NEW INDUSTRIAL METHOD OF MARBLING EVALUATION OF PORK MUSCLES

D. Lisiak*, A. Borys, K. Borzuta, E. Grześkowiak, and J. Strzelecki

Meat and Fat Research Institute in Warsaw, 04-190 Warszawa, ul. Jubilerska 4, Poland
Email:dsi.poznan@ipmt.waw.pl

Keywords: marbling, pork meat, model

Introduction

The content of intramuscular fat in muscles is considered as one of the most important factors influencing pork meat sensory quality (Egert *et al.*, 2002). Together with the increase in meatiness, deterioration of meat taste values can be observed. In addition, investigations revealed that the content of intramuscular fat correlates only slightly with the thickness of subcutaneous backfat (Blicharski and Pierzchała, 2005). Because of the considerable importance of marbling as an essential meat quality trait, attempts are made to find new methods of its assessment (Fernandez *et al.*, 1999). The most common methods include the analysis the ultrasound echo, computer image analysis and the application of the spectroscope (Altmann and Pliquunett, 2006). However, the above-mentioned methods have some defects. The ultrasound probe is very expensive and image analysis can only by carried out on cut muscles. On the other hand, endoscopy employing a special probe is an invasive method and, additionally, very slow. It can, therefore, be said that so far no simple and cheap method of marbling assessment in muscles has been proposed which could be commonly employed on an industrial scale in meat processing plants. Hence, the aim of the performed investigations was to develop a method which would be suitable for the application in industrial conditions.

Materials and Methods

The experimental material comprised 126 pig carcasses selected on slaughter lines of three meat processing plants. Using a 5-point scale, the degree of intramuscular fattening in the *m. gluteus medius* was evaluated on chilled half carcasses, where 1 point denotes the absence of fat traces and 5 points – very strong fattening. In order to determine the meat content in the carcass, carcasses were dissected according to the method of Walstra and Merkus (Walstra and Merkus 1996). Next, the following three muscles were prepared: *longissimus dorsi*, *semimembranosus* and *biceps femoris*. Using the same above-mentioned 5-point scale, the degree of intramuscular fattening was estimated. All the assessed muscles were photographed with the aim of elaborating fattening patterns of the *gluteus medius* muscle. The authors calculated correlation coefficients between the results of the marbling assessment of this muscle and the evaluation of the cross section of the other examined muscles.

Results and Discussion

Table 1 presents mean results from the dissection and marbling assessment of individual muscles.

Table 1: Mean results from the dissection and marbling assessment of individual muscles.

Trait	Mean	Minimum	Maximum	Standard deviation
Meatiness, %	51.01	35.72	68.40	6.85
LD, points	2.34	1.00	4.50	0.96
BF, points	2.76	1.50	4.50	0.74
SEM, points	2.42	1.00	4.50	0.75

It is evident from the performed investigations that the *longissimus dorsi* and *semimembranous* muscles were characterised by similar degrees of fattening, whereas the *biceps femoris* muscle was characterised, on average, by 0.3 – 0.4 points higher degree of marbling. That is why two separate regression equations were elaborated to estimate marbling of individual muscles; first – to assess marbling for the *longissimus dorsi* and *semimembranous* muscles and the second – for the *biceps femoris* muscle. The content of lean meat and the degree of marbling of the *gluteus medius* muscle were selected as independent variables because these traits showed high correlation coefficients (from r = 0.52 to r = 0.64) and they were easy to determine on the carcass.

