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Projektträger VDI|VDE|IT

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

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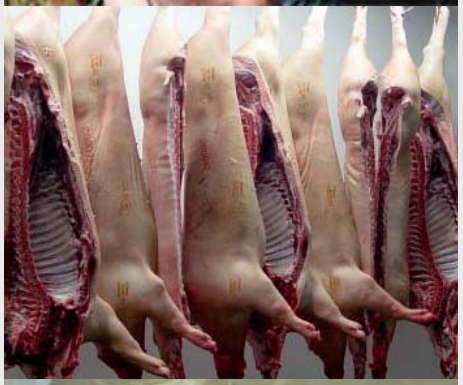
# Introduction



- 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
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Max Rubner-Institut
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Ferdinand-Braun-Institut für Höchstfrequenztechnik
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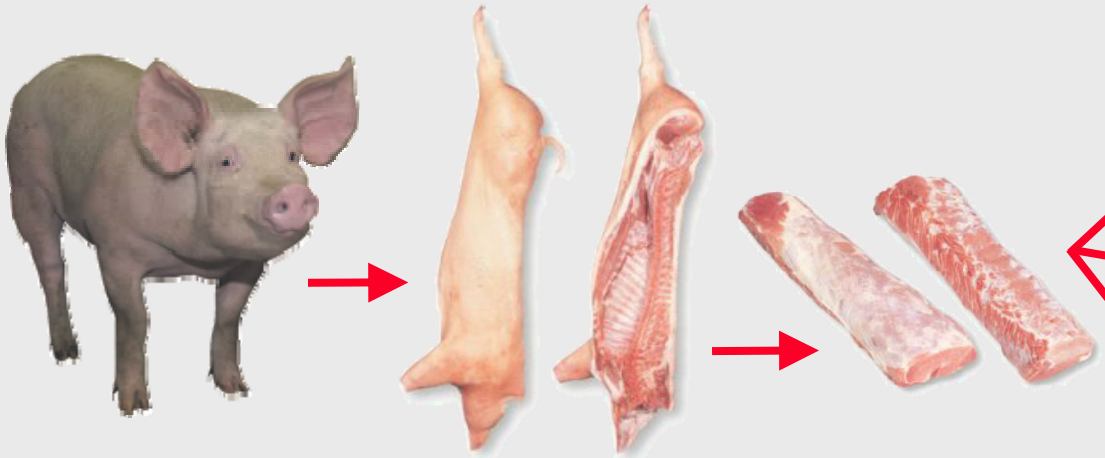
# Storage conditions



