Scientific Annals of Polish Society of Animal Production - Vol. 10 (2014), No 2, 57-64

Factors affecting the size of dissection losses in pig half-carcasses

Damian Knecht[1], Dariusz Lisiak[2], Kamil Duziński[1], Sebastian Środoń[1]

[1]Wrocław University of Environmental and Life Sciences, Institute of Animal Breeding, Pig Breeding Section,
ul. Chełmońskiego 38c, 51-630 Wrocław; e-mail: kamil.duzinski@up.wroc.pl
[2]Institute of Agricultural and Food Biotechnology,
Department of Raw Material Assessment and Meat Production in Poznań,
ul. Głogowska 239, 60-111 Poznań

The aim of the study was to determine the factors affecting the size of dissection losses in pig carcasses. The research material consisted of 56 pig half-carcasses. The half-carcasses were divided into 3 groups according to weight (less than 40 kg, 40-45 kg, more than 45 kg), into 4 groups according to meatiness (S, E, U, R) and into 3 groups based on the average back fat thickness from 5 points (less than 22 mm, 22-26 mm and over 26 mm). Dissection losses were determined based on the difference between the weight of a half--carcass before dissection and the total weight of all parts after they were separated and dissected in detail (ham, loin, shoulder and belly). Each person involved in the research was assigned a single function for the entire duration of the experiment (5 days). Losses during dissection were found to decrease as the weight of the half carcass increased. Statistically significant differences ($P \leq 0.05$) were found between half-carcasses weighing less than 40 kg and those weighing 40-45 kg and over 45 kg. The highest level of dissection losses was observed for carcasses in class S, and the lowest for class R ($P \leq 0.05$). The study showed no impact of back fat thickness on dissection losses. During detailed dissection the greatest losses were recorded for the loin and ham. Significant correlations were determined for the weight of the neck ($r=-0.21$), front shank ($r=-0.22$), back shank ($r=-0.19$) and hind foot ($r=-0.17$) with the level of dissection losses ($P \leq 0.05$). A statistically confirmed ($P \leq 0.01$) correlation coefficient between losses and the day of dissection ($r=-0.26$) was obtained.

KEY WORDS: pig carcass / dissection / dissection losses

Dissection remains the most accurate method for assessing the tissue composition of a carcass. The tissue composition of carcasses and information collected on this subject have been analysed for nearly 150 years [9]. Currently, precise evaluation of pig carcasses is done with pork grading instruments, video image analysis [16], magnetic resonance imaging [2] or computed tomography [14]. Nevertheless, they are still calibrated on the basis of manual methods of dissecting half-carcasses. The value of the carcass, besides its conformation and fat content, is also influenced by the proportions of the most valuable cuts [7]. The precision and accuracy of the dissection affect its results, and the results are largely dependent on the method used. Research is continually conducted on modifications of cutting and dissection techniques to obtain a fast image of the carcass [10].

The problem of accurate estimation of the value of pig carcasses has been discussed in many studies [20, 21]. Detailed dissection is costly and time-consuming and involves a large number of people, so it is important that it be done correctly. Only high-qualified staff should participate in the dissection and they must separate the cuts as precisely as possible. Apart from the human factor, which often affects the measurements made on the carcasses and the results of the dissection [13], attention should also be paid to carcass parameters. The accuracy of the measurements is directly affected by the amount of losses during dissection, which will not be included in the overall tissue composition of the carcass, or will be erroneously classified. However, there have been no studies on the role of dissection losses or analyses of the factors determining this parameter.

With this in mind, the aim of the study was to determine the factors influencing the amount of loss taking place during dissection of slaughtered pork half-carcasses.

Material and methods

Fattening pigs from the mass population were slaughtered at meat plants located in the Pomeranian Voivodeship. After the carcasses were bled and the bristles, gut, genitals, diaphragm, kidneys, perinephric fat, tongue, eyes and middle ear had been removed, the carcasses were divided along the midline, removing the brain and spinal cord. Further analysis included only material with a hot carcass weight between 60 and 120 kg. The research material consisted of 56 pork half-carcasses. After 24 h cooling, the half-carcasses were weighed with an electronic scale to within 1 gram. On the right half-carcasses, the thickness of the fat (mm) was measured to within 1 mm with a calliper at five points: above the shoulder blade at the thickest point, on the back, and above the cranial, medial and caudal sections of the gluteus medius muscle (KI, KII and KIII).

