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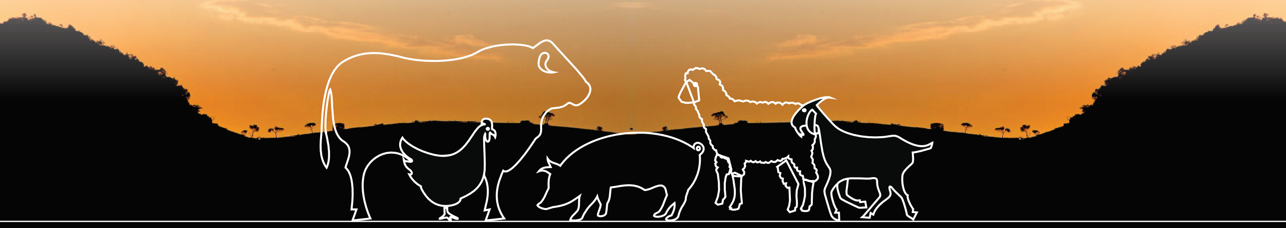

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RELIABILITY OF THE PIGLOG ASSESSMENT OF MEATINESS AND CORRELATION OF CARCASS QUALITY PROPERTIES

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Invited paper

Abstract: The aim of the work was to determine the reliability of measurement using PIGLOG 105 of fat thickness (SL1 and SL2), the depth of *Musculus longissimus* (ML) and to estimate the meatiness in living and slaughtered animals (dissection on the slaughter line according to the Ordinance of R. Serbia). The study was conducted on 170 animals of two genotypes: Swedish Landrace (n = 73) and F_1 crosses SLxLY (n = 97), of both sexes (castrated males n = 79 and females n = 91). The average fat thickness was determined at an average body mass of 109.6 kg using PIGLOG 105 - SL1 = 14.55 mm, SL2 = 12.74 mm, while the thickness of the fat was determined by dissection, and the following values were determined on the same locations: SL1 = 16.42 mm, SL2 = 14.19 mm. Depth of ML established using PIGLOG 105 was 47.59 mm, while the greater depth of ML was obtained by dissection (55.58 mm). Percentage and meat yield determined with PIGLOG 105, dissection and JUS were 55.77%; 57.72% and 49.36 kg and 44.42% and 38.64 kg, respectively. Based on these results obtained, we can see that JUS has significantly lower absolute values for percentage and yield of meat compared to PIGLOG 105 and dissection. It was found that there is a statistically significant difference (P<0.01) between the estimated meatiness values. Correlations between traits measured using PIGLOG 105 and the same values determined on dissected carcass sides are as follows: strong for SL1 (r = 0.724), very strong for SL2 (r = 0.820), and medium for the depth of ML (r = 0.447). The correlation for the percentage of meat is very strong (r = 0.787). There were statistically highly significant (P <0.01) correlations for the meatiness estimated using PIGLOG 105 and dissection.

Keywords: pigs, PigLog 105, lean meat content, carcass quality, correlation

Introduction

Pig breeding/production has a very important role in the production of food of animal origin because pork is of great importance both for human consumption and for processing into products of higher level of processing (*Radović et al., 2011; 2013a*). Demand for pork is constantly growing, because of the total requirements for animal proteins in the human diet over 50% is covered by this kind of meat. The first standards for assessing the quality of pig carcasses/carcass sides were defined at the end of the sixties, and before the end of the nineties, in most EU countries, meatiness/lean meat content evaluation was based on measurements of back fat thickness. The basis for such a valuation method is a high correlation (r = 0.75) between the thickness of backfat and lean meat content in carcasses/carcass sides. In recent years, a significant part of scientific research is focused on finding the optimal solution for fast and reliable quality assessment of pig carcasses *in vivo* and *in vitro*. Individual quantitative traits of pigs are unequally inherited, which means that the possibilities for their improvement by selection and breeding are different. Heritability coefficients for fattening and carcass quality traits are moderate to high (*Knapp et al., 1997; Radović et al., 2003*). Improved selection for the content of meat has caused significant reduction of subcutaneous fat, perhaps even more of intramuscular fat content (*Bahelka et al., 2007*). Payment to pig producers based on meat yield would motivate the producers of fattening pigs, i.e. enables them to realize a significantly higher price for pigs produced, adequate compensation for quality selection/breeding, choice of food, optimal finalization of fattening ... (*Okanović et al., 2008*). Based on the above said, we can perceive the importance and great responsibility of selection in assessing the breeding value, and permanent positive impact on the changes in the herd and thus increased production.