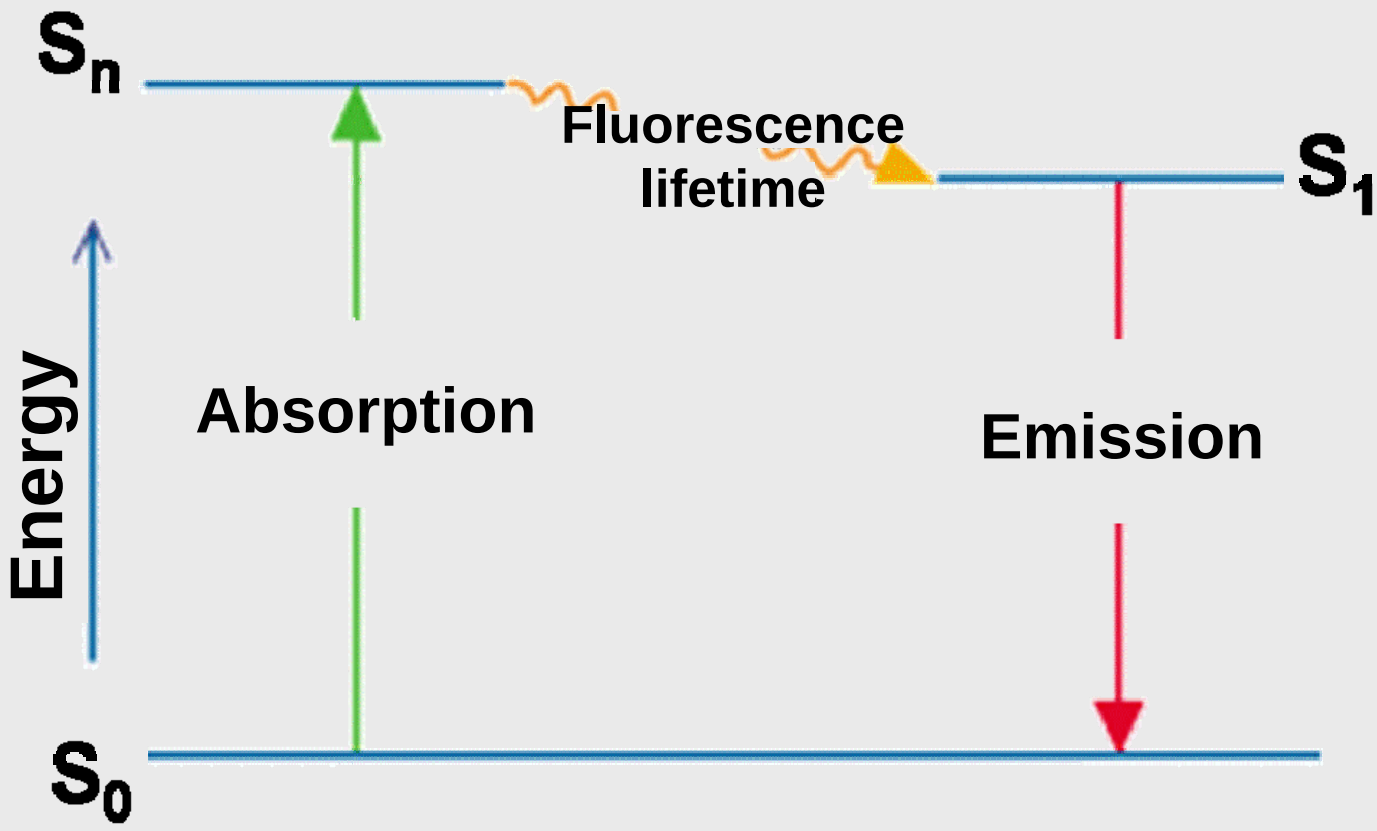



Storage:

- 5 °C, packed in PE bags
- 12 °C, packed in PE bags
- 5 °C, vacuum packed
- 5 °C, protective gas