The half-carcasses were divided into 3 groups according to weight (less than 40 kg, 40-45 kg, and above 45 kg), into 4 conformation classes (S, E, U, R), and into 3 groups according to average fat thickness from 5 measurements (less than 22 mm, 22-26 mm, and over 26 mm).

Then on the same half-carcasses, in accordance with the European Union reference methodology [4, 19], specially trained staff performed the dissection. The meat content in the half-carcasses was calculated using dissection data, according to the EU regulation [3]. A certified electronic scale was used to weigh the carcass cuts and dissected cuts to within 1 g. Dissection losses were determined based on the difference between the weight of the half-carcass before dissection and the total weight of all parts of the half-carcass following separation and dissection. Detailed analysis of the losses was carried out for the ham, loin, shoulder and belly, to determine losses resulting from separation into the skin with fat, muscles, bones, and intermuscular fat. In order to minimize human error resulting from dissection carried out by different individuals, each person was assigned one function for the entire experiment (5 days).

The numerical material was analysed using STATISTICA software (2014). The arithmetic means ($\bar{x}$) and standard deviations (SD) were calculated. The normality of the distribution of variables was tested by the Kolmogorov-Smirnov test and the homogeneity of variance by the Brown-Forsythe test. The results were analysed by one-way analysis of variance (ANOVA). The significance of differences between means was determined by Duncan's test, at $P \leq 0.05$ and $P \leq 0.01$. In addition, Pearson's correlation coefficients (r) were calculated between selected carcass parameters.

Results and discussion

The statistical analysis confirmed the relationship between the weight of the half-carcasses and the dissection losses. As the carcass weight increases, the loss of weight during dissection was found to decrease (Fig. 1). Statistically confirmed differences ($P \leq 0.05$) were found for half-carcasses weighing less than 40 kg as compared to those weighing 40-45 kg and over 45 kg, while the losses in half-carcasses weighing 40-45 kg and above 45 kg were similar. An increase in the weight of half-carcasses results in an increase in the weight of the cuts and improved conformation, which leads to a higher proportion of muscle tissue in them [6]. It can be assumed that in this case separation of individual parts of the carcass is easier. An increase in slaughter weight has also been found to involve losses in the belly during dissection [18], and these changes were proportional, which is consistent with the results of the present study.

The study showed a decreasing trend in the dissection losses as half-carcass weight increased. The weight of the slaughtered pigs is closely linked to the weight of the primal cuts and the tissue composition. The weight of the half-carcasses has been shown to affect the total weight of the cuts subject to dissection and to improve the precision of fat separation [5]. The nature of the material used largely determines the final effect.

Losses during dissection can also be associated with the method of dissection and the means of separating the tissue components. In contrast to carcass dissection by the SKURTCh method [9], more cuts were included in the dissection. This results in greater fragmentation of the carcass, which can affect accuracy and precision. Correlations between meat and fat content and the dissection method in accordance with European Union requirements are 0.997 and 0.996, respectively [1]. Various types of errors during slaughter, sampling and dissection may affect the accuracy of the assessment [11]. Direct comparison of losses for different methods of dissection will therefore be subject to error, additionally resulting from different methods of dividing the half-carcasses.

Distribution of dissection losses depending on the conformation class was different than in the case of half-carcass weight (Fig. 2). The greatest losses were observed for half-carcasses in class S. Statistically significant differences ($P \leq 0.05$) were shown in comparison with class R, where the losses were lowest. There were no statistically si-

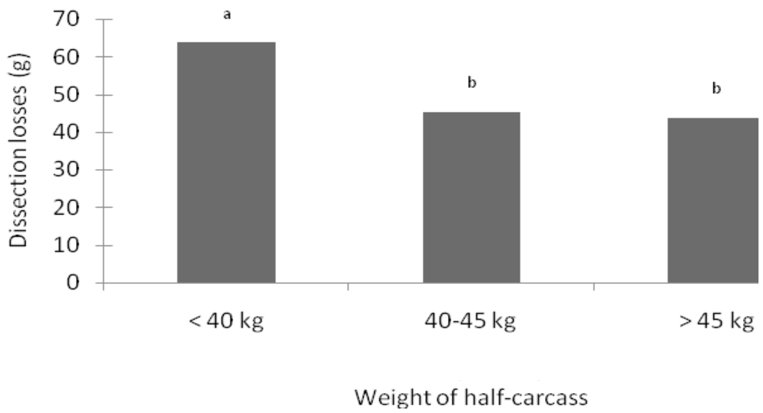

Fig. 1. The size of dissection losses depending on the weight of half-carcasses (different letters indicate means differing significantly at P≤0.05)

