Protein Thermal Denaturation of Beef Muscle: Neutron Imaging and spectroscopies

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Context of Project

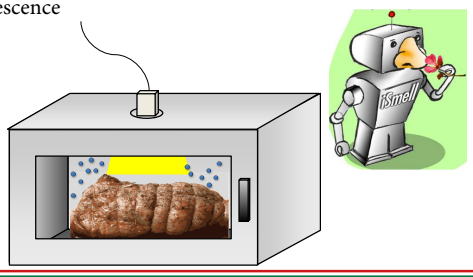
Open Food System is an academic and industrial projet with the purpose to follow meat cooking without any intrusion.

It concerns two main parts

1) Sensor Development

a) Spectroscopic Sensor
- Visible / InfraRed
- Fluorescence

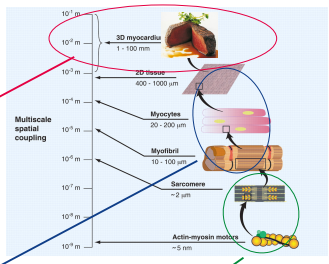
b) Olfactometer Sensor



2) Biochemistry of Muscle Cooking

Food Science Approach:

Macroscopic scale
Sensory Analysis
- Colour
- Texture
- Flavour



Our Approach:

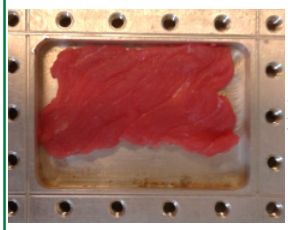
Microscopic scale (Neutron Imaging)

Molecular scale (Spectroscopies)

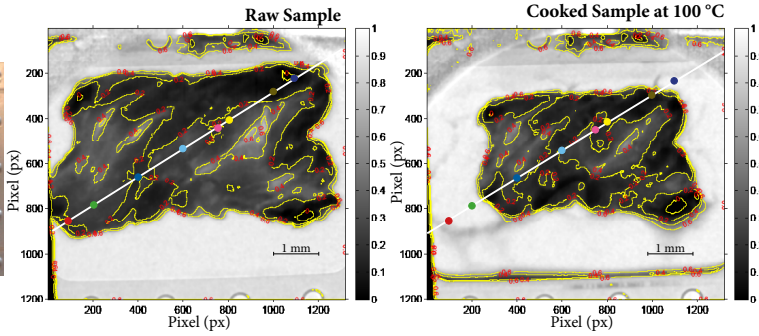
Neutron Imaging during Cooking

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

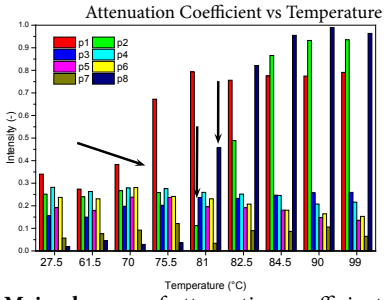
Optical Image of Muscle
Raw Sample
Thickness: 2 mm



Superposition of Contour Plots on Neutron Images



Attenuation Coefficient vs Temperature

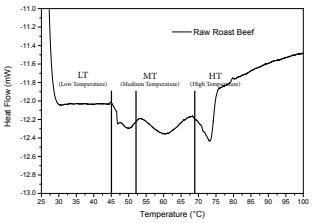


Main changes of attenuation coefficient take place at the **edge** of the sample

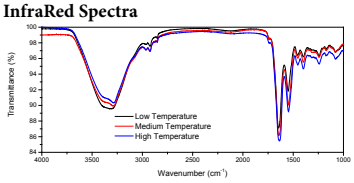
Spectroscopies: IR and Fluorescence

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

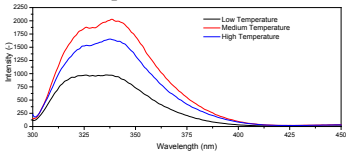


InfraRed Spectra



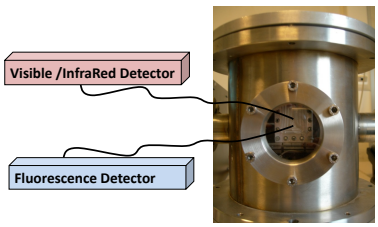
Principal Component Analysis - InfraRed
Separation on Cooking Degree:
- Beef: LT ≠ MT and HT

Fluorescence Spectra (ex. 291 nm)



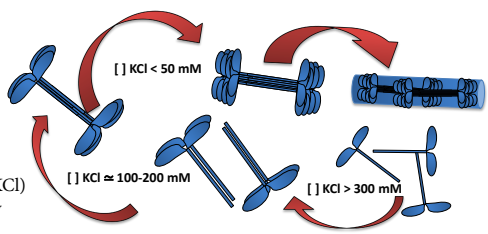
Principal Component Analysis - Fluorescence
Separation on Cooking Degree:
- Beef: LT ≠ MT and HT

Future



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



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www.openfoodsystem.fr

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