# Jablonski-diagram

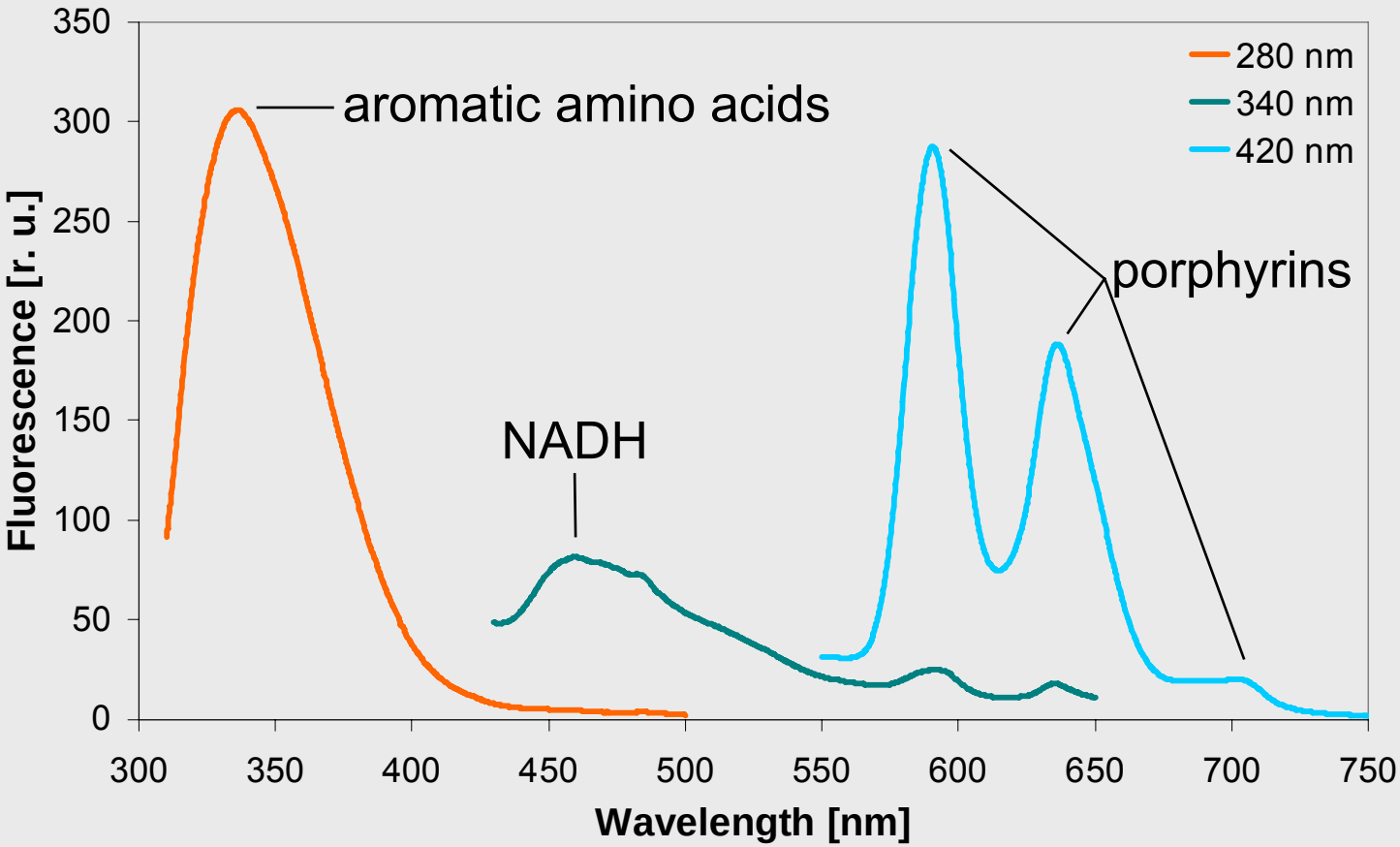





Stokes shift: $\lambda_{Absorption} < \lambda_{Emission}$

# Fluorescence spectra