gnificant differences between classes E, U and R. The level of dissection losses does not progress linearly according to the meat class. Although the greatest loss was recorded for class S and the lowest for class R, the losses were markedly higher in class U than in class E. The value of the carcass is determined primarily by the content of meat and

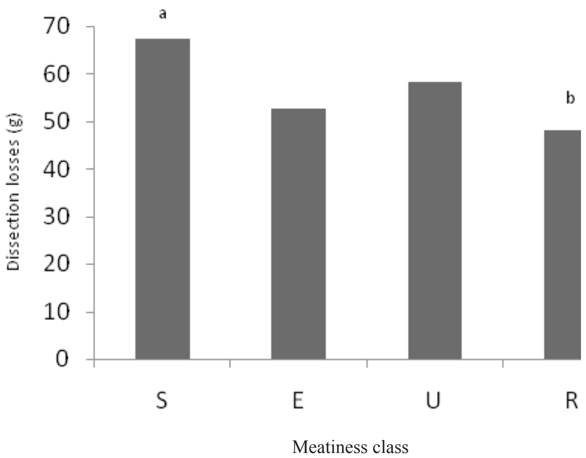

Fig. 2. The size of dissection losses depending on meatiness class (different letters indicate means differing significantly at P≤0.05)

fat. A higher content of meat in the carcass determines a higher proportion of primal cuts [12], but the dissection also includes the head, dewlap, front and rear knuckles and legs, belly groin and ham groin.

Consumer demand has forced producers to sell fatteners with a high proportion of meat in the carcass and low fat content. Pork carcasses in class S have lower fat content, which may make it more difficult to separate the intermuscular fat in the primal cuts. The higher proportion of subcutaneous fat in class R facilitates separation of tissues [6]. Fat in the body of the pig is deposited in the form of subcutaneous, intermuscular and intramuscular fat. Subcutaneous fat together with the skin is easily separated from the cuts, unlike intermuscular fat, which is firmly attached to other tissues [8]. This is confirmed by the fact that the fat content of the carcass assessed solely on the basis of the backfat thickness did not affect the amount of loss during dissection. Modification of the carcass structure through diet may affect the tissue composition of the carcass [15], which may result in losses during dissection.

Average dissection losses were also determined for the cuts undergoing detailed dissection and the remaining cuts in comparison with the overall losses during dissection of the carcass (Figure 3). The remaining cuts included the tenderloin, neck, head, front and hind knuckle, front and hind leg, dewlap, belly groin and ham groin. The highest dissection losses were recorded for the loin, which is contrary to the general view that the highest losses can be expected for the belly. A study on the Czech pig population did in fact find the highest losses in the case of the belly [18]. Due to its structure and tissue proportions, pork belly is difficult to dissect, and therefore the process is time-consuming. In contrast to the results of our study, detailed dissection of the shoulder and belly and the determination of meat content based on it have been found to be more subject to error than in the case of the ham and loin [11].

The ham and loin, as the heaviest cuts, have the largest surface area for dissection, which may have influenced the results obtained in our study. As the dissection time increases, the probability of error and improper cutting increases. The proportion of these cuts in the carcass may, however, vary depending on the genotype [17], but this was not analysed in our experiment.

In the experiment, we also calculated Pearson's correlation coefficients (r) between the dissection losses and selected carcass cuts that did not undergo detailed dissection. The weight of the neck was found to have a significant ($P \leq 0.05$) influence on the amount of dissection loss ($r = -0.21$). Confirmed correlations at $P \leq 0.05$ were also obtained for the front knuckle ($r = -0.22$), hind knuckle ($r = -0.19$) and hind leg ($r = -0.17$). These correlations confirmed the previously observed influence of half-carcass weight on the amount of loss during dissection. An increase in the weight of the cuts not subjected to detailed dissection decreases dissection losses.

