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# Protein Thermal Denaturation of Beef Muscle: Neutron Imaging and Spectroscopies

Paris - France  
9 to 11 of July 2014

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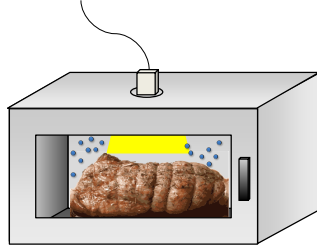
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## Context of Project

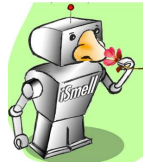
Open Food System is an academic and industrial project with the purpose to follow meat cooking without any intrusion. It concerns two main parts

### 1) Sensor Development

- a) Spectroscopic Sensor
- Visible / InfraRed
  - Fluorescence



### b) Olfactometer Sensor



### 2) Biochemistry of Muscle Cooking

#### Food Science Approach:

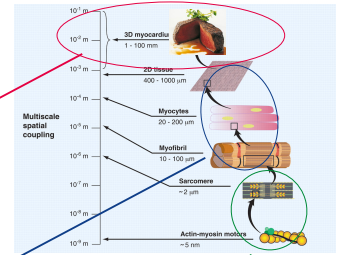
##### Macroscopic scale Sensory Analysis

- Colour
- Texture
- Flavour

#### Our Approach:

Microscopic scale (Neutron Imaging)

Molecular scale (Spectroscopies)



## Neutron Imaging during Cooking

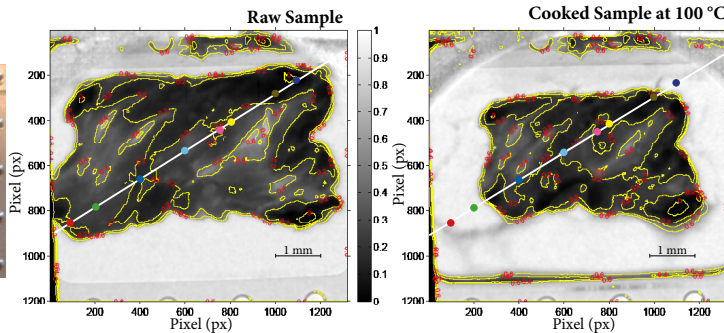
Neutron Imaging was used to follow muscle morphology changes (protein contraction) and juice migration inside the sample (through the evolution of Attenuation Coefficient)

### Optical Image of Muscle

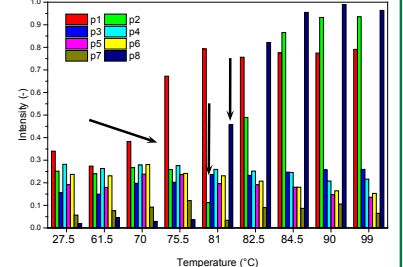
Raw Sample  
Thickness: 2 mm



### Superposition of Contour Plots on Neutron Images



### Attenuation Coefficient vs Temperature



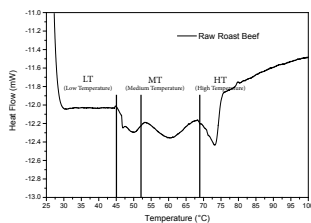
Main changes of attenuation coefficient take place at the edge of the sample

## Spectroscopies: IR and Fluorescence

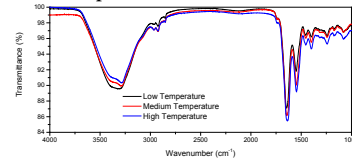
InfraRed and Fluorescence were carried out on muscle samples with the purpose to detect the spectroscopic signature of proteins at a particular cooking degree

### Calorimetry

Used to determine the cooking temperature parameters for the samples



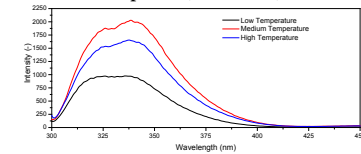
### InfraRed Spectra



Principal Component Analysis - InfraRed  
Separation on Cooking Degree:

- Beef: LT ≠ MT and HT

### Fluorescence Spectra (ex. 291 nm)



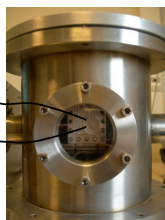
Principal Component Analysis - Fluorescence  
Separation on Cooking Degree:

- Beef: LT ≠ MT and HT

## Future

Visible / InfraRed Detector

Fluorescence Detector

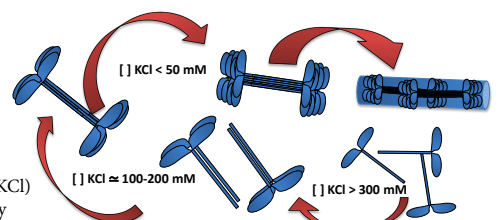


### Microscopic Scale on Neutron Imaging:

- 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)