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QUALITY OF PIG CARCASSES ON SLAUGHTER LINE ACCORDING TO PREVIOUS AND CURRENT EU REGULATION

O. Kosovac[1], V. Vidović[2], B. Živković[1], Č. Radović[1], T. Smiljaković[1]

[1]Institute for Animal Husbandry, 11080, Belgrade-Zemun, Republic of Serbia
[2]Faculty of Agriculture, Trg Dositeja Obradovića 8, 21000, Novi Sad, Republic of Serbia
Correpsonding author: okos@sezampro.rs
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Abstract: Investigation was carried out on 135 pig carcasses/carcass sides of both sexes, in several slaughterhouses in Vojvodina. Stratification of carcass sides was done based on coefficient of linear regression of traits in relation to mass of cooled carcass sides. Analysis „General regression Models"/Statistika 8 was applied. Percentage of muscle tissue was evaluated in three ways: simulation of instrumental FOM method according to formula defined by *Petrović et al. (2009*) and application of dissection method, using formula issued in EU Regulation from 1994 *(Commission Regulation, 3127/94)* and 2006 *(Commission Regulation, 1197/2006)*. Obtained results showed that relative share of muscle tissue in carcass sides determined according to previous EU1 regulation was significantly ($p<0,05$) lower (49,90%) than established share of muscle tissue determined according to mathematical FOM model (53,71%) and current regulation EU2 (54,03 %). The greatest share of muscle tissue was determined in leg/ham (67,67 %), and the lowest in BRP (48,65%). In BRP the highest share of KoPo and IMMT (31,10% and 13,72 %) were established, and the lowest in leg/ham (18,67 % and 5,60%). In cooled pig carcass sides, share of leg meat was 16,05%, share of muscle tissue of shoulder 7,11%, BLP 8,49% and BRP 4,95%. Leg contributes to the highest share of KoPo in carcass side (4,42 %), and shoulder to the lowest (2,63 %). The highest share of IMMT in carcass side was established in BRP, and the lowest in shoulder (0,87 %). For the purpose of distribution of pig carcasses into commercial classes according to SEUROP system using FOM and EU2 methods, all carcass sides were categorized into medium commercial classes (E and U), whereas according to EU1 formula only 36,30% of carcass sides were categorized in the same commercial classes, and 63,70% in lower class (R). None of the formulas applied resulted in classification of carcasses into meat class of highest meat ratio »S« or lowest meat ratios »O« and »P«. Based on this we concluded that investigated sample was of medium quality, i.e. that carcass sides can be categorized as commercial classes (E, U and R). Finally, it can be concluded that because of the established differences in

regard to obtained lean meat ratio by application of previous (EU1) and current (EU2) formula, additional research are necessary.

Key words: pig, quality of carcass/carcass sides, evaluation methods

Introduction

The quality of pig carcasses is permanent topic in pig production, which deserves attention of science as well as practice. Quality of pig carcasses is reflected in high share of muscle tissue in major carcass side parts, especially the most important parts: leg, shoulder, BLP and BRP. In accordance to criteria of the global market to rear pigs with high share of meat of good quality, the issue of objective assessment and validation of pig carcasses/sides is current.

First standards for assessment of the quality of pig carcasses/sides were defined during sixties of the last century and by the end of the nineties in most of EU countries, evaluation of meatiness was based on measuring of back fat thickness. Basis for this method of assessment is high correlation (r = 0.75) between back fat thickness and lean meat ratio in pig carcasses/sides *(Pedersen, 1988)*.

Significant part of scientific researches in recent years was directed towards finding of optimal solutions for fast and reliable evaluation of the quality of pig carcasses/sides. Today, evaluation of the quality of pig carcasses/sides is done using different methods, and the highest accuracy of the lean meat ratio evaluation is achieved by total dissection of carcass sides. First reference method of dissection used in EU countries was called "Kulmbach reference method" developed by the Institute of meat technology in Germany. However, this method included total dissection to basic tissues which was very complicated, expensive and time consuming. Therefore, in countries with traditionally developed pig production there have been many efforts to develop short method for determination of the quality of pig carcasses/sides.

For this purpose modern methods were constructed which enable fast, precise and objective evaluation/assessment of the quality of carcasses/sides, which are: destructive (dissection) and non-destructive (at slaughter line) method.