Bearing in mind the above mentioned, the aim of this study was to determine the accuracy of measurements of back fat thickness and precision of *in vivo* evaluation of meatiness/lean meat content and to emphasize the necessity of amendments to the *Regulation on quality of slaughtered pigs and pork categorization (OJ SFRY, 1985).*

Material and methods

In order to determine the reliability of measurement using PIGLOG 105, fat thickness (SL1 and SL2) and the depth of *Musculus longissimus* (ML) were measured on live and slaughtered animals. The study was conducted on 170 animals of two genotypes: Swedish Landrace (n = 73) and F_1 crosses SLxLY (n = 97), of both sexes (castrated males n = 79 and females n = 91). The measuring of the thickness of the fat in the loin section (SL1) was performed using ultrasound apparatus (PIGLOG 105), between the 3rd and 4th lumbar vertebra (measured from the last lumbar vertebra), 7 cm lateral to the back line. The second measurement of back fat thickness in the lumbar part (SL2) and depth of ML was taken between the 3rd and 4th rib from the back, 7 cm lateral to the back line.

Places for measuring of fat thickness and ML depth were previously marked by tattooing on live animals. After chilling of carcass sides, fat thickness was measured (SL1 and SL2) and ML depth in order to determine the correlation between measures taken on live animals and carcass sides. The back fat thickness and depth ML were measured on animals of live mass from 90 kg to 120 kg. In order to determine the reliability of estimates of lean meat content using PIGLOG 105, 170 animals were dissected according to the method of *Weniger et al. (1963).* Slaughtering of pigs and dissection were performed in the experimental slaughterhouse of the Institute for Animal Husbandry, Belgrade. To determine the yield (kg) and the share of meat (%) in the carcass sides (JUS), on the basis of measurements of warm carcass sides and the sum of the thickness of fat on the back (back fat in the middle of the back and the second measure of back fat thickness in the area where *m. gluteus medius* grows into adipose tissue) tables for meaty pigs are used, which are an integral part of the *Regulation (1985).*

The measurements were made on the slaughter line and a third at the beginning of said muscle - cranial).

Genetic correlation (r_G) were calculated by using the formula:

$$r_G = \frac{Cov}{\sqrt{\sigma^2{}_{IZ} * \sigma^2{}_{UN}}}$$

where:
rg = genetic correlations
$\sigma^2{}_{IZ}$ = variance between groups (sires)
$\sigma^2{}_{UN}$ = variance within groups (sires)
Cov = covariance

The strength of the correlation between the properties is defined by Roemer-Orphalov scale of classification (quote - *Latinović, 1996*). Testing of zero hypothesis that there is no correlation between the two properties at the population level, was carried out based on the tables of critical values of *t* distribution for the level of significance of 5 and 1 % and degree of freedom n-2 (*Snidikor and Cochran, 1971*).

Results and Discussion

Table 1 shows the average values and the variability of indicators of meatiness/lean meat content obtained when processing data using PIGLOG 105, dissection and JUS. The average body mass of the examined pigs was 109.6 kg, while the mass of warm carcass side was 87.69 kg. The average fat thickness determined by PIGLOG 105 was SL1 = 14.55 mm, SL2 = 12.74 mm, while the thickness of the fat determined by dissection on the same places was SL1 = 16.42 mm, SL2 = 14.19 mm. Depth of ML established by PIGLOG 105 is 47.59 mm, while the depth of ML determined by dissection was greater (55.58 mm). Share and yield of meat determined using the PIGLOG 105, dissection and JUS was 55.77%; 57.72% and 49.36 kg, and 44.42% and 38.64 kg, respectively. Based on these results, we see that according to JUS, absolute values were significantly lower for share and yield of meat in relation to PIGLOG 105 and dissection. Results in Table 1 show significant absolute differences in carcass quality traits determined by PIGLOG 105, dissection and according to the applicable *Regulation (1985).* Based on the average values obtained using PIGLOG 105 and dissection for SL1 = 14.55 and 16.42 mm, SL2 = 12.74 and 14.19 mm, respectively, ML = 47.59 mm and 55.58 mm, and the percentage of meat = 55.77% and 57.72%, identified differences were highly statistically significant ($P<0.01$). The established values for fat thickness by ultrasound device Piglog 105 in our study were in absolute vale significantly higher (SL1 and SL2 14.55 mm 12.74 mm in relation to research by *Gogić et al. (2013)* for the same genotypes (SL1 and SL2 12.98 mm 27.11 mm), while for the depth and the estimated lean meat content lower values were established (47.59 mm 50.72 mm and 55.7% : 58.8%, respectively). Also higher estimated lean meat content in relation to our result for the four genotypes was determined in research of *Tyra et al. (2006).* These authors found similar estimation of the lean meat content by Piglog 105 and Aloka SSD 500 (57.1% and 57.7%) and slightly higher value by dissection of 60.6%. Approximately similar value of estimated meatiness/lean meat content by PIGLOG 105 was determined in the study of *Tyra et al. (2011)* according to the genotypes Large White (55.8%) and Landrace (56.1%) which were also subject of our study (55.77%), while the estimated lean meat content by partial dissection was higher than in our study for the mentioned genotypes (0.9% and 1.0%).

