NEW RATING METHOD TO SCORE THE FATNESS OF BEEF CATTLE CARCASSES IN FRENCH SLAUGHTERHOUSES

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Abstract – French beef operators sort carcasses towards commercial circuits according to home-made fatness rate, mainly based on 5th rib and caparison fat, because the European fatness rating table is not adequate to do it. In 2010, the Institut de l'Elevage carried out a study for the French beef industry, to develop a new reference system to rate fatness of beef cattle carcasses based on internal fat. This new method combines 3 components: condition of use of this method, "ART8/AVT5" cut localization - to estimate quality of the cut - and 5th rib and caparison fat ratings. Fat scores are obtained from hand drawings of the 5th rib and caparison which are then scanned and analyzed using an image analysis software: fat surfaces are estimated and compared to the total surface to calculate the fat percentage. First tests on 203 half-carcasses indicate that this new scoring method can efficiently discriminate carcasses according to fat levels: an important variability on 5th rib and caparison fats was showed. However, this protocol failed to confirm the relationship between measures of fat and commercial orientations because the method used was not appropriate: a new test is needed to verify the reliability between fat measures and carcasses orientation.

Key Words – Fat, Beef cattle carcasses, Marbling, Intermuscular fat, Caparison fat

I.   INTRODUCTION

In France, beef carcasses are rated according to the European rating table: fatness is rated in 5 classes (1, 2, 3, 4, 5). According to French operators, this classification system does not allow to select and to orientate carcasses into the adequate commercial circuit. Usually, carcasses rated "3" immediately after slaughter are actually scored "4" after being cut into quarters ("ART8/AVT5" cut). This is why French operators sort carcasses to commercial circuits according to a home-made fatness rate, mainly based on internal fat, which is not the same between slaughterhouses and is never written.

In 2010, the French beef industry asked the Institut de l'Elevage to develop a new reference system to rate fatness of beef cattle carcasses based on internal fat: initially, it does not aim to be used in routine in slaughterhouses but it must predict accurately the value and the commercial orientation of beef carcasses. Then, if this new scoring method can efficiently discriminate carcasses according to fat levels, it will be necessary to develop and to calibrate a tool more easy to use to help slaughterhouses to orientate carcasses into the adequate commercial circuit.

II.   MATERIALS AND METHODS

After surveys at slaughterhouses and supermarkets (6 carcasses dispatchers and 6 sales representatives), only two kinds of fat were used in the new reference system based on their use by operators to determinate the orientation and the valuation of beef carcasses (table 1): caparison fat and internal fat (marbling and intermuscular fat).

Table 1 Impact of fat on orientation and value of beef carcasses

Internal fat	Caparison fat	Orientation	Valuation
=	=	Whole/compensated carcass	100%
=	+	- Hindquarter: compensated - Forequarter: categorical/minced	90%
+	+	Categorical/minced	75-80%
++	+	Promotion/OOH[*]	Less than 75%

= normal, + fat, ++ very fat
[*]Out of Home

According to survey results, it was also decided that the new reference should only be used in meat and mixed breeds. Indeed, dairy breeds which are

mainly valuated in minced meat and only meat yield is relevant for these breeds.

The construction of the new reference system was carried out in several steps. First, all possible measures for both kinds of fat were described with accurate anatomical localization and the type of measures (thickness, surface, ratio ...). Fat deposition was inspected in several carcasses to identify feasible measures and to estimate the variability of these measures. Moreover, an inventory of measurements made in other countries was searched whereas, in parallel, new accurate and reliable tools were looking for. Thereafter, the new tools have been tested on few carcasses to determine how they can be used. Finally, these data were combined to develop and to validate the new reference system.

In a second step, other fats, more easily measurable, were compared to the 5th rib fat or caparison fat to develop a future tool used routinely by slaughterhouses.

In the final step, the new reference system has been tested in three slaughterhouses with a diversity of animals and commercial circuits. A total of 203 half-carcasses were rated, representing 142 animals: both half-carcasses of 61 animals were scored. Each half-carcass was photographed.

The correlation of both kinds of fat with commercial orientation of carcasses, animal characteristics and other measures of fat was tested. A descriptive data analysis was performed to describe the variability of the fat level in the population we studied. Observed frequencies, means, standard deviations, minima and maxima were estimated. Then, the correlation between the different kinds of fat was calculated to assess the feasibility to predict 5th rib and caparison fat from easiest measurable fats.

A logistic regression (SAS®) was used to test internal and caparison fat levels which could predict the different commercial orientations of carcasses. Then, a segmentation (SAS®) was processed to predict the commercial destination from all data combined.

III.   RESULTS AND DISCUSSION

The new rating method we elaborated is divided into three parts. First, the scope of use is defined as an indispensable prerequisite. Indeed, all carcasses are not measurable: only carcasses with an "ART8/AVT5" cut (between 5th and 6th rib) can be scored by this method. Indeed, 5th rib and caparison fats levels vary according to the rib which is considered. It must also ensure caparison ribs are uncut, which will tend to pull on the caparison and distorting measures.

In a second step, this new reference system requires the accurate positioning of "ART8/AVT5" cut to avoid measures bias according to the quality of the cut. During data analysis, if it appears that the position of cut does not affect fat levels, this step would be removed. Three elements are used to estimate the quality of cut: depth of caparison cut (Figure 1, [1]), cut height between the 5th and 6th rib (Figure 1, [2]) and cut inclination (Figure 1, [3]).
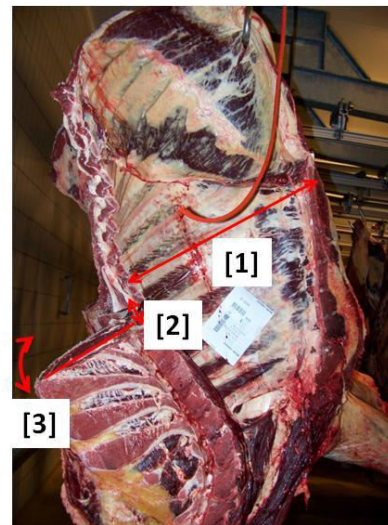

Figure 1 The different measures to estimate quality of the "ART8/AVT5" cut

Finally, each kind of fat is independently measured with a protocol of its own. Intermuscular fat rating aims to accurately calculate the percentage of fat in the 5th rib compared to the total surface of this rib. To rate it, the rib is hand drawn on a transparent sheet with contours of bones, fats, and rib eye (Figure 2).