EU Council (1992) recommended special dissection method introduced in 1994 *(Commission Regulation (EC) No 3127/94, 1994),* described in detail by *Walstra and Merkus (1996).* In EU legislation the latest method for assessment of meatiness in carcasses was introduced and implemented, i.e. EU reference method of dissection *(Commission Regulation-EC) No. 1197/2006.* This method is based on change of factors included in the equation, determined in dissection to four major parts (leg, shoulder, BLP and BRP).

Results of the research carried out by many authors showed that there are differences between pig populations in relation to carcass side composition and distribution of certain tissues *(Luković et al., 2000; Timanović, 2003; Bahelka et al., 2005; Kušec et al., 2006; Kosovac et al., 2007; Ukmar et al., 2008; Đurkin et al., 2008)*. It is completely certain that the effect of the application of different methods of assessment of the pig carcasses/sides is undisputable.

In Slovenia, since 1995, and in Croatia since 1999, the Regulation on the quality of pig carcasses/sides in accordance to EU regulations is implemented. In Serbia, different methods of assessment of quality of pig carcasses are implemented. We are among few countries in Europe where sale and trade of non-categorized pig carcasses is still present. This causes non-objective and inadequate evaluation and valuing of their quality, which has impact not only on producers but also on processors and consumers. Accordingly, in order to provide total standardization, optimization and economical validation in pork production, in accordance to domestic needs and experiences of other countries, issuing and enforcing of domestic regulation and standards will be necessary, which would be based on objectively established parameters and criteria, and which relate to quality of pig carcasses/sides produced on our farms. Considering previously mentioned, objective of this study was to determine the meatiness of pig carcasses/sides in the pig population in Serbia, using methodology issued by EU legislation *(Commission Regulation EC No 1197/2006)*. Obtained results were compared with meatiness established by dissection and calculated according to EU reference method *(Commission Regulation EC No 3127/1994),* described in detail by *Walstra and Merkus (1996)* and on slaughter line according to parameters and criteria stated in the proposal of the Regulation on quality of slaughtered pigs *(Petrović, 2009)*.

Materials and Methods

Research was done on 135 pig carcasses/sides from different genotypes and sexes, slaughtered in several slaughterhouses in Vojvodina. Stratification of carcass sides according to body mass was done based on coefficient of linear regression of traits on mass of cooled carcass sides The analysis: „General regression Models"/ statistika 8 was applied.

Measuring of mass of warm carcass sides was done 45′ post mortem (3220/84), and before cutting on warm right carcass sides, percentage of muscle tissue was assessed by simulation of the instrumental method FOM and lean meat content in carcass sides and class of carcass sides determined (SEUROP). According to formula defined by *Petrović (2009*), content of meat was determined by measuring of the fat thickness on two locations/points which are adequate to positions where FOM probe is inserted (LF and RF) and dimater of *M. longisimus dorsi* (MLD):

LF = fat tissue thickness (with skin) in millimetres, measured 8 cm away from medial carcass line, between 3. and 4. lumbal vertebrae, from caudo-cranial point of view;

RF = fat tissue thickness (with skin) in millimetres, measured 7 cm from medial carcass line, between 3. and 4. rib, from caudo-cranial point of view;

RM = diameter of M. longissimus dorsi (MLD) in millimetres, measured at the same time and same position as RF.

In accordance to regulations of the majority of EU countries, linear measures of LF, RF and RM were taken manually using a ruler.

Based on obtained results, percentage of meat in carcass sides was calculated using mathematical model defined and presented in the proposal of the Regulation on quality of slaughtered pigs *(Petrović, 2009):*

$$Y = 55.6925 - 0.2402\ LF - 0.4575\ RF + 0.1578\ RM$$

Mass of cooled carcass sides was obtained by decreasing of mass of warm carcass sides by 2% (2967/85).

One day after slaughtering of pigs, left carcass sides were dissected according to EU reference method *(Commission Regulation, 3127/94),* described in detail by *Walstra and Merkus (1996)*. According to this method, carcass side is cut precisely according to defined scheme into 12 parts. Based on the quantity of meat in four major carcass side parts: 1. leg, 2. shoulder, 3. back-loin part (BLP), and 4. belly-rib part (BRP), which contain 75% of total musculature and mass of tender loin, the percentage of meat in carcass sides was calculated.

Four major carcass parts were dissected into main tissues: muscle tissue, skin with subcutaneous tissue (KoPo), intermuscular fat (IMMT) and bones.