Table 1. Average values and variability of indicators of meatiness/lean meat content

Properties	$\overline{\mathbf{X}}$	SD	CV
Body mass, kg	109.60	10.57	9.64
Mass of warm carcass sides (both), kg	87.69	8.97	10.23
PIGLOG 105			
SL1, mm	14.55	2.45	16.84
SL2, mm	12.74	2.32	18.21
ML, mm	47.59	5.16	10.84
Meat share, %	55.77	2.34	4.19
DISSECTION			
SL1, mm	16.42	3.95	24.06
SL2, mm	14.19	3.56	25.09
ML, mm	55.58	6.13	11.03
Meat share, %	57.72	2.89	5.01
Meat, kg	49.36	4.38	8.87
JUS			
Back fat – loin, mm	16.10	3.34	20.74
Back fat – back, mm	17.58	2.82	16.04
Meat share, %	44.42	2.78	6.25
Meat, kg	38.64	3.76	9.73

Table 2 shows the significance of differences for meat percentage (%) and meat yield (kg) tested by t-test between PIGLOG 105 and JUS, dissection and PIGLOG 105 as well as dissection and JUS. On the basis of these results statistically significant difference (P<0.01) between the estimated meatiness values was determined. Significant differences in the estimated meatiness/lean meat content between JUS and partial dissection (44.23% : 60.69%) was found in the study of *Radovic et al. (2012).* In an identical experiment *Radovic et al. (2013b)* have found significantly higher values for fat thickness SL1 and SL2 and lower values for the depth of the ML and the leanness estimated using PIGLOG, dissection and JUS method compared to the repeated research.

Table 2. The significance of differences in meatiness/lean meat content (%, kg) between PIGLOG 105: JUS, Dissection: PIGLOG 105 and Dissection: JUS

Properties	PIGLOG 105	JUS	t-test
	$\bar{x}$	$\bar{x}$	
Meat share, %	55.77	44.42	**
Properties	DISEKCIJA	PIGLOG 105	t-test
	$\bar{x}$	$\bar{x}$	
Meat share, %	57.72	55.77	**
Properties	DISEKCIJA	JUS	t-test
	$\bar{x}$	$\bar{x}$	
Meat share, %	57.72	44.42	**
Meat, kg	49.36	38.64	**

** ⇨ P<0.01; * ⇨ P<0.05; NS ⇨ P>0.05;

Table 3 shows the degree of dependence between PIGLOG 105, dissection and JUS for meatiness/lean meat content indicators. By examining the correlations between traits measured using PIGLOG 105 and the same traits determined by dissection, it can be seen that the correlation for SL1 was strong (r = 0.724), for SL2 very strong (r = 0.820), and medium for the depth of ML (r = 0.447). The correlation between the percentage of meat is very strong (r = 0.787). Very strong correlation between SL1 and SL2 (r = 0.812) was found in measurements of these properties obtained by dissection compared with the same properties that were measured using PIGLOG 105, where the correlation was somewhat weaker (r = 0.708). When it comes to genetic correlations between body fat i.e. fat thickness and meatiness/lean meat content, in the research of *Sonesson et al. (1998)* a strong negative correlation (r_G = -0.77) between fat thickness and meatiness/lean meat content was established. The study by *van Wijk et al. (2005)* reveales the absolute negative genetic correlation between fat thickness and share of meat (r_G=-0,98) obtained using the assessment with Hennessy grading probe. The results of our study confirmed the results of *Groeneveld et al. (1998)*, who identified a genetic correlation of 0.60 to 0.82% for meat measured using PIGLOG 105 and dissection. Based on the tested level of significance according to *Snedecor and Cochrann (1971)* and given values it can be seen that all of these correlations were statistically highly significant (P<0.01). On the basis of these results we can see that the stronger correlation is determined for SL2 in comparison with SL1. Also, it can be seen that the correlation between PIGLOG-105 and dissection for meatiness/lean meat content is stronger, compared to the same trait between dissection and JUS.

