameters. Calibration models will be based on partial least squares (PLS) regression combined and tested with different pre-processing methods to qualitatively and mainly quantitatively analyse the spectral data.

Literature

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