Reference meat percentage was calculated using two formulas/equations: first (EU1) issued by EC. No. 3127/94,

EU1:

$$Y = 1.3 \times 100 \times \frac{\text{mass of tender loin + muscle mass of 4 major parts}}{\text{mass of tender loin + total mass of 12 carcass side parts}}$$

and the other method (EU2) which is presently in force and implemented, EC No. 1197/2006. This method is based on change of factors included in the equation, established in dissection into four major parts (leg, shoulder, BLP, BRP).

EU2:

$$Y = 0.89 \times 100 \times \frac{\text{mass of tender loin + muscle mass of 4 major parts}}{\text{mass of tender loin + total mass of 4 major parts}}$$

Obtained data was statistically processed using program package STATISTIKA 8, and statistical significance between differences of mean values was investigated using Tukey test.

Results and Discussion

Average values on share of muscle tissue in carcass sides calculated using FOM method, according to previous (EU1) and current regulation (EU2) are presented in table 1. Obtained data show that relative share of muscle tissue in carcass sides determined according to previous regulation (EU1) is significantly ($p<0.05$) lower (49.90%) compared to share of muscle tissue determined according to mathematical model FOM (53.71%) and current regulation EU2 (54.03%). This indicates insufficient accuracy of the formula/equation for assessment of meat yield according to previous regulation (EU1), i.e. this method of assessment underestimates the share of meat in pig carcass sides. Also, by comparing obtained percentage of meat by dissection according to previous formula (EU1) and current formula (EU2) it is noticeable that obtained results differ significantly (49.90 vs. 54.03 %), therefore further research is necessary.

Table 1. Meatiness of carcass sides calculated using FOM method, according to previous (EU1) and current, valid regulation (EU2) (N=135)

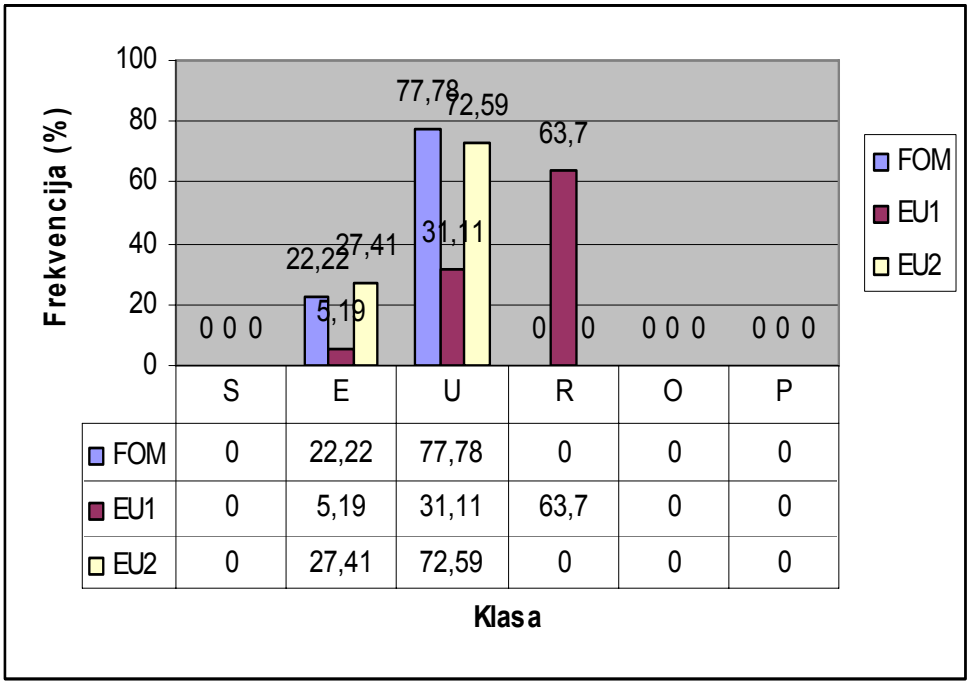
Statistical parameter	FOM	EU1	EU2
Arithmetic mean value	53.71[a]	49.90 [b]	54.03 [a]
Minimum	51.33	46.54	50.58
Maximum	56.30	57.92	59.68
Standard deviation	1.36	2.44	2.12

a,b – significance at the level of 0.05 (*$p<0.05$)

Similar research was done also by *Luković et al. (2000); Timanović (2003); Bahelka et al. (2005); Kušec et al. (2006); Kušec et al. (2006); Kušec et al. (2007)*. In these researches also significant differences were established between results of comparative studies of the meatiness of carcass sides determined by FOM apparatus and dissection. Contrary to stated authors, *Bahelka et al. (2005)* in their research of the assessment of the quality of carcass sides using instrumental FOM method and method of partial dissection established that value of the meat content assessed using two different methods was equal (55.54 %).