The obtained equations assumed the following forms:

Equation 1 – for the *m. longissimus dorsi* and *m. semimembranosus*

$$Y = 13.98367 - 7.23056 \log x_1 + 0.27374 x_2 \qquad RSD = 0.68$$

Equation 2 – for the *m. biceps femoris*

$$Y = 9.69371 - 4.38471 \log x_1 + 0.21326 x_2 \qquad RSD = 0.59$$

where:

x_1 – meat content in the carcass, %
x_2 – evaluation of the marbling of the *gluteus medius* muscle, points

Mörlein *et al.*, (2005) obtained a smaller estimation error (RMSE = 0.36) but in their investigations they employed a very expensive ultrasound probe used in medicine.
The obtained equations were used to elaborate marbling patterns where carcass meatiness was placed in lines assuming the principle that one line corresponds to one percentage point in the range from 35% to 65%, while the points of assessment of the degree of fattening of the *gluteus medius* muscle were placed in columns assuming the principle that one column corresponds to 0.5 point in the range from 1 to 5 points. The estimated marbling value of the examined meat can be read at the intersection of the selected column and line. Because two regression equations were employed, also two marbling patterns were elaborated: one of them refers to the *longissimus dorsi* and *semimembranous* muscles and the second – to the *biceps femoris* muscle.
In the course of the performed investigations, special attention was paid to the fact that the marbling evaluation of the *gluteus medius* muscle must be carried out not earlier than three hours after slaughter, *i.e.* when this muscle is already partially chilled. This is due to the fact that warm intramuscular fat is transparent and, therefore, poorly seen with the naked eye. Once the muscle is cold, the fat becomes white and is clearly visible against the background of red meat and marbling can be evaluated.
The obtained photographs and tables allowed to develop a new pattern of marbling. On the face side of the page, we can see the photographs of the *gluteus medius* muscle in the 5-point scale of marbling, whereas on its reverse -the table with the marbling assessment of the appropriate muscle is presented. The adopted approach allows the grader to evaluate the degree of fattening of the largest muscles rapidly, cheaply, simply and in a non-invasive manner. It is enough to assess the *gluteus medius* muscle, which is always visible in the half carcass, using the adopted 1 - 5 point scale and then determine the meatiness of the carcass. The meat content in the carcass can be read from the print on the carcass skin or from the slaughter report. If it is impossible to determine carcass meatiness in the way mentioned above, it is still possible to use the allocated EUROP class adopting the mean meat content for a given class, *e.g.* E class – 57.5%; U class – 52.5%; R class – 47.5% etc. Knowing the above-mentioned values, the grader reads the required value of muscle marbling from the table placed on the back page of the pattern.

Conclusions

The authors developed a new method of evaluation of marbling of the *m. longissimus dorsi* and *semimembranous* muscle and the *biceps femoris* muscle. The method is based on the visual assessment of the degree of marbling of the *gluteus medius* muscle taking into account the meat content in the carcass. It is worth emphasising that the method is characterised by a small estimation error only slightly higher than that of the methods which employ expensive electronic devices.

References

Altmann M. and Pliquunett (2006). Prediction of intramuscular fat by impedance spectroscopy. Meat Science, 72, 666 – 671.

Blicharski T. and Pierzchała M. (2005). Tłuszcz śródmięśniowy u świń, Trzoda Chlewna 11, 62 – 64.

Eggert, J. M., Depreux, F. F. S., Schinckel, A. P., Grant A. L. and Gerrard D. E. (2002). Myosin heavy chain isoforms account for variation in pork quality. Meat Science, 53, 2, 117 – 126.

Fernandez, X., Monin, G., Talmant A., Mourot J., and Lebret B. (1999). Influence of intramuscular fat contentment on the quality of pig meat – 1. Composition of the lipid fraction and sensory characteristics of M. longissimus lumborum. Meat Science, 53,1, 67-72.

Mörlein D., Rosner F., Brand S., Janderka K. V. and Wicke M., (2005). Non – destructive estimation of the intramuscular fat content of the longissimus muscle of pig by means of spectral analysis of ultrasound echo signals. Meat Science, 69, 187 – 199.

Walstra P. and Merkus G.S.M. (1996). Procedure for assessment of the lean meat percentage as a consequence of the new UE reference dissection method in pig carcass classification - Raport ID-DLO 96.014, 1-22 - Inst. for Animal Sci. and Health Lelystud.