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Session 02: Carcass and meat quality: from measurement to payment

VISUALIZATION OF MARBLING AND PREDICTION OF INTRAMUSCULAR FAT OF PORK LOINS WITH COMPUTED TOMOGRAPHY

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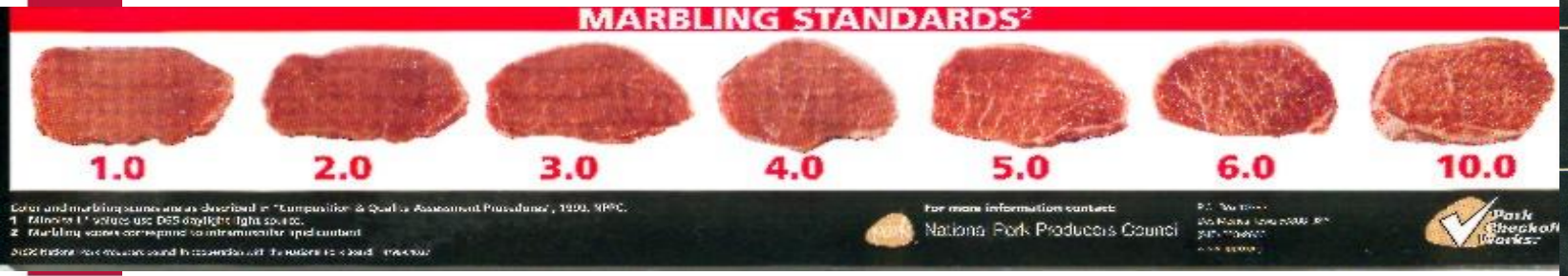
INTRAMUSCULAR FAT - MARBLING

Intramuscular fat content (IMF) and marbling varied across breed, sex, diet, muscle and slaughter weight.

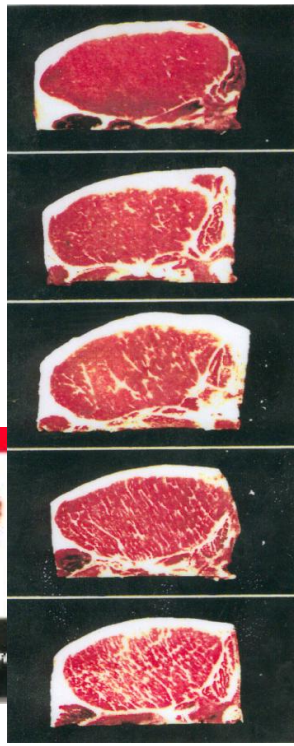
IMF and marbling are moderately related (Font-i-Furnols et al., 2012; Faucitano et al., 2004).

→ Not all the IMF can be seen visually

Marbling standards



NPPC



ITP

IMF – SENSORY TRAITS

IMF has been positively related with acceptability and tenderness (Bejerholm & Barton-Gade, 1986; Berge et al., 1993; Cannata et al., 2010; Font-i-Furnols et al., 2012; Fortin et al., 2005)

→ lubrication during chewing

However, in other works IMF had few (Johnson et al., 1988) **or even negative** (Andrieghetto et al., 1999) **effect on acceptability and tenderness**

The same discrepancy between studies has been found in preferences of marbled loins by consumers.

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Images
http://www.carniceriapedrorivas.com

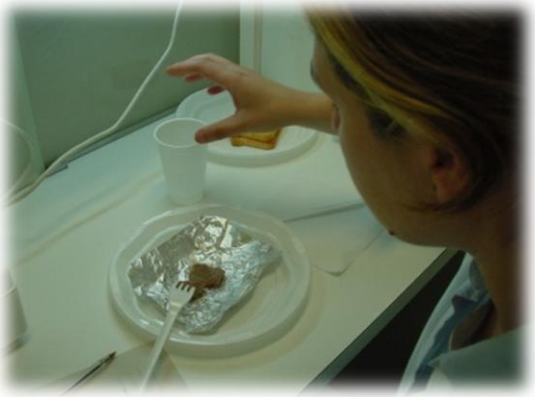
What do consumers like??