Figure 2 Drawing of the 5th rib on transparent sheet

Then, drawings are scanned and various areas are calculated using an image analysis software, Geotool®, (Figure 3). Fat areas are added and compared to the total surface of the rib to provide the fat percentage of the rib.
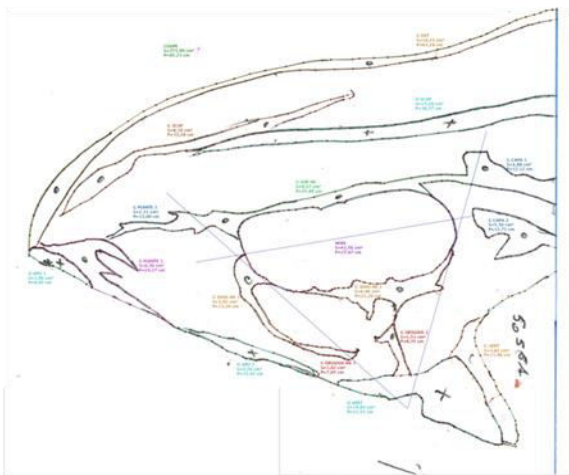

Figure 3 Scan of the 5th rib

The same method is used for caparison fat rating. However, caparison is too large to be fully drawn: ribs number 6, 8 and 10 are drawn, together and processed with areas between the 7th and the 8th ribs in one hand and between the 9th and the 10th ribs in the other hand. All measurements of caparison (height, width and distances between ribs) are recorded in order to calculate the total area. The percentage of fat in the caparison between the 6th rib and the 11th rib is them processed.

Definition of the scope of use, "ART8/AVT5" cut localization and 5th rib and caparison fat ratings compose the new reference system: it allows to evaluate carcasses fatness much more accurately than European rating table. The characterization of the new reference system has indicated the necessary measures to be scored in order to discriminate carcasses according to 5th rib and caparison fats. It has also helped in standardizing where these measures should be taken and methods to score them. Finally, it appears this new reference system can be applied to any kind of carcasses with an "ART8/AVT5" cut and not only meat and mixed breeds as originally planned: good dairy animals which are not used to make minced meat could also be scored with this new method.

Tests of the reference system, based on 203 half-carcasses, were mainly realized on carcasses of cows (80%) and heifers (15%). Meat breeds (mainly Charolaise) represent 57% of the sample whereas mixed breeds (mainly Normande) 38%. According to the European external fatness rating table, 174 half-carcasses were rated "3", 12 rated "2" and the 8 others "4", this rating method failing to discriminate carcasses. Those carcasses were directed to 11 commercial circuits.

Table 2 5th rib and caparison fats results

	Mean	Min	Max
Fat % in the 5th rib	15.0% ± 5.6%	3.7%	35.6%
Fat % in the caparison	26.0% ± 8,7%	0.0%	48.5%

First results of the test show that mean fat values (table 2), 15.0% in the 5th rib and 26.0% in the caparison, are highly variable between carcasses: fat in the 5th rib ranges from 3.7 to 35.6% while caparison fat from 0.0 to 48.5%. Therefore, the new reference system is promising to discriminate carcasses according to their 5th rib and caparison fats levels.

The "ART8/AVT5" cut localization (step 2 of the reference system) showed small impacts, especially with the depth of caparison, on fat quantities (r<0.20). This step in the new rating method is therefore essential in order to correct these effects.

Finally, the relationship between measures of fat and commercial orientations has been modelized. Although significant, commercial orientation is only slightly affected by 5th rib and caparison fat levels (table 3).

Table 3 Relationship between measures of fat and commercial orientations

	Probability	R²
Fat % in the 5th rib	<0.0001	0.28
Fat % in the caparison	<0.0001	0.17

These weak correlations can be explained: orientations given in this study reflect the needs of customers and other criteria such as race, weight, conformation, age. They are not only based on fat. The segmentation fitted to the collected data does not predict the commercial destination.

IV.   CONCLUSION

This study has contributed to elaborate a new method to score carcasses fatness at slaughterhouse. This method is composed of three parts: the definition of the scope of use, the "ART8/AVT5" cut localization and the 5th rib and caparison fat ratings. The new rating method allows an accurate measurement of fats which have the greatest impact on carcasses orientation and value. It is applicable to any kind of carcasses with an "ART8/AVT5" cut.

First results of the test show an high variability on 5th rib and caparison fats and the new reference system can then correctly discriminate carcasses according to their fat levels. The "ART8/AVT5" cut localization has a moderate impact which should be taken into account to be corrected. However, our reference system failed to predict the commercial orientations of carcasses: actual orientations were affected by market conditions and by other criteria than fat. Therefore, a new test is necessary to check the ability of the new reference system to commercially orient carcasses. This test should only be based on fat criteria and should not take into account current market needs. Pictures of carcasses, those taken during the test, will be presented to operators which orientate carcasses in slaughterhouses: they

will rate them based only on fat. It should confirm or not the reliability between the measures and carcasses orientation and value and validate the new reference system to rate fatness of beef cattle carcasses.