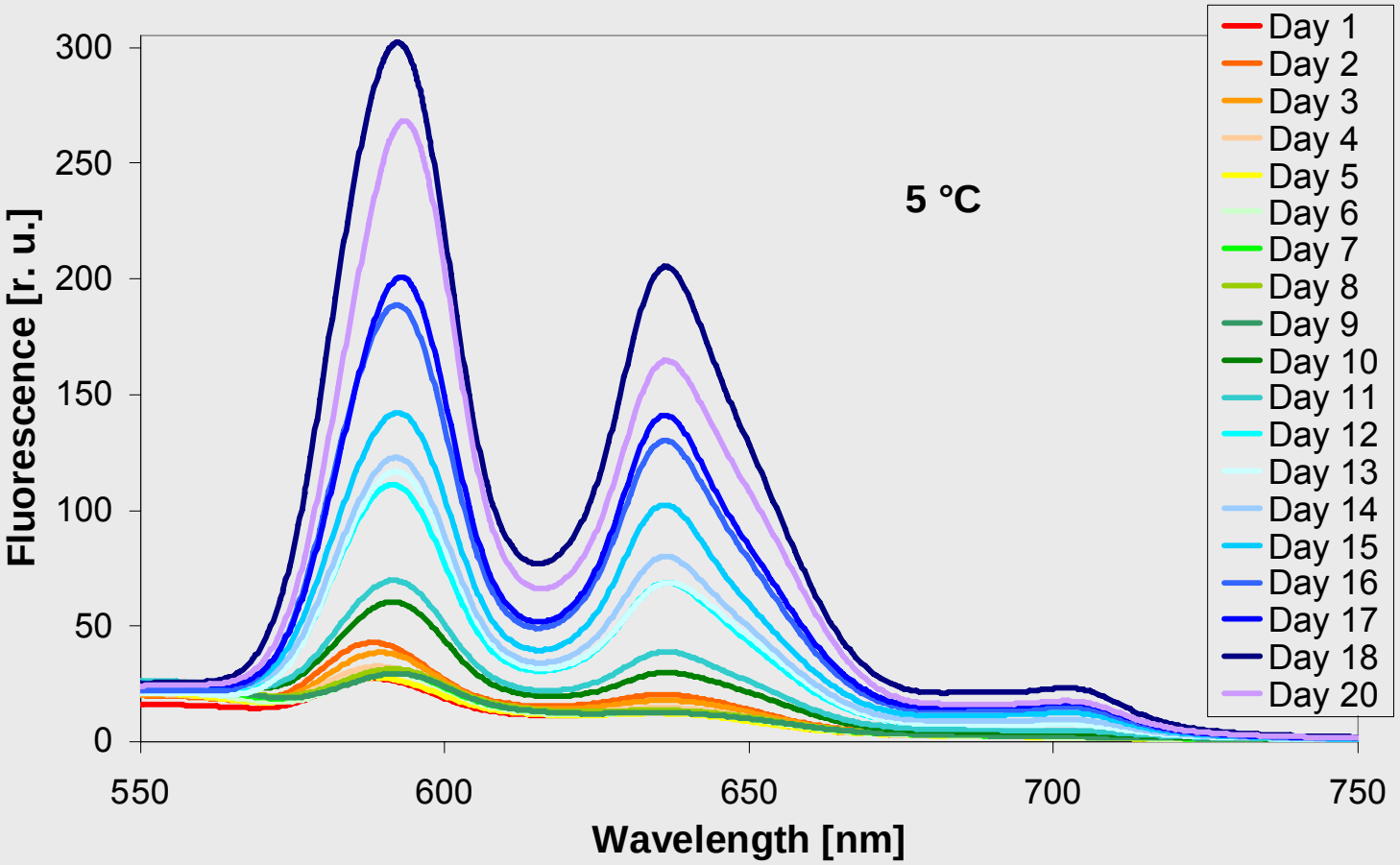





Fluorescence spectra at different excitation wavelength of porcine *musculus longissimus dorsi* at day 18 *p.m.* stored at 5 °C.