Images : IRTA

G4	G3	G2	G1	
5.78	3.72	2.11	0.96	IMF(%)
1	1-2	3	3-4	NPPC

55% “lean loin lovers” (preferred mainly loins from G1 and G2)

45% “marbling loin lovers” (preferred mainly loins from G3 and G4)



Both
“marbling loin lovers”
and
“lean loin lovers”
gave higher scores in
acceptability, tenderness and juiciness
of loins with higher marbling and IMF (G3 and G4).

IMF is a parameter that could produce an added value to the product

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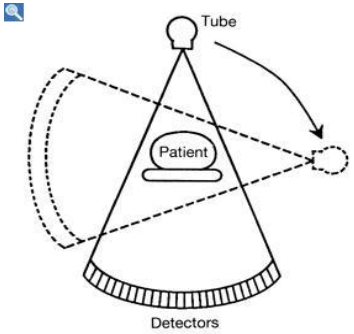
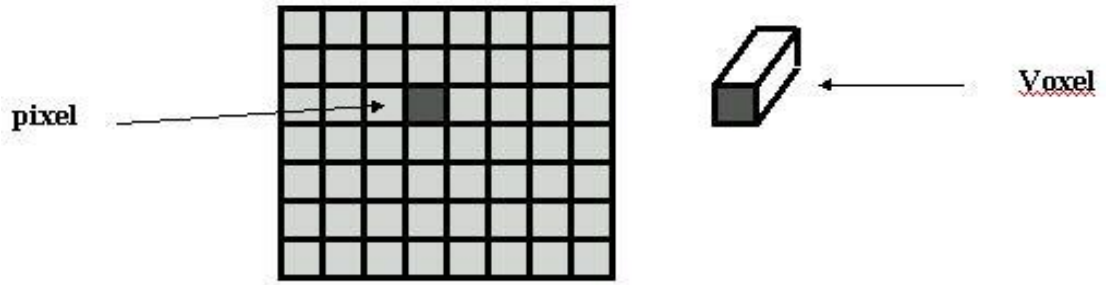
Font-i-Furnols et al. (2012) Meat Sci., 91, 448

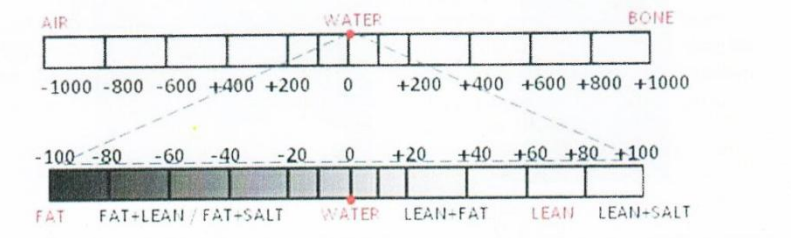
COMPUTED TOMOGRAPHY

- On their way through tissues, emitted X-ray are attenuated
- Attenuation mainly determined by the density of the tissues



