Potential of porphyrin fluorescence signals to serve as matrix-related Time-Temperature-Indicators in fresh meat production

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Introduction

- Development of a fast and precise method for food quality and safety control of fresh meat
  → Demonstration model of a miniaturised detector system

- Meat properties depend on: (beside others)
  - Time and temperature of storage
  - Contaminations with microorganisms and fungi
  - Status and conditions of further processing

- Optical methods can be applied fast and non-destructive through the packaging material
Project partner

Fraunhofer Institute for Reliability and Microintegration

Max Rubner-Institute
Federal Research Centre for Nutrition and Food – Institute for Safety and Quality of Meat – Kulmbach

Ferdinand-Braun-Institute for High-Frequency Technology

Technical University Berlin
Institute of Optics and Atomic Physics
Research Centre for Microperipheric Technologies

Leibniz Institute for Agricultural Engineering Potsdam-Bornim
Storage conditions

- 5 °C, packed in PE bags
- 12 °C, packed in PE bags
- 5 °C, vacuum packed
- 5 °C, protective gas
Stokes shift: $\lambda_{\text{Absorption}} < \lambda_{\text{Emission}}$
Fluorescence spectra at different excitation wavelength of porcine *musculus longissimus dorsi* at day 18 p.m. stored at 5 °C.
Fluorescence spectra ($\lambda_{ex} = 420$ nm) of porcine *M. long. dorsi* stored at 5 °C over 20 days in PE bags.
Fluorescence spectra ($\lambda_{ex} = 420$ nm) of porcine *M. long. dorsi* stored at 12 °C over 18 days in PE bags.
Kinetics of fluorescence intensity at 592 nm ($\lambda_{\text{ex}} = 420$ nm) of porcine *M. long. dorsi* stored at 5 °C and 12 °C.
Comparison of fluorescence kinetics at 592 nm ($\lambda_{ex} = 420$ nm) with microbial count [CFU/cm²] at the same slice.
Technical concept

**Logistic-Logger**
Recording of storage and transportation conditions

- protocols
- logistical information
- reference data
- wireless, 13.56 MHz
- ISO 14443
- food quality
- logistical information

**Database**
Consolidation of all information

- measured data
- Logger-data
- wireless, 2.4 GHz
- Bluetooth
- reference data
- additional information

**Handheld detector**
Optical determination of food quality

- protocols
- logistical information
- reference data
- wireless, 13.56 MHz
- ISO 14443
- food quality
- logistical information

**Introduction**

- Storage conditions
- Fluorescence
- Basics
- Overview
- Porphyrins

**Technical concept**

**Summary**
Summary

- Peaks of protoporphyrins ($\lambda_{ex} = 420 \text{ nm}$) are detectable at
  - 5 °C, packed in PE bags after approx. 10 days
  - 12 °C, packed in PE bags after approx. 6 days
  - 5 °C, under vacuum after approx. 3 days
  - 5 °C, under protective gas (70% O$_2$, 30% CO$_2$) not at all
    (no change to beginning level)
- Results can be used for the development of a matrix-related indicator to survey inadequate temperature conditions during transportation and storage
Thank you for your attention