Possibilities for development of methods for assessment of meat productivity in skinned pigs II. Possibilities to use some measurements to develop methods for assessment of meat productivity in skinned pigs

J. Nakev[1†], Maya Ignatova[2], Teodora Popova[2], Tania Nikolova[1], Penka Marinova[2]

[1]Agricultural Institute, 9700 Shumen, Bulgaria; [2]Institute of Animal Science, 2232 Kostinbrod, Bulgaria

SUMMARY

The aim of this research was to investigate the possibilities to use some linear and weight carcass measurements to develop methods for assessment of meat productivity in skinned pigs. The information about the composition of the left half carcasses of a total of 70 pigs (♀Youna x ♂Pietrain) was used in this study. The animals were reared in the experimental farm of the Institute of Animal Science-Kostinbrod, Bulgaria, and slaughtered in a certified abattoir at the average live weigh of 105 kg /± 2.5%/. The carcasses were further skinned and their heads and feet were removed.

After measurement and carcass analysis it was found that the inclusion of the backfat thickness and the depth of *m. Longssimus dorsi* (m. LD) measured at the cutting line in order to predict the lean meat percentage in the carcass ensures higher accuracy in comparison to the measurement done 7 cm laterally at the last rib and between the 3[d] and 4[th] rib.

Keywords: pigs, assessment methods, meat productivity

INTRODUCTION

The percentage of lean meat might be considered as a dependent variable with a value determined by the ratio of the different morphological components in the carcass. Along with meat, fat content is important for the quality assessment of the carcass. The meat and fat deposition is closely related, as the variability of these traits depends on many factors such as nutrition, breeding, age. This indicates that the

† Corresponding author e-mail address: jivko_nakev@abv.bg

differentiated evaluation of the fat content and its location is of crucial importance for determination of the carcass quality.

The direct determination of the ratio between the individual morphological components of the carcass through full dissection is difficult to use in practice, hence the researchers focus on development of indirect methods for determination of the lean meat percentage. Such methods use the backfat thickness and depth of m. LD measured at different locations with the aid of accurate device (Lisiak et al., 2006; 2012; Vítek et al., 2012).

For small scale meat enterprises a method (ZP) that does not require expensive devices has been developed (Branscheid and Sack, 1988; Daumas and Dhorne, 1994; 1996; Lisiak et al., 2015; Font-I-Furnols et al., 2016 Machev and Valchev, 2001).

The objective of the present study was to investigate the possibilities to use some linear and weight carcass measurements for development of methods for assessment of the meat productivity in skinned pigs.

Material and Methods

The slaughter characteristics and morphological components of the carcass and its individual parts in skinned pigs were determined using the information on the composition of the left half carcasses of 70 pig, crosses of ♀Youna and ♂Pietrain, reared in the experimental farm of the Institute of Animal – Kostinbrod, Bulgaria. The animals were slaughtered in a certified abattoir, at a distance of 5 km from the Institute on the day of the transportation of the pigs. The average live weight at slaughter was 105 kg /± 2.5%/. The carcasses were skinned, without head and feet. The linear measurements and carcass analysis were performed on each left half carcass after 24 h storage at + 4◦C, according to the Rules for assessing the breeding value, production and classification of breeding pigs, 1996. The left carcass halves were then divided into cuts according to the DLG method (Scheper and Scholze, 1985). Each cut was weighed and subjected to further dissection, as the weights of separated muscle, intermuscular fat, subcutaneous fat and bones were determined.

Prediction equations were developed according to the method of Causeur et al., (2003) using Minitab 17 software package.

Results and discussion

The models that use the carcass measurements as variables are shown in Table 1. The model including the backfat thickness at L_2 and the depth of m. *LD* measured between the cranial end of m. *Gluteus medius* (m. GM) and the dorsal end of Canal rachidien (ZP method) determined 55% of the lean meat in the skinned carcasses that are object of the study. This method has

been applied in the western European countries since 1987. According to Branscheid and Sack, (1988), in Germany the two-point method ZP use the following prediction model:

$$Y = 47.978 + 26.0429 \frac{S}{F} + 4.5154 \sqrt{F} - 2.5018 \log S - 8.4212 \sqrt{S}$$

where:
S – the thickness of the backfat at the slightest part, above m.GM (L_2)
F – the depth of m. LD between the cranial end of m.GM and Canal rachidien.