- Axial/helical cuts obtained, with an specific thickness



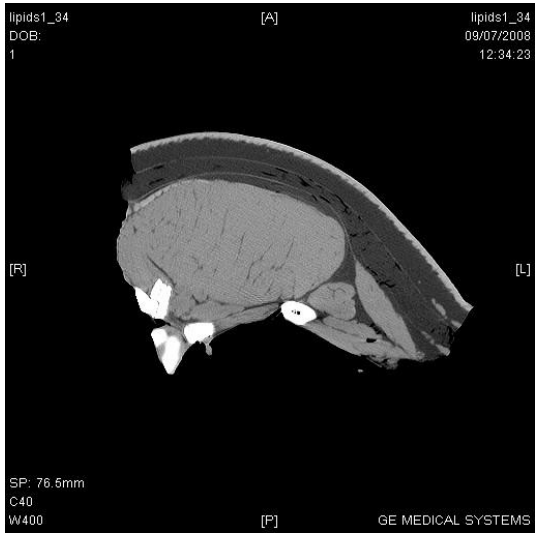


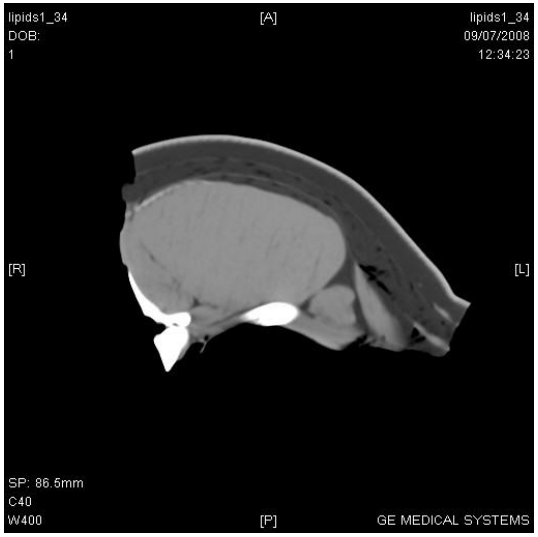
The aim of the present work was to use computed tomography (CT) to visualize marbling and quantify IMF in loin pork.

EXPERIMENTAL DESIGN

365 pork loins

CT scanned (3rd-4th last rib)
. Axial 120 (to visualize marbling)
. Axial 140 (to predict carcass composition)





Axial full 3s
1mm thick
120 kV
200 mA
EDGE

Axial full 1s
10mm thick
140 kV
145 mA
STND

GE HiSpeed Zx/I

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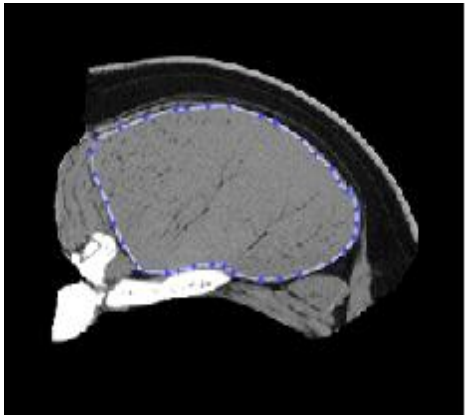
EXPERIMENTAL DESIGN

