VISION VERSUS REFLECTANCE TECHNOLOGY TO ESTIMATE PORK CUTS COMPOSITION

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Abstract – The objective of this article is to compare the precision of two carcass classification methods to assess the lean meat percentage (LM%) of the major pork cuts. One method is automatic by vision (CSB Image-Meater®, IM) and the other is semi-automatic by reflectance (CGM). A sample of 241 carcasses, comprising 50 % of females and 50 % of castrated males, was measured by both methods. The left sides were cut according to the EU procedure and the four main cuts were weighed and scanned by X-Ray tomography. Each LM% was regressed on the one hand on the two CGM thicknesses and, on the other hand, on the four IM thicknesses. The thickness M4 of IM was not significant. The hierarchy of the cuts has been preserved in terms of increasing residual standard deviation (RSD): ham, shoulder, loin and belly. The RSD rose about 15 % for the limbs and 30-35 % for the trunk. The help of carcass classification for directing cutting should turn out to be weakened.

Key Words – CGM, CSB Image-Meater®, X-Ray tomography.

I. INTRODUCTION

In a context of highly developed and highly competitive cuts trading, sorting cuts is an ongoing challenge. Many operators use weighing and carcass grading information for pre-sorting. Since 2013 about three quarters of pigs slaughtered in France have been classified with the "Image-Meater®" automatic machine (IM) of the German company CSB-System, which now equips most of the large French slaughterhouses. The remaining quarter is classified with the Fat / Lean Sensor (CGM), introduced in 1993. Automation of pig classification was accompanied by a change both in the measurement principle and in the location of the measured variables. The objective of this article is to compare the precision of the two methods IM and CGM to predict the composition of the major cuts, expressed by the proportion of muscle in the cut.

II. MATERIALS AND METHODS

A sample of 250 carcasses, stratified by sex, 50% female and 50% castrated male, was selected from three slaughterhouses. All selected carcasses were measured on the slaughter line by the IM and then on a side rail by the CGM manipulated by a skilled operator. The variables are those of the methods authorized for carcass classification [1, 2], namely:

- IM: two thicknesses of fat (G3 and G4) and two thicknesses of muscle (M3 and M4) on the splitline, at the junction between loin and ham;
- CGM: thicknesses of fat (G2) and muscle (M2) between the third and fourth last ribs, 6 cm from the dorsal midline and parallel to it.

After cooling the left half carcasses were transported daily from each slaughterhouse to the IFIP facilities in Romillé. The day after the killing, these half carcasses were prepared and cut according to the European procedure [3]. The four main cuts (ham, shoulder, loin and belly) were then weighed and scanned. Acquisition and image analysis were made according to the procedure developed by Daumas *et al.* [4] and reminded by Daumas *et al.* [5], allowing to calculate the LM%. The LM% was regressed by ordinary least squares on the one hand on CGM thicknesses and on the other hand on IM thicknesses. All calculations were performed with SAS software version 9.4 [6].

III. RESULTS AND DISCUSSION

Nine carcasses were discarded due to an incorrect identification by the IM apparatus. Table 1 presents some descriptive statistics about the LM% in each cut. Cuts are sorted in the descending order of mean which corresponds to the ascending order of standard deviation (SD).

Table 1. Descriptive statistics of the observed LM% in each cut (SD = standard deviation)

Cut	Mean	SD	Mini -mum	Maxi -mum
Ham	73.5	3.04	65.0	81.2
Shoulder	69.1	3.04	59.3	76.4
Loin	61.1	4.66	48.5	73.0
Belly	57.8	5.09	45.0	71.7

Table 2. Determination coefficients (R^2) and residual standard deviation (RSD) of estimation of LM% in each cut by method

Cut	R^2 CGM	R^2 IM	RSD CGM	RSD IM
Ham	0.64	0.52	1.82	2.10
Shoulder	0.55	0.43	2.00	2.27
Loin	0.73	0.51	2.40	3.25
Belly	0.65	0.41	3.02	3.91

As the average muscle thickness (M4) was not significant for IM, parameters were estimated from the three variables model: G3, G4 and M3. Table 2 gives the CGM and IM accuracy. In terms of R^2, the descending order was for CGM: loin, belly-ham, shoulder. For IM the descending order was: ham-loin, shoulder-belly. Nevertheless, the quality of fit was better for CGM than for IM and the hierarchy of cuts was different. The decrease in R^2 was about 0.12 for limbs and 0.23 for trunk. In terms of residual standard deviation (RSD), the hierarchy of cuts was identical for the two methods: ham, shoulder, loin, belly, in ascending order. This hierarchy is in accordance with Hulsegge *et al.* [7] results. The RSD rose about 15% between CGM and IM for limbs, from 1.8 to 2.1 for ham and 2.0 to 2.3 for shoulder. On the other hand, it increased from 30 to 35% for trunk, from 2.4 to 3.3 for loin and from 3.0 to 3.9 for belly.

IV. CONCLUSION

The 20% increase in the prediction error of LM% for IM with respect to CGM is not homogeneous between cuts. The error increased much more strongly in trunk (loin and belly, 30 to 35%) than in limbs (ham and shoulder, about 15%). On the other hand, the hierarchy of cuts has been preserved: ham, shoulder, loin, belly, according to a growing error. For IM the error (RSD) in estimating the LM% in belly (3.9) is almost double than in ham (2.1). Assuming that the results can be extrapolated to industrial cutting, the help of carcass classification for directing cutting in large meat plants equipped with IM should turn out to be weakened. Improvements are needed in terms of modelling, extracting extra variables from image, or even acquiring additional off-field information from the current image.

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REFERENCES

1. Blum, Y., Monziols, M., Causeur, D. & Daumas, G. (2014). Recalibrage de la principale méthode de classement des carcasses de porcs en France (New calibration of the main method for classifying pig carcasses in France). In Proceedings 46th Pig Research Days, 39-43, 4-5 February 2014, Paris, France.
2. Daumas, G., Causeur, D. & Prédin, J. (2010). Validity of the French equation of prediction of the lean meat percentage (LMP) of pig carcasses by the CGM method. In Proceedings 42nd Pig Research Days, 229-230, 2-3 February 2010, Paris, France.
3. 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.
4. 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.
5. Daumas, G. & Monziols, M. (2016). X-ray Computed Tomography: reference for pig classification. Cahiers IFIP 3(1): 59-71.
6. SAS Institute Inc. (2012). SAS /STAT Software Release 9.4, Cary, NC, USA.
7. Hulsegge, B., Sterrenburg, P. and Merkus, G.S.M. (1994). Prediction of lean meat proportion in pig carcasses and in the major cuts from multiple measurements made with the Hennessy Grading Probe. Animal Production 59: 119-123.