Table 1. Prediction models developed on the results of the carcass measurements

Prediction models	Mult, R	R^2	SE
1. LM= 63.40 -0.925X_6 +0.1028F	0.74	0.55	3.14
2. LM = 64.2 – 0.75X_1 + 0.02 X_2 + 0.11X_3 + 0.01X_4	0.60	0.36	3.99
3. LM= 70.70 -0.1650X_8 -0.071X_5 -0.378X_6 -0.315X_7 +0.0784F	0.78	0.62	2.95
4. LM= 71.11 -0.1510X_8 -0.027X_5 -0.423X_6 -0.317 X_7- 0.0889M +0.0905F	0.79	0.63	2.95
5. LM = 72.69 -0.193X_8 -0.059X_5 -0.504X_6 -0.231X_7 - 0.099M +0.0868F +0.047X_2-0.0101X_4	0.77	0.60	3.33
6. LM = 72.33 -0.189X_8 -0.082X_5 -0.525X_6 -0.178X_7 +0.0450F +0.001X_1+0.0129X_3	0.77	0.60	3.32
7. LM= 79.7 -0.1936X_8 -0.058X_5 -0.422X_6 -0.262 X_7- 0.0563M +0.0824F +0.227X_9-0.376X_{10}	0.80	0.64	2.93
8. LM= 79.6 -0.2403 X_8-0.081X_5 -0.242X_6-0.332 X_7- 0.0034M +0.1119F +0.249X_9-0.331X_{10}-0.034X_{11}-0.1049X_{12}	0.81	0.66	2.90

LM – musculature. %;
X_1- backfat thickness 7 cm laterally at the last rib, mm;
X_2- backfat thickness 7cm laterally at 3-4 ribs, mm;
X_3- depth of m. LD at 7cm at the last rib, mm;
X_4 – depth of m. LD at 7cm at 3-4 ribs, mm;
X_5- backfat thickness at L_1, mm;
X_6- backfat thickness at L_2, mm;
X_7- backfat thickness at L_3, mm;
X_8- backfat thickness at withers, mm;
X_9 – carcass big length, cm;
X_{10}- carcass small length, cm;
X_{11}- leg length, cm;
X_{12} –leg circumference, cm;
F – depth of m. *LD* measured between the cranial end of m .*GM* and the dorsal end of Canal rachidien, mm;
M – depth of m. GM at L_2, mm;

In France Daumas et al. (1998) proposed the following formula:

$Y = 53{,}28 – 0{,}102\ x_1 – 0{,}119\ x_2 – 0{,}299\ x_3 – 0{,}231\ x_4 + 0{,}076\ x_5 + 0{,}058\ x_6 + 0{,}135\ x_7$

where:

x_1 – minimum thickness of the backfat above m. GM (L_2)

x_2 – backfat thickness between 2-3 last ribs, 6 cm laterally

x_3 – backfat thickness between 3d and 4th last ribs , 6 cm laterally

x_4 – backfat thickness between 3d and 4th lumbar vertebrae, 8 cm laterally

x_5 – depth of m.LD between the cranial end of m. GM and the dorsal end of Canal rachidien

x_6 – depth of m. LD at x_2

x_7 – depth of m. LD at x_3

With the application of the model, the authors found significant difference between the female and castrated male pigs in regard to the backfat thickness and the depth of m. LD and develop ZP models considering the effect of the sex of the animals.

female : $Y = 54.84 – 0.545\ x_1 + 0.194\ x_2$

male : $Y = 48.35 – 0.488\ x_1 + 0.255 x_2$

where:

x_1 –backfat thickness at L_2

x_2 – muscle depth between the cranial end of m.GM and the dorsal end of Canal rachidien.

Abraham-Barna, (2011) reported that since 17.07.2008 in Romania, ZP method has been using the following model:

$Y = 50.89767 - 0.70985 \times 0.26457 \times X_1 + X_2$

Lisiak et al., (2015) proposed a model for application of the ZP method in Poland: LMCZP= 52.61–0.6148 F + 0.1842 M

The authors proposed the use of measurement template in practice for determination of the lean meat percentage in small scale abattoirs with capacity of 40 slaughtered pigs per hour.

Font-I-Furnols et al., (2016) used data of 951 pig carcasss in Belgium, France, Germany, Slovenia and Spain and apply 12 approved ZP equations in Europe. They aimed to find the difference and the possibilities for a general ZP equation in order to harmonise the pig carcass classification. The authors found differences between some of the equations (up to approximately 5 % lean meat) and accentuated on the necessity of improvements.

The inclusion of the backfat thickness at withers, L_1 and L_3 (Model 3) as well as the depth of m. GM at L_2 (Model 4) increased the accuracy of the prediction by 7% (R^2=0.62) and 8% (R^2=0.63), respectively. The thickness of the backfat and the depth of m. LD, measured 7 cm laterally at the last

and 3d/4th rib, used as prediction parameters (Model 2) determined to a low extent (R^2=0.36) the percentage of the musculature of the skinned carcass. Their inclusion in Model 4 decreased the accuracy by 3 % (Models 5 and 6). The determination coefficients found, showed increase of the precision when the lengths of the carcass were included in Model 4 (by 1%) (Model 7; R^2=0.63) while when the leg length and circumference were included the accuracy rised by 2% (Model 8).