Table 3. Correlation between Piglog 105, dissection and JUS indicators for meatiness/lean meat content

Properties	PIGLOG 105				DISSECTION					JUS	
	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	Meatiness/lean meat content, kg (13)
B. mass - live (1)	0.479**	0.436**	0.237**	-0.471**	0.469**	0.418**	0.167*	-0.249**	0.772**	-0.419**	0.802**
Mass of cooled carcass sides - both(2)	0.502**	0.446**	0.298**v	-0.474**	0.517**	0.470**	0.190**	-0.272**	0.800**	-0.438**	0.791**
PIGLOG 105											
SL1 (3)		0.708**	0.031ns	-0.882**	0.724**	0.743**	-0.128ns	-0.661**	0.069ns	-0.584**	0.141*
SL2 (4)			-0.153*	-0.935**	0.754**	0.820**	-0.256**	-0.760**	-0.046ns	-0.577**	0.125ns
ML (5)				0.204**	0.046ns	-0.070ns	0.447**	0.214**	0.422**	-0.056ns	0.268**
Mesnatost, % (6)					-0.778**	-0.841**	0.270**	0.787**	0.035ns	0.605**	-0.129ns
DISSECTION											
SL1 (7)						0.812**	-0.197**	-0.768**	0.020ns	-0.677**	0.108ms
SL2 (8)							-0.284**	-0.772**	-0.035ns	-0.628**	0.074 ms
ML (9)								0.502**	0.495**	0.108ns	0.266**
Meatiness, % (10)									0.352**	0.590**	0.079ns
Meatiness, kg(11)										-0.055ns	0.819**
JUS											
Meatiness, % (12)											0.148*

Conclusion

It can be concluded that the PIGLOG 105 established the backfat thickness, depth ML and the percentage of meat in live animals with a lower degree of accuracy in relation to the dissection of animals. It should be noted that the accuracy of measurements of back fat thickness and ML depth by ultrasound was affected by the following factors: body mass at the end of the test, the number of the fascia on the back fat, the movements of the animals during the measurement, the probe of the apparatus (size and frequency at which the probe runs) mistakes made by ultrasonic apparatus in measurements, as well as systematic errors made by the operators themselves in measurements. Also, it can be concluded that JUS with a lesser degree of reliability assesses meatiness/lean meat content of carcass sides compared to PIGLOG 105. All this confirms the fact that the Yugoslav standard for fattening pigs for industrial processing JUS E.CL.021 adopted in 1969 and modified in 1985 does not give a sufficiently accurate estimation of meatiness/lean meat content at the slaughter line. From the above, we conclude that it is necessary to edit the old or adopt the new Regulation for the estimation of meatiness at the slaughter line, as soon as possible.

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Pouzdanost procene mesnatosti piglog-om i povezanost osobina kvaliteta trupa

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Rezime

Cilj rad je bio da se utvrdi pouzdanosti merenja PIGLOG-om 105 debljine slanine (SL1 i SL2), dubine *Musculus longissimus-a* (ML-a) i procene mesnatosti na živim i zaklanim grlima (disekcijom i na liniji klanja pomoću važećeg Pravilnika R. Srbije). Istraživanje je sprovedeno na 170 grla dva genotipa švedski landras (n=73) i F_1meleza ŠLxVJ (n=97), oba pola (muška kastrirana grla n = 79 i ženska grla n = 91). Pri prosečnoj telesnoj masi od 109.6 kg utvrđena je prosečne

debljine slanine PIGLOG-om 105 iznose SL1=14.55 mm, SL2=12.74 mm, dok je debljina slanine utvrđena disekcijom na istim mestima bila SL1=16.42 mm, SL2=14.19 mm. Dubina ML-a utvrđena PIGLOG-om 105 je 47.59 mm, dok je utvrđena veća dubina ML-a disekcijom (55.58 mm). Procenat i prinos mesa utvrđen PIGLOG-om 105, disekcijom i JUS-om bio je: 55.77%; 57.72% odnosno 49.36 kg i 44.42 % odnosno 38.64 kg. Na osnovu navedenih rezultata vidimo da JUS ima apsolutne vrednosti znatno manje za udeo i prinos mesa u odnosu na PIGLOG 105 i disekciju. Utvrđeno je da postoji statistički visoko značajna razlika ($P<0.01$) između procenjenih mesnatosti. Povezanost između osobina merenih PIGLOG-om 105 i istih utvrđivanih na polutkama disekcijom vidi se da je korelacija za SL1 jaka ($r=0.724$), za SL2 vrlo jaka ($r=0.820$), dok je za dubinu ML-a srednja ($r=0.447$). Korelacija za procenat mesa je vrlo jaka ($r=0.787$). Između procenjene mesnatosti pomoću PIGLOG-a 105 i disekcijom korelacije su bile statistički visoko značajne ($P<0.01$).

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