# Porphyrins (5 °C, PE-bags)

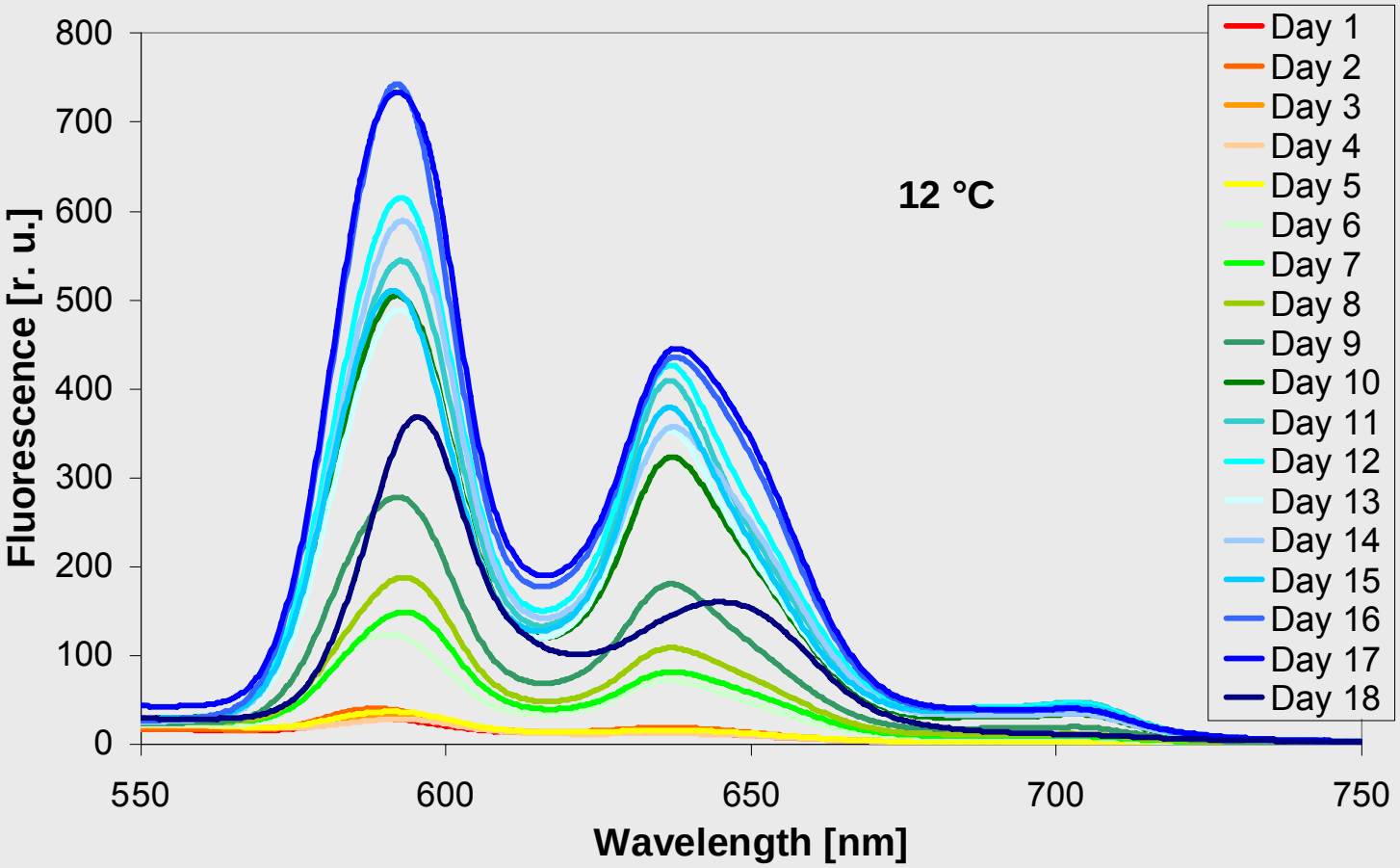





Fluorescence spectra ($\lambda_{ex}$ = 420 nm) of porcine *M. long. dorsi* stored at 5 °C over 20 days in PE bags.