The carcasses were dissected in the experiment over a period of 5 days. The correlation coefficient between dissection losses and the day of dissection was calculated to be $r = -0.26$, at $P \leq 0.01$. This correlation coefficient can be explained by the human factor. Despite the relatively uniform conditions created for each carcass undergoing dissection (each employee performed the dissection at the same station throughout the experiment),

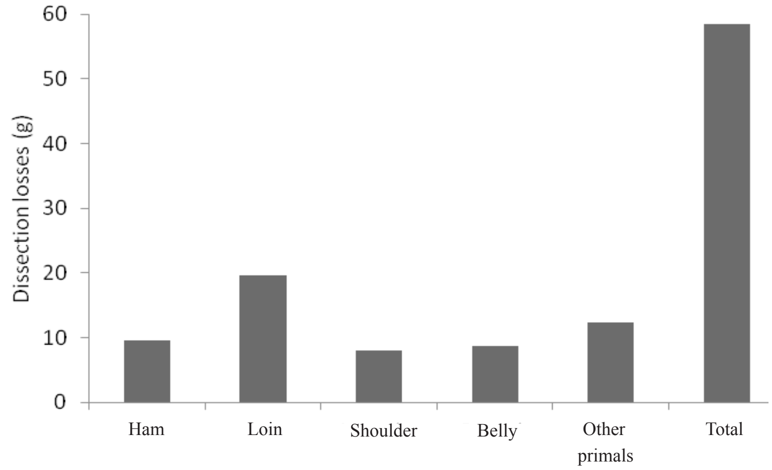

Fig. 3. Average dissection losses determined for primal cuts subjected to detailed dissection, the remaining primals, and the average value for the half-carcasses

discrepancies were still observed. The human factor is the main factor to be considered in analysing the results of the dissection. The separation of cuts and detailed dissection are the most critical moments determining the extent to which the process is performed correctly [11]. As the dissection was planned for 5 days without interruption, it was possible to gain efficiency and experience at one's position. In this way, dissection losses were reduced each day. A good recommendation for training of personnel would be to have them perform trial dissections immediately before the actual dissections in order to reduce losses.

To sum up, the half-carcass weight and conformation class were found to influence the amount of dissection loss. In the sample analysed, changes in the parameters of the losses were inversely proportional to the half-carcass weight and almost directly proportional to the conformation class. Detailed analysis showed the highest losses for the loin, ham and cuts that did not undergo detailed dissection. The correlations observed between dissection loss and the weight of the neck, front and hind knuckle and hind leg showed which of the cuts that were not subjected to detailed dissection accounted for the greatest losses. The study showed no effect of carcass fat content on the amount of dissection losses. Despite efforts to minimize human error, an inverse relationship was noted between the day of the dissection and the amount of the loss. Taking into account the results obtained in the study during dissection may help to reduce losses and improve the accuracy of dissection.