In graph 1 distribution of pig carcass sides into commercial classes (SEUROP) according to percentage of meat assessed according to mathematical method of FOM apparatus and utilization of two formulas issued by previous and current EU regulation, is presented. It is obvious from graph that when FOM and EU2 methods were used all carcass sides were categorized in medium commercial

classes (E and U), whereas EU1 formula categorized only 36.305 of pig carcass sides into the same commercial class, and 63.70% into lower commercial class (R). It can be seen that none of the formulas categorized carcass into commercial classes of meat with the highest »S« and the lowest share of meat »O« and »P«. Based on this we concluded that investigated sample is of medium quality, i.e. carcass sides belong to medium quality commercial categories/classes (E,U and R).



	S	E	U	R	O	P
FOM	0	22,22	77,78	0	0	0
EU1	0	5,19	31,11	63,7	0	0
EU2	0	27,41	72,59	0	0	0

Graph 1. Distribution of pig carcass sides into commercial classes (SEUROP) according to meat percentage (N = 135)

Obtained results on investigation of the share of certain tissues in carcass side parts and whole carcass side are presented in table 2. From data presented it is obvious that on cooled carcass sides of slaughtered pigs share of leg was 16.05%, share of muscle tissue of the shoulder 7.11%, BLP 8.49% and BRP 4.95%. The highest share of KoPo in carcass side derives from leg - 4.42%, and the lowest from shoulder (2.63%). LBLP and BRP have approximately same values (3.41 and 3.16%) of share of KoPo in carcass side. The highest share of bones was determined in BLP (15.60%) and it participates in the carcass side with 2.35%, and the lowest was established in BRP of 6.54%, i.e. share in carcass side of 0.60%. Share of IMMT in carcass side is mostly contributed by BRP with 1.40%, followed

by leg with 1.33%, and approximate values of 0.87% and 0.89 % of shoulder and BLP.

Similar research was carried out by *Kosovac et al. (2008)* investigating the quality of carcass and meat deriving from pigs of different genotypes. Depending on the investigated group of pigs, share of meat in leg varied from 73.12 to 76.46%, in shoulder from 61.38 to 67.59%, BLP from 59.77 to 63.66%, and in BRP from 55.68 to 59.70%. These values are significantly higher compared to those obtained in this research.

Table 2. Share of individual tissues in main pig carcass side parts

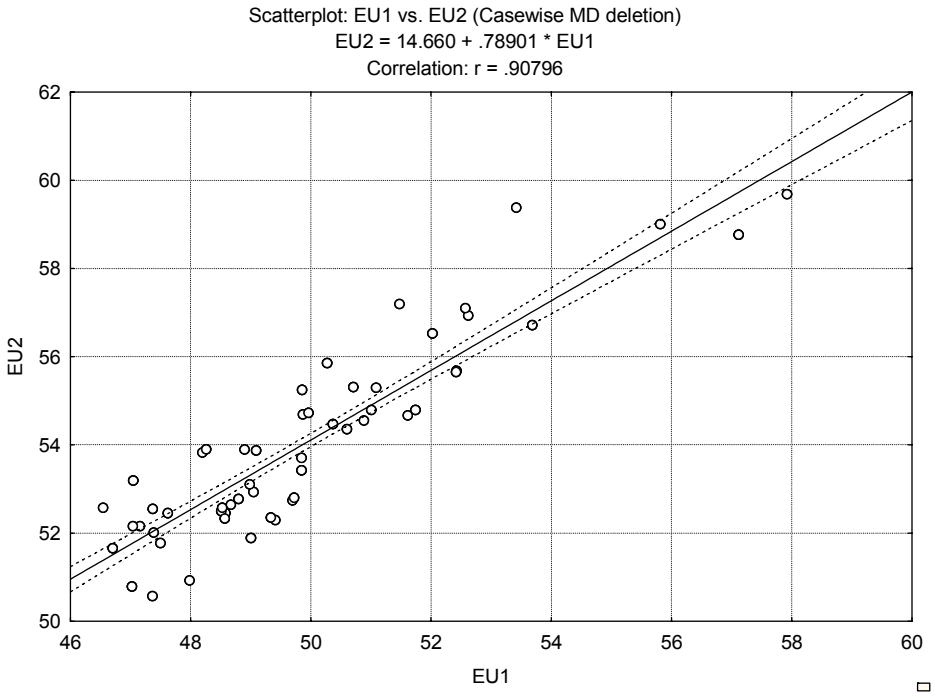
Carcass side part	Share in carcass side part (%)	Share in whole carcass side (%)
	Muscle tissue	
Leg	67.67	16.05
Shoulder	59.37	7.11
Back – loin part	56.07	8.49
Belly – rib part	48.65	4.95
	KoPo	
Leg	18.67	4.42
Shoulder	22.04	2.63
Back – loin part	22.47	3.41
Belly – rib part	31.10	3.16
	Bones	
Leg	8.07	1.91
Shoulder	11.36	1.35
Back – loin part	15.60	2.35
Belly – rib part	6.54	0.66
	Intermuscular fat tissue	
Leg	5.60	1.33
Shoulder	7.22	0.87
Back – loin part	5.86	0.89
Belly – rib part	13.72	1.40