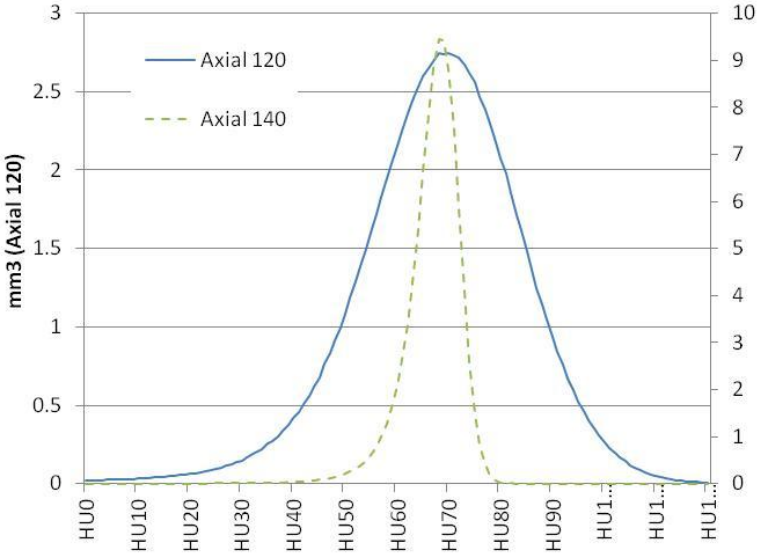
365 pork loins

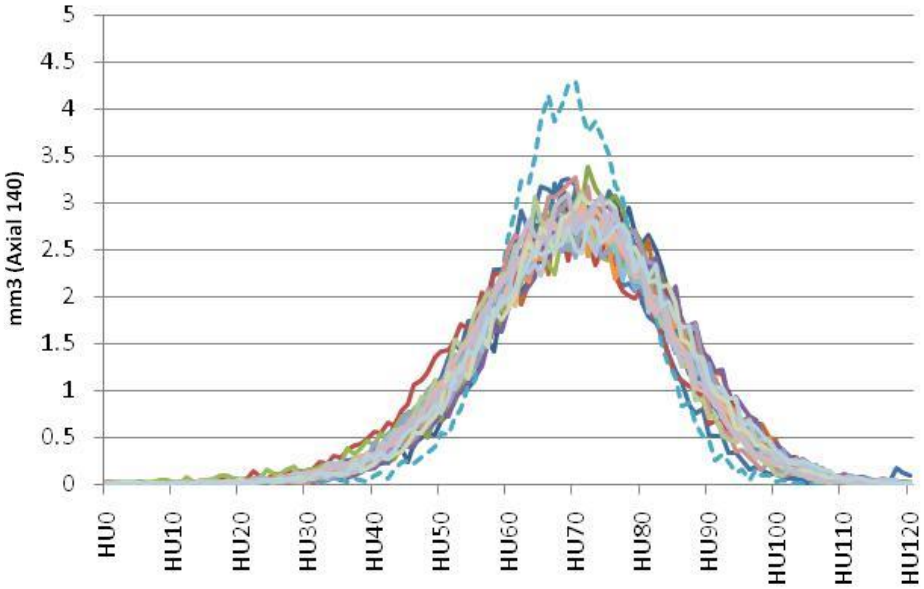
↓

CT scanned (3rd-4th last rib)
. Axial 120 (to visualize marbling)
. Axial 140 (to predict carcass composition)



Histograms generation and checking for data analysis





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EXPERIMENTAL DESIGN

365 pork loins

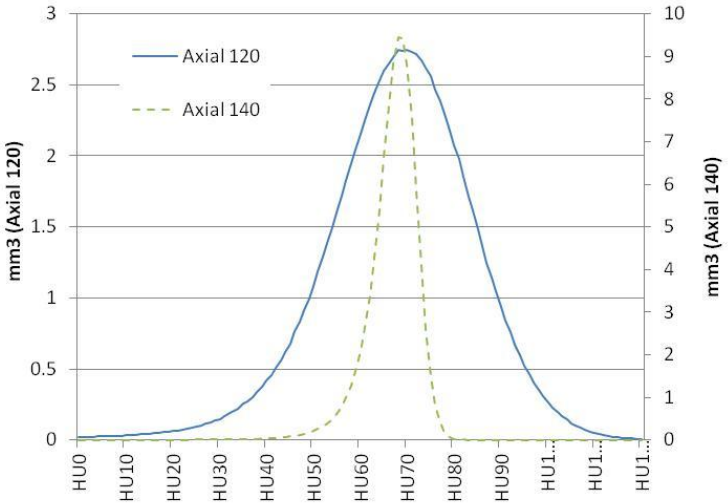
CT scanned (3rd-4th last rib)
. Axial 120 (to visualize marbling)
. Axial 140 (to predict carcass composition)

Histograms generation and checking for data analysis

Calibration data set (2/3)

Validation data set (1/3)

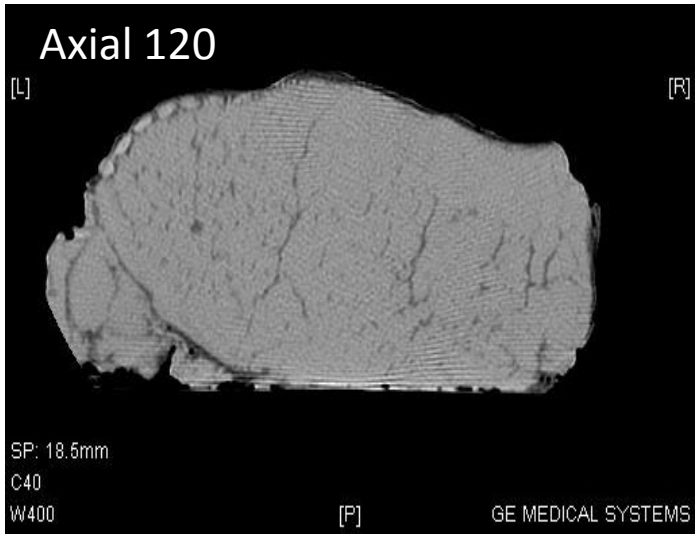
Ordinary Linear Regression
Independent variables:
partial relative volumes every 10 or 20 HU values
maximum value