REFERENCES

1. BRANSCHEID W., DOBROWOLSKI A., SACK E., 1990 – Simplification of the EC reference method for the full dissection of pig carcasses. ***Fleischwirtschaft*** 70, 565-567.
2. COLLEVET G., BOGNER P., ALLEN P., BUSK H., DOBROWOLSKI A., OLSEN E., DAVENEL A., 2005 – Determination of the lean meat percentage of pig carcasses using magnetic resonance imaging. ***Meat Science*** 70, 563-572.
3. COMMISSION REGULATION (EC) No 1197/2006 of 7 August 2006 amending Regulation (EEC) No 2967/85 laying down detailed rules for the application of the Community scale for grading pig carcases.
4. COMMISSION REGULATION (EC) No 1249/2008 of 10 December 2008 laying down detailed rules on the implementation of the Community scales for the classification of beef, pig and sheep carcasses and the reporting of prices thereof.
5. FREDEEN H.T., MIKAMI H., 1986 – Mass selection in a pig population: correlated changes in carcass merit. ***Journal of Animal Science*** 62, 1546-1554.
6. GARCIA-MACIAS J.A., GISPERT M., OLIVER M.A., DIESTRE A., ALONSO P., MUÑOZ-LUNA A., SIGGENS K., CUTHBERT-HEAVENS D., 1996 – The effects of cross, slaughter weight and halothane genotype on leanness and meat and fat quality in pig carcasses. ***Animal Science*** 63, 487-496.
7. KARAMUCKI T., KORTZ J., RYBARCZYK A., GARDZIELEWSKA J., JAKUBOWSKA M., NATALCZYK-SZYMKOWSKA W., 2004 – The weight and content of valuable elements in pig carcasses classified according to EUROP grading system and related to fitness. ***Animal Science Papers and Reports*** 22 (Suppl. 3), 127-135.
8. KOUBA M., BONNEAU M., 2009 – Compared development of intermuscular fat and subcutaneous fat in carcass and primal cuts of growing pigs from 30 to 140 kg body weight. ***Meat Science*** 81, 270-274.
9. LISIAK D., ŁYCZYŃSKI A., BORZUTA K., GRZEŚKOWIAK E., 2006 – Badania porównawcze metod dysekcji tusz wieprzowych. ***Roczniki Instytutu Przemysłu Mięsnego i Tłuszczowego*** 44/1, 7-17.
10. MARCOUX M., POMAR C., FAUCITANO L., BRODEUR C., 2007 – The relationship between different pork carcass lean yield definitions and the market carcass value. ***Meat Science*** 75, 94-102.
11. NISSEN P.M., BUSK H., OKSAMA M., SEYNAEVE M., GISPERT M., WALSTRA P., HANSSON I., OLSEN E., 2006 – The estimated accuracy of the EU reference dissection method for pig carcass classification. ***Meat Science*** 73, 22-28.
12. NOWACHOWICZ J., 2009– Ocena zmian wartości handlowej tusz wieprzowych. ***Roczniki Instytutu Przemysłu Mięsnego i Tłuszczowego*** 47/1, 15-20.
13. OLSEN E.V., CANDEK-POTOKAR M., OKSAMA M., KIEN S., LISIAK D., BUSK H., 2007 – On-line measurements in pig carcass classification: Repeatability and variation caused by the operator and the copy of instrument. ***Meat Science*** 75, 29-38.
14. ROMVARI R., DOBROWOLSKI A., REPA I., ALLEN P., OLSEN E., SZABO A., HORN P., 2006 – Development of a computed tomographic calibration method for the determination of lean meat content in pig carcasses. ***Acta Veterinaria Hungarica*** 54, 1-10.
15. SKIBA G., RAJ S., POŁAWSKA E., PASTUSZEWSKA B., ELMINOWSKA-WENDA G., BOGUCKA J., KNECHT D., 2012 – Profile of fatty acids, muscle structure and shear force

of musculus longissimus dorsi (MLD) in growing pigs as affected by energy and protein or protein restriction followed by realimentation. ***Meat Science*** 91, 339-346.

16. SÖNNICHSEN M., DOBROWOLSKI A., HÖRETH R., BRANSCHEID W., 2002 – Videobildauswertung an Schweinehalften. ***Fleischwirtschaft*** 82, 98-101.
17. SZULC K., SKRZYPCZAK E., BUCZYŃSKI J.T., STANISŁAWSKI D., JANKOWSKA-MĄKOSA A., KNECHT D., 2012 – Evaluation of fattening and slaughter performance and determination of meat quality in Złotnicka Spotted pigs and their crosses with the Duroc breed. ***Czech Journal of Animal Science*** 57(3), 95-107.
18. VALIŠ L., PULKRÁBEK J., PAVLÍK J., VÍTEK M., WOLF J., 2005 – Conformation and meatiness of pork belly. ***Czech Journal of Animal Science*** 50(3), 116-121.
19. 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.
20. WINIARSKI R., WAJDA S., BORZUTA K., 2004 – Szacowanie składu tkankowego tusz wieprzowych dzielonych na elementy według zasad stosowanych w Unii Europejskiej. ***Żywność. Nauka. Technologia. Jakość*** 3(40), 24-31.
21. ZYBERT A., KOĆWIN-PODSIADŁA M., KRZĘCIO E., SIECZKOWSKA H., ANTOSIK K., 2005 – Uzysk i procentowy udział mięsa i tłuszczu ogółem w półtuszy pozyskanych z rozbioru i wykrawania tusz wieprzowych zróżnicowanych masą oraz klasą mięsności według systemu klasyfikacji EUROP. ***Żywność. Nauka. Technologia. Jakość*** 3(44), 254-264.