Correlations between % of meat assessed using mathematical model FOM and two formulas issued by previous and current EU regulation are presented in table 3. and vary within limits from 0.38 to 0.91. High positive correlation was established (0.91) between percentage of meat obtained using formula EU1 and current regulation EU2.

Table 3. Correlation coefficients (r) between percentage of meat established using different methods in investigated pig carcass sides (N = 135)

FOM		**EU1**
EU1	EU2	EU2
0.38	0.38	0.91

For the purpose of easier perception and understanding of results presented in table 3, graph 2 shows presence of positive regression since spots on the dispersion diagram move from the bottom left corner towards top right corner.



Graph 2. Graphical presentation of the regression of share of meat in carcass side determined using methods EU1 and EU2, Y = 14,66 + 0,79x

Conclusion

Based on research and comparison of quality of pig carcasses on slaughter line according to previous (EU1) and current regulation of EU (EU2) the following can be concluded:

- Relative share of muscle tissue in pig carcass sides determined according to previous regulation (EU1) is significantly ($p<0.05$) lower (49.90%) compared to share of muscle tissue determined using mathematical model FOM (53.71%) and current regulation EU2 (54.03 %).
- The highest share of muscle tissue was determined in leg (67.67%), and the lowest in BRP (48.65%).

- Share of leg in cooled carcass sides is 16.05%, share of muscle tissue of shoulder 7.11%, BLP 8.49% and BRP 4.95%.
- In distribution of pig carcass sides into commercial classes according to SEUROP system and application of FOM and EU2 methods, all carcass sides were categorized as medium commercial classes (E and U), whereas EU1 formula categorized only 36.30% of pig carcass sides into same commercial class, and 63.70% into lower commercial class (R).
- None of the applied formulas categorized carcass sides in commercial classes of the highest »S« and lowest share of meat »O« and »P«. Based on this, it can be concluded that investigated sample is of medium quality, i.e. carcass sides belong to medium quality commercial classes (E,U and R).

Finally, we can conclude that due to established differences in percentage of meat obtained using previous (EU1) and current (EU2) formuila, further research on this topic is necessary.

Kvalitet svinjskih trupova na liniji klanja, prema prethodnom i tekućem pravilniku EU

O. Kosovac, V. Vidović, B. Živković, Č. Radović, T. Smiljaković

Rezime

Istraživanje je urađeno na 135 svinjskih polutki različitih genotipova, oba pola u nekoliko klanica u Vojvodini. Stratifikacija polutki prema telesnoj masi izvršena je na osnovu koeficijenta linearne regresije osobina na masu ohlađenih polutki. Primenjena je analiza „General regression Models"/statistika 8. Procenat mišićnog tkiva procenjivan je na tri načina: simulacijom instrumentalne metode FOM i primenom metode disekcije *(Commission Regulation, 3127/94* (EU1) et *Commission Regulation, 1197/2006 (EU2)*. Dobijeni rezultati su pokazali da je relativni udeo mišićnog tkiva u polutkama svinja određen prema prethodnom pravilniku *(EU1)* signifikantno ($p<0,05$) niži (49.90%) od utvrđenog udela mišićnog tkiva prema matematičkom modelu FOM (53.71%) i prema važećem pravilniku EU2 (54.03 %). Na ohlađenim polutkama zaklanih svinja udeo mesa buta čini 16.05%, udeo mišićnog tkiva plećke 7.11%, LSD 8.49% i TRD 4.95%. Distribucijom svinjskih trupova u tržišne klase prema SEUROP sistemu primenom FOM i EU2 metode sve ispitivane polutke svrstane su u srednje trgovačke klase (E i U), dok je EU1 formula klasifikovala samo 36.30% svinjskih polutki u istu trgovačku klasu, a 63.70% u nižu trgovačku klasu (R). Nijedna formula nije klasifikovala nijedan trup u tržišne klase mesa sa najvišim »S« i najnižim udelom mesa »O« i »P«. Na osnovu toga, zaključeno je da je ispitivani uzorak srednjeg

