



# Histochemical and biochemical characteristics of four major muscles of the ham

Carlier M.<sup>1</sup>, Martin J.L.<sup>1</sup>, Vautier A.<sup>2</sup>, Gault E.<sup>2</sup>, Bombrun L.<sup>1,3</sup>, Burton O.<sup>4</sup>, Loison O.<sup>3</sup>, Danon J.<sup>3</sup>, Santé-Lhoutellier V.<sup>3</sup> and Astruc T.<sup>3</sup>

IFIP, French institute for pig and pork industry: <sup>1</sup> F-94700 Maisons-Alfort, France; <sup>2</sup> F-35651 Le Rheu, France; [www.ifip.asso.fr](http://www.ifip.asso.fr)

<sup>3</sup>INRA, UR370 Qualité des Produits Animaux, F-63122 Saint Genès Champanelle, France, [www.inra.fr](http://www.inra.fr)

<sup>4</sup>ADIV, process engineering, technology and products quality department, F-63039 Clermont-Ferrand Cedex, [www.adiv.fr](http://www.adiv.fr)

## Objectives

The aim of this work was to characterise four muscles of the ham and imitate the manufacturing process at laboratory to investigate the relationship between structure, composition and evolution.

## Introduction

It was the first step of a large project, aiming to develop a mass transfer mathematical model in cooked ham with reduced sodium content.

## Materials and Methods

At 24h *post mortem*, muscles were removed from 8 pork gilt carcasses (post slaughter weight 95.0±3.5 kg; pHu 5.65±0.05; lean yield 60.9±0.8% lean meat) and technological measurements were done. Samples for biochemical and histological analysis were taken. Muscles were tumbled with brine and steam-cooked in oven until the core temperature reached 66°C.

Structure, connective tissue, fiber types and adipocytes distribution were assessed by image analysis histology. Cryofixed serial sections (10 µm thick). For each muscle category, about 4000 fibers were counted and analyzed.

## Results and discussion

Results by muscles	<i>Biceps femoris</i>	<i>Gluteus medius</i>	<i>Rectus femoris</i>	<i>Semimembranosus</i>	p-value
Weight (g)	1787	891	563	1204	
L*	44.1 bc	51.4 a	40.9 c	46.3 b	<0.001
a*	13.5 a	8.0 b	12.4 a	8.6 b	<0.001
b*	4.3 a	3.5 ab	3.0 b	3.4 ab	<0.01
pH	5.84 b	5.72 b	6.11 a	5.74 b	<0.001
Glycolytic potential (µmol lactate / g)	105 a	117 a	84 b	115 a	<0.001
Drip loss (%)	1.7 b	3.8 a	0.3 c	1.8 b	<0.001
Fiber type (ATPases) Black: type I Light grey: type IIA Dark grey: type IIX/IIB					
Percentage of the different fiber types					
Moisture (%)	74.1 b	74.8 ab	76.5 a	75.1 ab	<0.001
Free fat (%)	4.5 a	2.4 b	1.7 b	2.0 b	<0.001
Red oil coloration Fat in red Muscle fibers in light grey Extra cellular spaces in white					
Protein (%)	21.0 b	22.1 a	21.4 ab	22.3 a	<0.001
Collagen (%)	0.8 a	0.6 b	0.7 ab	0.7 ab	<0.05
Sirius red coloration Muscle fibers in yellow Connective tissue in red					
Phosphorus (% P <sub>2</sub> O <sub>5</sub> )	0.484 b	0.513 a	0.508 a	0.505 a	<0.01
Cooking yield					
brine B1 :18 g salt/kg	84.4 c	89.7 a	88.3 ab	89.3 ab	< 0.05
brine B2 :13 g salt/kg	81.2 d	87.0 bc	85.8 bc	86.8 bc	

*Rectus femoris* presented the highest pH and the lowest glycolytic potential, which affected positively its drip loss. It's also more oxidative than the three other muscles studied.

*Biceps femoris* had the higher level of intramuscular free fat. *Gluteus medius* and *Semimembranosus* had the highest level of protein content and *Biceps femoris* had the lowest one.

As expected, less salt reduced the cooking yield, differences were significant only for *Biceps femoris* and *Gluteus medius* muscles. Our results showed that a decrease of 5 g of salt / kg resulted in a 3% loss of cooking yield whatever the muscle considered. It therefore appears that in our conditions, the biochemical and structural characteristics of the muscles have little effect on the evolution of cooking yields after salting.

## Conclusion

- Biochemical and histochemical properties differed largely between the four studied muscles.
- Histochemistry results were in accordance with chemical data and gave information about repartition of intramuscular fat tissue, collagen and fiber typing.
- Cooking loss were dependent of muscle, but decreasing salt reduced the cooking yield of a similar value whatever the muscle considered.