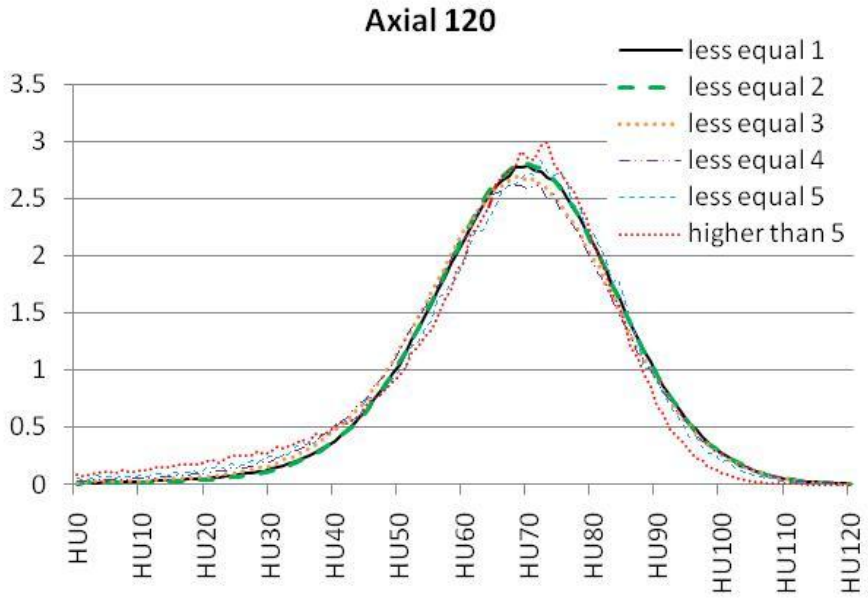
Axial 120: HU 0 to HU 120
Axial 140: HU 0 to HU 120
*: HU 40 to HU 80