# Porphyrins (12 °C, PE-bags)

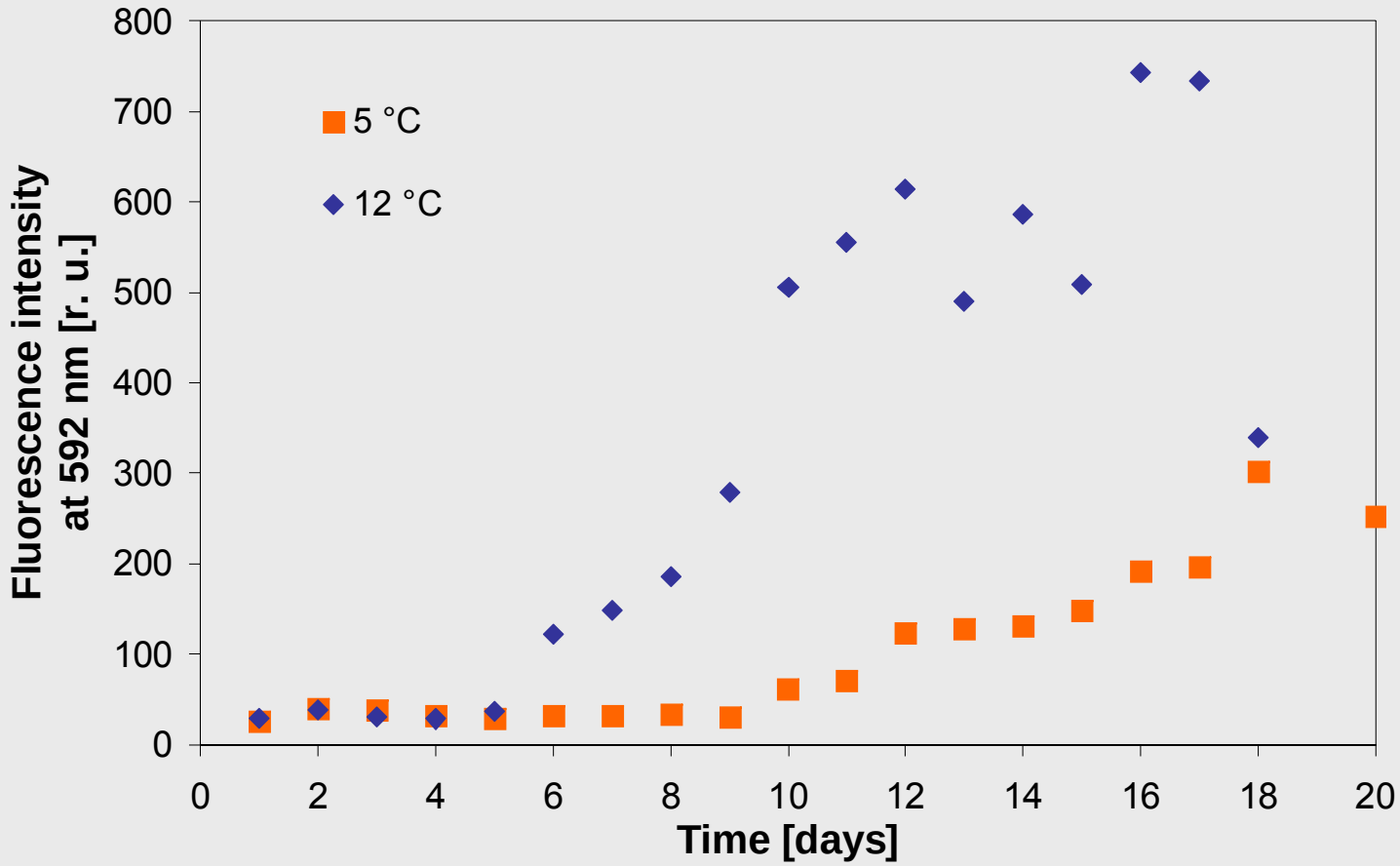





Fluorescence spectra ($\lambda_{ex}$ = 420 nm) of porcine *M. long. dorsi* stored at 12 °C over 18 days in PE bags.