kvaliteta, tj. polutke su klasifikovane u srednje kvalitetne trgovačke klase (E, U i R). Na kraju, može se zaključiti da zbog ustanovljenih razlika dobijenog procenta mesa primenom prethodne (EU1) i važeće (EU2) jednačine neophodna su dalja istraživanja na ovu temu.

References

BAHELKA I., DEMO P., PEŠKOVIČOVÁ D. (2005): Pig carcass classification in Slovakia-New formulas for two point method and measuring instruments. Biotechnology in Animal Husbandry, 21, 5-6, 181-185.

COMMISSION REGULATION (EC) No 3127/94 of 20 December 1994 amending regulation (EC) No 2967/85 laying down detailed rules for the application of the Community scale for grading pig carcasses. Official Journal, L 330, 21/12/1994, 0043-0044.

COMMISSION REGULATION (EC) No 1197/2006 of 7 August 2006 amending regulation (EC) No 2967/85 laying down detailed rules for the application of the Community scale for grading pig carcasses. Official Journal, 49, L 217, 8/8/2006, 0006-0007.

DJURKIN I., KUŠEC G., PETRIČEVIĆ A., KRALIK G., MALTAR Z., MARGETA V. (2008): Lean Share of Croatian Pigs Assessed By Previous and Current EU Legislation. Proceedings of 54th International Congress on Meat Science and Technology, 10-15 August 2008, Cape Town, South Africa.

KOSOVAC O., ŽIVKOVIĆ B., RADOVIĆ Č. (2007): Prinos mesa u trupovima svinja različitih genotipova. 42. Hrvatski i 2. Međunarodni Simpozij agronoma, 13.-16. Veljače 2007, Opatija, Hrvatska. Zbornik radova, 548-551.

KOSOVAC O., STANIŠIĆ N., ŽIVKOVIĆ B., RADOVIĆ Č., PEJČIĆ S. (2008): Kvalitet trupa i mesa svinja različitih genotipova. Biotechnology in Animal Husbandry, 24, 1-2, 77-86.

KUŠEC G., ĐURKIN I., PETRIČEVIĆ A., KRALIK G., MALTAR Z. (2006): Utjecaj spola na distribuciju tkiva u svinjskim polovicama. Krmiva, 48, 3, 131-142.

KUŠEC G., KRALIK G., PETRIČEVIĆ A., ĐURKIN I., MARGETA V., MALTAR Z. (2006): Comparasion of different methods for lean percentage evaluation in pig carcasses. Acta Agraria Kaposvariensis,10, 2, 57-62.

KUŠEC G., ĐURKIN I., PETRIČEVIĆ A., KRALIK G., MALTAR Z., MARGETA V., HANŽEK D. (2007): Equations for lean share estimation in swine carcasses in Croatia. Agriculture, 13, 1, 70-73.

LUKOVIĆ Z., UREMOVIĆ M., HRABAK V., UREMOVIĆ Z., AMBRUŠEC LJ. (2000): Difference in Predicting Swine Meatiness as a Result of Different Measurements. Agriculturae Conspectus Scientificus, 65, 4, 213-217.

PEDERSEN O.K. (1988): Present conditions and perspekctives of pig carcass evaluation and comercial grading.international meeting on pig carcass and meat quality. Reggio Emilia. Italia.
PETROVIĆ LJ. (2009): Definisanje parametara i kriterijuma za ocenu kvaliteta polutki svinja u cilju izrade predloga pravilnika o kvalitetu zaklanih svinja i kategorizaciji svinjskog mesa. http://www.minpolj.gov.rs/download/izvestaj.pdf
TIMANOVIĆ S**.** (2003): Efekat različitih modela selekcije i šema ukrštanja na prinos i kvalitet mesa svinja. Doktorska disertacija, Poljoprivredni fakultet, Novi Sad.
UKMAR R., DJURKIN I., MALTAR Z., KRALIK G., PETRIČEVIĆ A., KUŠEC G. (2008): Mesnatost i sastav klaonički obradjenih trupova svinja u Hrvatskoj. Meso: prvi hrvatski časopis o mesu, X, 6, 452-458.
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, 22.

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