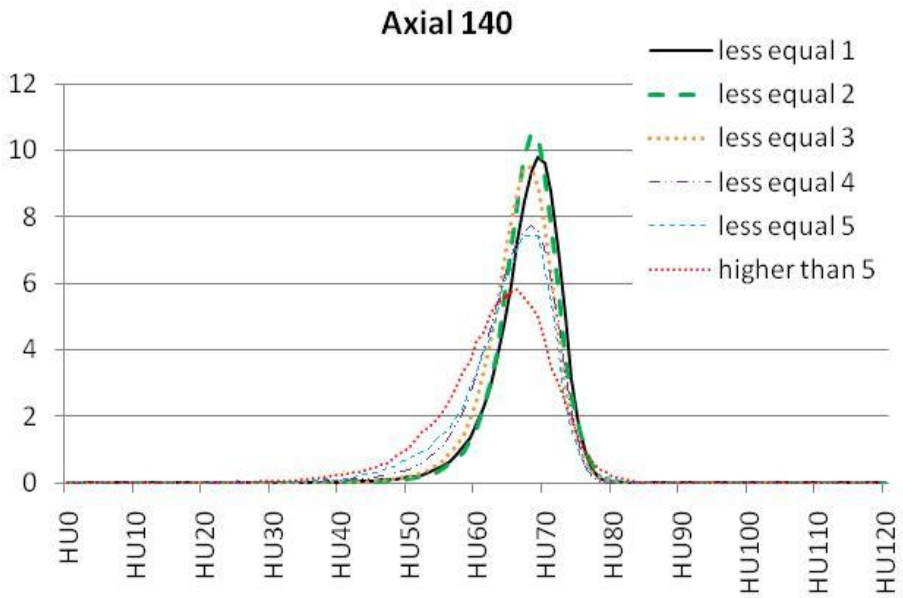
MARBLING


6


Axial 120
[L]
[R]
SP: 18.5mm
C40
W400
[P]
GE MEDICAL SYSTEMS


MARBLING STANDARDS
1.0
2.0
3.0
4.0
5.0
6.0
10.0
National Pork Producers Council





	Axial 140	Axial 140	Axial 140*
Max	-0.06	**-0.79**	**-0.79**
HU 0 to 20	**0.87**	**0.40**	
HU 21 to 40	**0.67**	**0.69**	**0.69**
HU 41 to 60	**0.18**	**0.77**	**0.77**
HU 61 to 80	**-0.20**	**-0.78**	**-0.78**
HU 81 to 100	**-0.31**	**0.28**	
HU 101 to 120	**-0.26**	0.00	
HU 40 to 50			**0.79**
HU 51 to 60			**0.75**
HU 61 to 70			0.04
HU 71 to 80			**-0.34**

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Linear regression

	Scanning protocol	Calibration		Validation		Variables included in the model
		R^2	RMSEPCV	R^2	RMSEP	
A	Axial 120	0.79	0.54	0.76	0.56	max, sum 0 to 20, 61 to 80
B	Axial 140	0.76	0.56	0.76	0.54	max, sum 0 to 20, 41 to 60, 61 to 80
C	Axial 140[1]	0.75	0.56	0.76	0.55	max, sum 40 to 50, 51 to 60

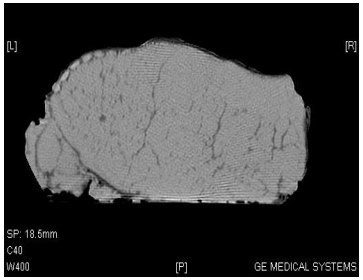
RMSEPCV: Root Mean Squared Error of Prediction obtained by cross-validation; RMSEP: Root Meat Square Error of Prediction; R^2: coefficient of determination; [1]: proportion from 40 to 80 Hounsfield values.

Linear regression

	Scanning protocol	Calibration R^2	Calibration RMSEPCV	Validation R^2	Validation RMSEP	Variables included in the model
A	Axial 120	0.79	0.54	0.76	0.56	max, sum 0 to 20, 61 to 80
B	Axial 140	0.76	0.56	0.76	0.54	max, sum 0 to 20, 41 to 60, 61 to 80
C	Axial 140[1]	0.75	0.56	0.76	0.55	max, sum 40 to 50, 51 to 60
	A and B[2]	0.83	0.46	0.84	0.45	A (max, sum 0 to 20, 81 to 100) B (max, sum 61 to 80, 71 to 80)

RMSEPCV: Root Mean Squared Error of Prediction obtained by cross-validation; RMSEP: Root Meat Square Error of Prediction; R^2: coefficient of determination; [1]: proportion from 40 to 80 Hounsfield values. [2]: n=222 for calibration and n=116 for validation

MARBLING



8%

	NPPC-CT				
NPPC	%	1	2	3	>3	TOTAL
	1	13	3	0	0	16
	2	35	19	4	0	58
	3	6	11	5	1	23
	>3	0	1	2	0	3
	TOTAL	54	34	11	1	100

55%

IMF IN LIVE ANIMALS

It would be of interest to determine IMF in live pigs. We have a national project (INIA-RTA2010-00014-00-00) in which we will try to estimate IMF in growing pigs from 30 to 120 kg.

By the moment:

-The determination of IMF in small pigs (70 kg) or less is difficult because of the lower amount of this tissue.

-It is possible to determine IMF in 100-120 kg pigs. Results are better if pigs have higher IMF content.

CONCLUSIONS

- Combination of data from images taken using two different adquisition conditions improves the estimation of intramuscular fat.

- Intramuscular fat can be predicted from loins using computed tomography images with a RMSEP of 0.45%.

- Evaluation of marbling from CT images using a scale for fresh meat produces an lower marbling scores.

- It is necessary to create a new marbling scale based on CT images for its evaluation.

- The determination of IMF in live pigs would produce an added value usefull for meat industry.

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Thank you for your attention

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