According to Diestre et al. (1989) the length of carcass influenced the accuracy of the prediction of lean meat percentage. The authors concluded that the use of prediction models that did not take into account the carcass length led to 7% inaccuracy of the assessment of the muscle percentage.

Our results define a tendency toward increase of the accuracy of the prediction with the increase of the parameters used. The low precision of Model 4 showed the necessity of precise selection of the points of measurement, included in the models. When developing regression equations for prediction of carcass quality, Borzuta et al. (1994) concluded that attention must be payed to the experimental material, as different muscle content of the carcass and its weigh were also considered.

Conclusions

The inclusion of the backfat thickness and the depth of m. LD, measured at the line of cutting in the carcass into a model for prediction of the musculature proportion in the skinned pig carcasses, provided higher accuracy in comparison to the measurements performed 7 cm laterally at the last and between 3d and 4th ribs.

References

Abraham-Barna, T., 2011. Correlations between the different pig carcass grading methods before and after changing the Romanian National Formula. Bulletin UASMV Agriculture, 68(2) 555-559.

Borzuta, K., Grzeskowiak, E., Pieshocki, T., Borus, A., Dimke, W., 1994. Badania nad przydatnościa urzadzenia utradźwiekowego Ultra-FOM do oceny miesnosci tusz wieprzowych w Polsce. Roczniki Instytutu Orzemyslu Miesnego I Tluszczowego, T. XXXI, 7-29.

Branscheid, W., E. Sack, E., 1988. Comparison of objective grading devices among extremely different breeds. Pig news and information, 2, 129-135.

Causeur, D., Daumas, G., Dhorne, Th., Dobrowolski, A., Engel, B., Font-I-Furnols, M., Hojsgaard, S., 2003. Statistical handbook for assessing pig grading methods. Growth Project GRD 1-1999-10914 "EUPIGCLASS" WP 2 Task 3 report, draft 4.0, September 18, 2003.

Daumas, G., Dhorne, T., 1994. Nouvelles équations Francaises de prediction du taux de muscle des carcasses de porc. Journées Rech. Porcine en France, 26, 151-156.

Daumas, G., Dhorne, T., 1996. Historique et futur du classement objectif des carcasses de porc en France. Journées Rech. Porcine en France, 28, 171-180.

Daumas, G., Causeur, D., Dhorne, T., Schollhamer, E., 1998. Les méthodes de classement des carcasses de porc autorisées en France en 1997. Journées Rech Porcine en France, 30, 1-6.

Diestre, A., Gispert, M., Oliver, A., 1989. Pig carcass classification using automatic probes in Spain. New techniques in pig carcass evaluation, 94-97.

Font-I-Furnols, M., Čandek-Potokar, M., Daumas, G., Gispert, M., Judas, M., Seynaeve, M., 2016. Comparison of national ZP equations for lean meat percentage assessment in SEUROP pig classification. Meat Sci., 113, 1-8.

Lisiak, D., Borzuta, K., Borys, A., Strzelecki, J., Rogalski, J., Grześkowiak, E., 2006. Elaboration of regression equation for the purpose of estimating meat content in pig carcasses with the help of Polish optical-needle probe IM-03. Offi. J. Br. Soc. Anim. Sci., 1, Suppl.: 81–82.

Lisiak, D., Borzuta, K., Janiszewski, P., Magda, F., Grześkowiak, E., Strzelecki, J., Powałowski, K., Lisiak, B., 2012. Verification of regression equations for estimating pork carcass meatiness using CGM, IM-03, Fat-o-Meater and Ultra-Fom 300 devices. Ann. Anim. Sci.,12, 585–596.

Lisiak, D., Borzuta, K., Janiszewski, P., Grześkowiak, E., Powałowski, K., Samardakiewicz, Ł., Lisiak, B., 2015. Development of ZP method for SEUROP pig carcass grading in Poland. Ann. Anim. Sci., 15 (4), 987–996.

Machev, M., Valchev, G., 2001. Study on the carcass market value for basic for the country pig breeds and the possibility for harmonizing BSS qualifying system with the system SEUROP, Anim. Sci., 1, 117-125 (Bg).

Minitab 17 Statistical Software [Computer software] State College, PA: Minitab, Inc. 2010.

Rules for assessing the breeding value, production and classification of breeding pigs, 1996.

Scheper J., Scholz W., 1985. DLG-Schnittfuhrung fur die Zerlegung der Schlachtkorper von Rind, Kalb und Schwein. DLG-Verlag, Frankfurt/M, Germany.

Vítek, M., Pulkrábek, J., Vališ, L., David, L., 2012. The prediction of lean meat content in pig carcasses before evisceration using the ufom-300 apparatus. Research in pig breeding, 6, (1), 62-65.