PORK CUTS COMPOSITION MEASURED BY SCANNER AS INLUENCED BY SEX AND HALOTHANE GENOTYPE

G. Daumas*, and M. Monziols

IFIP-Institut du Porc, BP 35104, 35601 Le Rheu Cedex, France.

*Corresponding author email: gerard.daumas@ifip.asso.fr

Abstract – The aim of this study was to quantify the main effects influencing the tissue composition measured by computed tomography (CT) of pork cuts. A representative sample of the French pig slaughtering was selected in three abattoirs and stratified according to sex (50% castrated males and 50% females). An ear sample was analysed for Halothane gene (Hal). The left sides were cut according to the EU procedure and the four main cuts were CT scanned. Images were thresholded in order to determine muscle, fat and bone weight. Sex and Hal effects on tissues proportions were analysed by variance analysis. Interaction between sex and Hal was never significant. Sex was significant on all the tissues proportions in the cuts, except the bone % in ham and loin. Hal was significant on all the tissues proportions in the cuts, except the fat % in shoulder and the bone % in belly. Sex had a major effect (1 standard deviation) on the muscle% in the loin and the fat % in the shoulder. The important effects of sex and Hal on pork cuts composition should be taken into account by pork industry for sorting cuts and carcasses and for selecting suppliers.

Key Words – Fat, muscle, X-Ray tomography.

I. INTRODUCTION

Pork industry is interested in sorting cuts. Knowledge of the main factors influencing the cuts composition can help sorting. Sex and halothane gene, well known for their effects on carcass composition, deserve to be studied on cuts. Carcass and cuts composition was traditionally studied by manual dissection, which was time consuming and suffered from a limited reproducibility. X-Ray tomography has been used successfully to measure body composition in farm animals [1] and has been recently intensively studied within a COST action [2, 3]. The aim of this work is to study the sex and halothane gene effects on the proportions of tissues into the four main pork cuts: ham, shoulder, loin and belly.

II. MATERIALS AND METHODS

A sample of 250 pigs was selected in 3 abattoirs and stratified according to sex (50% castrated males and 50% females). An ear sample was analysed for Halothane gene (Hal). The left sides were cut according to the EU procedure [4].The four main cuts – ham, shoulder, loin and belly – were CT scanned according to the acquisition procedure developed by Daumas *et al.* [5]. Tissues were separated by using the following fixed thresholds on the Hounsfield (HU) scale: [-500, -1] for fat, [0, 120] for muscle and >120 for bone. Choice of these thresholds was argued by Daumas *et al.* [6]. Muscle and fat volumes were converted into weights through a fixed density: 1.04 for muscle and 0.95 for fat. As bone density is highly variable, bone weight was calculated by difference between cut weight (from the scale) and the weight of muscle and fat. Tissues % were then deducted by dividing tissues weight by cut weight. Twelve dependent variables were studied: the Muscle % (M%), the Fat % (F%) and the Bone % (B%) in each of the four cuts. Analyses of variance were done with the main effects sex and Hal; interaction was tested. Least Square Means per subpopulation and t tests were calculated by the GLM procedure of SAS software [7].

III. RESULTS AND DISCUSSION

Because essentially of missing values for Hal tests the complete dataset comprised 209 observations. The proportions in the sample of Nn and NN genotypes, respectively 52% and 48%, were close to the proportions in the French population. The proportions of Hal genotypes intra-sex were well balanced too. Some descriptive statistics of tissue % in each cut are presented in Table 1. Cuts are sorted in the descending order of M% which corresponds to the ascending order of F%, i.e.: ham, shoulder, loin and belly. Coefficients of variation (CV) are the lowest for M%, in the range 4-8%, and the highest for F%, in the range 16-19%. They are in the range 7-10% for B%.