# Porphyrins (Kinetics)

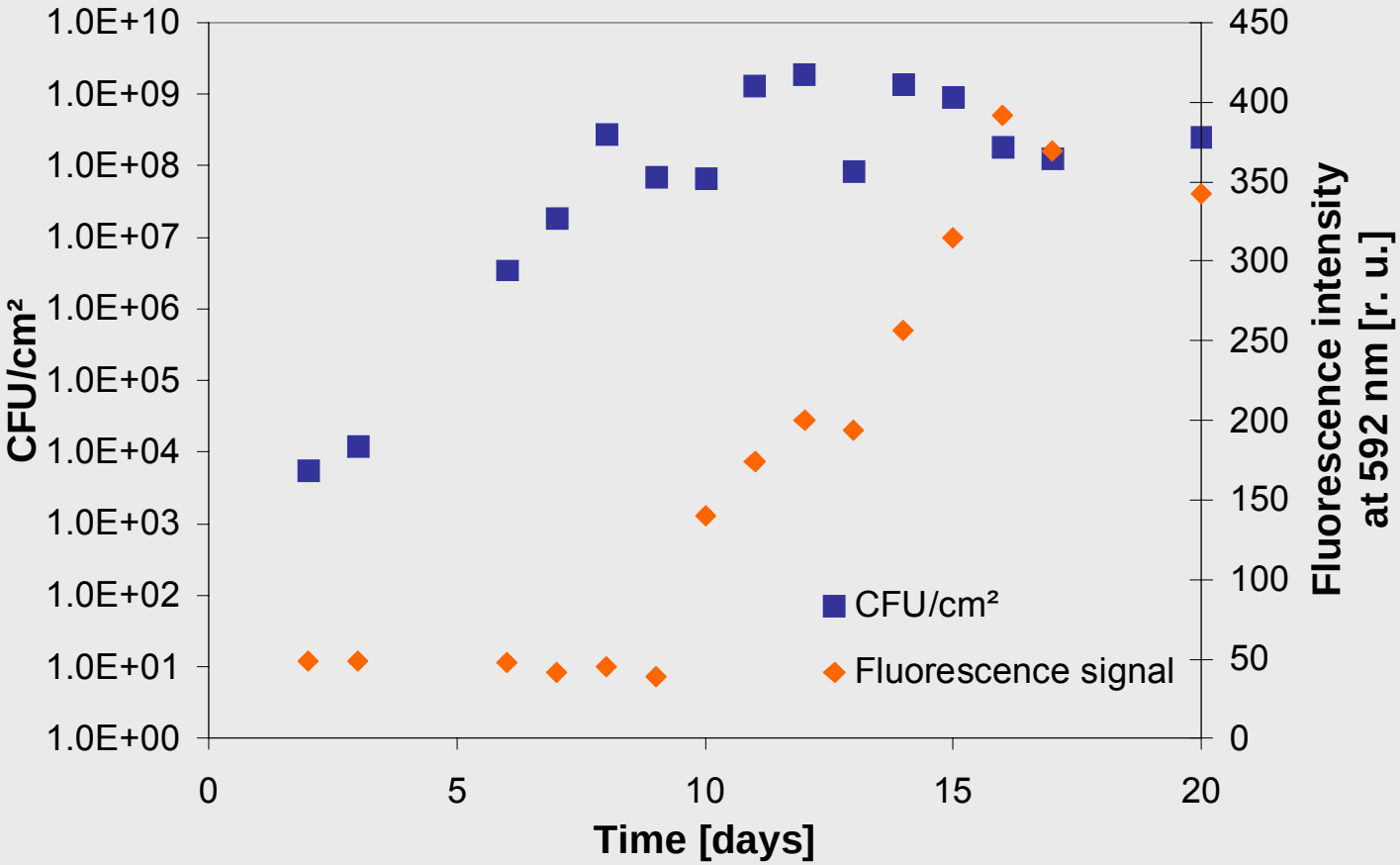





Kinetics of fluorescence intensity at 592 nm ($\lambda_{ex}$ = 420 nm) of porcine *M. long. dorsi* stored at 5 °C and 12 °C.

# Porphyrins (Kinetics/CFU)

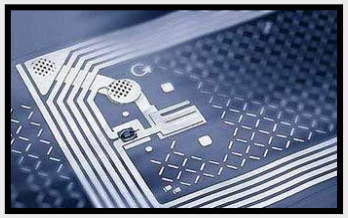





Comparison of fluorescence kinetics at 592 nm ($\lambda_{ex}$ = 420 nm) with microbial count [CFU/cm²] at the same slice.

# Technical concept





## Logistic-Logger

Recording of storage and transportation conditions

## Database

Consolidation of all information

**wireless, 13.56 MHz**
**ISO 14443**

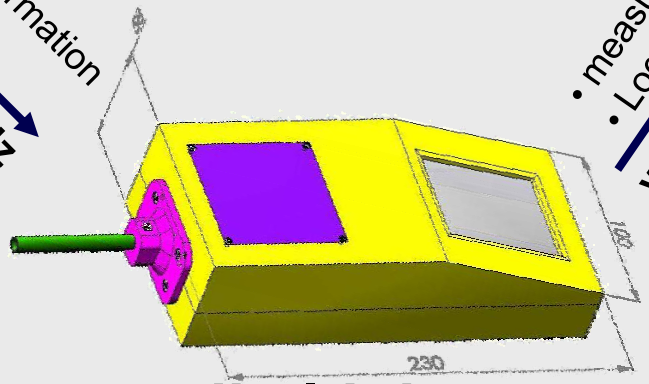
- protocols
- logistical information
- reference data

- food quality
- logistical information

**wireless, 2.4 GHz**
**Bluetooth**

- measured data
- Logger-data

- reference data
- additional information




## Handheld detector

Optical determination of food quality

# Summary



- Peaks of protoporphyrins ($\lambda_{ex}$ = 420 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