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Protein Thermal Denaturation of Beef Muscle: Neutron Imaging and Spectroscopies

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Paris - France

9 to 11 of July 2014

Paris - France

9 to 11 of July 2014

Context of Project

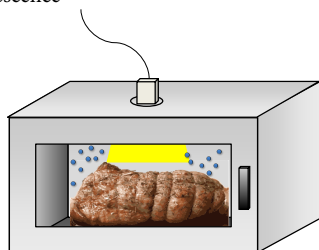
Open Food System is an academic and industrial project with the purpose to follow meat cooking without any intrusion.

It concerns two main parts

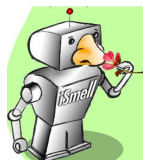
1) Sensor Development

a) Spectroscopic Sensor

- Visible / InfraRed
- Fluorescence



b) Olfactometer Sensor



2) Biochemistry of Muscle Cooking

Food Science Approach:

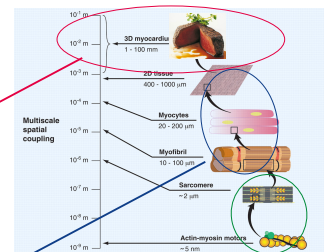
Macroscopic scale Sensory Analysis

- Colour
- Texture
- Flavour

Our Approach:

Microscopic scale (Neutron Imaging)

Molecular scale (Spectroscopies)



Neutron Imaging during Cooking

Neutron Imaging was used to follow muscle **morphology** changes (protein contraction) and **juice migration** inside the sample (through the evolution of Attenuation Coefficient)

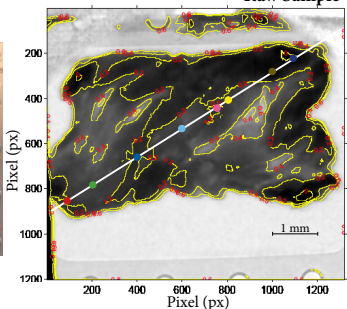
Optical Image of Muscle

Raw Sample
Thickness: 2 mm

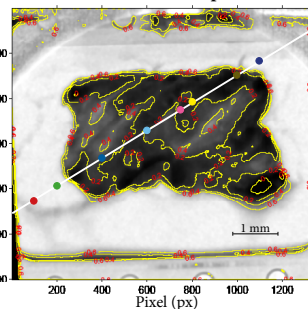


Superposition of Contour Plots on Neutron Images

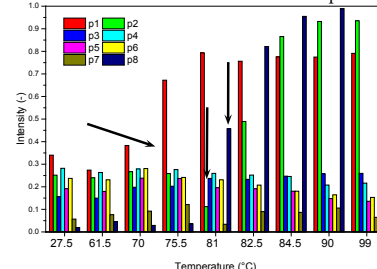
Raw Sample



Cooked Sample at 100 °C



Attenuation Coefficient vs Temperature



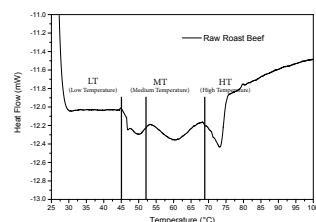
Main changes of attenuation coefficient take place at the **edge** of the sample

Spectroscopies: IR and Fluorescence

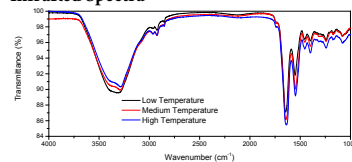
InfraRed and Fluorescence were carried out on muscle samples with the purpose to detect the spectroscopic signature of proteins at a particular cooking degree

Calorimetry

Used to determine the cooking temperature parameters for the samples



InfraRed Spectra

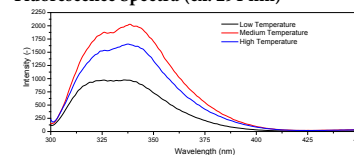


Principal Component Analysis - InfraRed

Separation on Cooking Degree:

- Beef: LT ≠ MT and HT

Fluorescence Spectra (ex. 291 nm)



Principal Component Analysis - Fluorescence

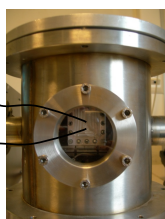
Separation on Cooking Degree:

- Beef: LT ≠ MT and HT

Future

Visible / InfraRed Detector

Fluorescence Detector

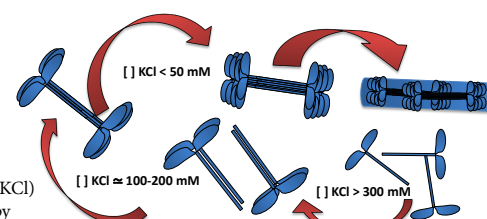


Microscopic Scale on Neutron Imaging:

- Coupling Neutron Imaging with Surface Spectroscopies (IR and Fluorescence) during heating Process

Molecular Scale:

- Myosin Thermal Denaturation depending on ionic strength (KCl)
- Structural Studies by IR, Fluorescence and SANS spectroscopy



Acknowledgement:

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www.openfoodsystem.fr

References:

Chien et al., 322 (5907), 1494-1497 (Science)