Table 1. Descriptive statistics of tissue % in each cut
(SD = standard deviation, CV = coefficient of variation)
(M% = Muscle %, F% = Fat %, B% = Bone %)

Tissue %	Mean	SD	CV	Range
n	209			
M% Ham	73.6	3.01	4.2	15.4
M% Shoulder	69.1	2.98	4.4	17.1
M% Loin	61.2	4.64	7.8	24.6
M% Belly	57.9	5.07	8.9	26.7
F% Ham	17.5	3.02	17.3	16.4
F% Shoulder	20.2	3.16	15.8	19.7
F% Loin	26.1	5.03	19.4	27.3
F% Belly	34.6	5.50	16.0	29.8
B% Ham	9.0	0.83	9.6	9.2
B% Shoulder	10.7	0.69	6.5	3.3
B% Loin	12.7	1.23	9.8	9.3
B% Belly	7.6	0.75	9.8	3.8

Table 2. Least Square Means of tissue % in each cut per sexual type and Hal genotype
(M% = Muscle %, F% = Fat %, B% = Bone %)

Tissue %	Females	Castrates	Hal Nn	Hal NN
n	106	103	108	101
M% Ham	74.5 a	72.2 b	74.1 A	72.7 B
M% Shoulder	70.4 a	67.6 b	69.5 A	68.4 B
M% Loin	63.2 a	58.7 b	62.0 A	59.9 B
M% Belly	59.9 a	55.3 b	58.8 A	56.5 B
F% Ham	16.6 a	18.8 b	17.1 A	18.2 B
F% Shoulder	18.8 a	21.8 b	20.0 A	20.6 A
F% Loin	24.0 a	28.8 b	25.5 A	27.2 B
F% Belly	32.3 a	37.4 b	33.8 A	35.9 B
B% Ham	8.9 a	9.0 a	8.9 A	9.1 B
B% Shoulder	10.9 a	10.6 b	10.5 A	10.9 B
B% Loin	12.9 a	12.6 a	12.5 A	12.9 B
B% Belly	7.8 a	7.3 b	7.5 A	7.6 A

a, b or A, B: within row and factor, values not followed by the same letter differ ($P<0.05$)

In the analyses of variance the interaction between sex and Hal was never significant. Least Square Means per subpopulation are gathered in Table 2 for the three tissue proportions in the four cuts. Sex was significant on all the tissues proportions in the cuts, except the B% in ham and loin. Hal was significant on all the tissues proportions in the cuts, except the F% in shoulder and the B% in belly. Sex had a major effect (1 standard deviation) on the M% in the loin and the F% in the shoulder. The highest Hal effect (0.6 standard deviation) was on the B% in the shoulder.

IV. CONCLUSION

There was no significant interaction between sex (females and castrates) and Hal genotype (Nn and NN) on the composition of pork cuts, meaning these factors can be studied independently. Sex effect was the most important and affected the muscle % and fat % of all the four main cuts (ham, shoulder, loin and belly). Hal effect was significant for all muscle % and most fat % of the four main cuts. Sex and Hal factors should thus be taken into account by the pork industry for sorting cuts and carcasses and for selecting suppliers. As carcass classification data are often used for sorting carcasses attention should be paid on sex and Hal effects on classification methods.

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REFERENCES

1. Scholz, A. M., Bünger, L., Kongsro, J., Baulain, U. and Mitchell, A. D. (2015). Non-invasive methods for the determination of body and carcass composition in livestock: dual-energy X-ray absorptiometry, computed tomography, magnetic resonance imaging and ultrasound: invited review. Animal: 1-15.
2. COST Association (2011). FA COST Action FA1102: Optimising and standardising non-destructive imaging and spectroscopic methods to improve the determination of body composition and meat quality in farm animals (FAIM). http://www.cost.eu/COST_Actions/fa/FA1102 (accessed on 7 April 2017).
3. Daumas, G., Donkó, T., Maltin, C. & Bünger, L. (2015). Imaging facilities (CT & MRI) in EU for measuring body composition. Edinburgh: SRUC.
4. Walstra, P. & Merkus, G.S.M. (1996). Procedure for assessment of the lean meat percentage as a consequence of the new EU reference dissection method in pig carcass classification. Report ID-DLO 96.014, March 1996.
5. Daumas, G. & Monziols, M. (2011). An accurate and simple computed tomography approach for measuring the lean meat percentage of pig cuts. In Proceedings 57th International Congress of Meat Science and Technology (paper 061), 7-12 August 2011, Ghent, Belgium.
6. Daumas, G. & Monziols, M. (2016). X-ray Computed Tomography: reference for pig classification. Cahiers IFIP 3(1): 59-71.
7. SAS Institute Inc. (2012). SAS /STAT Software Release 9.4, Cary, NC, USA.