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Verification of lean meat percentage estimation formulae for pig carcass classification in Croatia

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The study was performed on 136 pig carcasses representing the Croatian pig population with regards to the breed structure. The carcasses were dissected according to the EU reference method and lean meat percentage was estimated using the Hennessy Grading Probe (HGP7) device and the "Two points" (ZP) method. Comparison of lean meat percentage obtained by dissection and two prediction methods showed significant differences in estimating the lean meat percentage of pig carcasses ($P < 0.05$). The distribution of carcasses according to SEUROP system showed a difference in the classification depending on the applied method, indicating a need for adjustment of current formulae for lean meat percentage estimation in Croatia.

Keywords: pig, carcass, lean meat percentage, dissection, EU reference method

1 Introduction

The lean meat percentage (LMP) is used as the primary classification variable for the quality of pig carcasses in the European Union (Gangsei et al., 2016). At the slaughter line, LMP is estimated using different devices, usually based on optical or ultrasound measurements of the fat layer and loin muscle depth. Additionally, in small slaughterhouses, the "Zwei-Punkte-Messverfahren" (two points, ZP) method, based on the manual measurements of backfat thickness and muscle depth (Sack, 1983), is widely used in EU countries. The data obtained either by different devices or by ZP method, however, do not represent a direct measurement of LMP but are used as predictor variables in equations derived from the results of dissection trial performed by one or a combination of the dissection methods recommended by European Commission (Regulation (EU) No. 1308/2013; Commission delegated regulation (EU) 2017/1182). According to these regulations, for the construction of sufficiently precise equations to be used with the estimation methods, the dissection trial should include at least 120 pig carcasses. Due to the change of leanness in pig population, and to correctly classify the pig carcasses, the equations to estimate LMP should be regularly updated.

The first regulation on pig carcass quality applying the methods for pig carcass classification into market classes (SEUROP) at the slaughter line according to LMP and compatible to EU model has been adopted in Croatia in 1995. From that time, two dissection trials were performed to update the formulae for LMP estimation at the slaughter line (Kušec et al., 2007, Kušec et al., 2009, Kušec et al., 2011), the last one being conducted in 2011. Consequently, there is a requirement to investigate whether there was a change in the LMP of Croatian pig population and a need for recalibration of current formulae for online LMP estimation. Therefore, the aim of the present paper was to compare the LMP in the carcasses of Croatian pig population determined by EU reference dissection method

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(Walstra and Merkus, 1996) with LMP estimation methods that are currently used in Croatian slaughterhouses.

2 Material and methods

A total of 136 carcasses (sex ratio approximately 50%:50%) representing the Croatian pig population regarding the breed structure (i.e. Pig Improvement Company, 50.39%; Topigs, 30.36%; other breeds, 9.31%) as recommended by Causeur et al. (2003) were used in the study. Weight range of selected pig carcasses was set to 60-120 kg. Presentation of the carcass was in concordance with the Croatian Regulation as conforming the Commission Delegated Regulation (EU) 2017/1182.

Currently, two LMP estimation methods are approved in Croatian slaughterhouses: Hennessy Grading Probe (HGP7) device and manual ZP method (Croatian regulation NN 71/2018). When using HGP7 device, the fat thickness was measured 7 cm off the split line on the outside and 4 cm off the split line on the inside between the second and third last ribs. In ZP method, measures of the backfat thickness (BT) is defined as the minimum thickness of subcutaneous fat (with skin) at the split of the carcass, above *M. Gluteus medius*, whilst muscle thickness (MT) is defined as the shortest connection between the cranial end of the lumbar muscle and dorsal edge of the vertebral canal. According to Regulation (EU) No.1308/ 2013, carcasses were classified into groups based on the following criteria: S if LMP ≥ 60%; E if 55% ≤ LMP < 60%; U if 50% ≤ LMP < 55%; R if 45% ≤ LMP < 50%; O if 40% ≤ LMP < 45%; and P if LMP < 40%.

One day after the slaughter, left sides of carcasses were dissected according to EU reference method (Walstra and Merkus, 1996) and LMP was calculated using the following formula:

$$LMP_{ref} = 0.9448 \text{ x } 100 \frac{\text{weight of tenderloin+ weight of lean (fascia included) in the shoulder,loin,ham and belly}}{\text{weight of tenderloin+weight of dissected cuts}}$$

Lean meat percentage was also estimated by ZP method and the HGP7 device currently approved in Croatia according to the following formulae:

$$LMP_{ZP} = 67.93148 - \left(43.07594 \text{ x} \frac{\text{S}}{\text{M}}\right) + \left(1.6567\ x\ \sqrt{M}\right) - (49.45989\ x\ logS) + (10.99155\ x\ \sqrt{S})$$

$$LMP_{HGP7} = 59.603676 - 0.864 \text{ x S} + 0.192 \text{ x M}$$

Statistical analysis was performed using Kruskal-Wallis test, followed by Mann-Whitney U test as a *post hoc* test for comparison of methods using the nonparametric procedure of Statistica v. 13 programme package (TIBCO Software Inc., 2018).

3 Results and discussion

Measurements of warm carcass weight, backfat and muscle thickness obtained using the HGP7 device and ZP method are presented in Table 1. The average weight of warm pig carcasses was 91.86 kg. Backfat thickness measured by HGP7 device was 12.84 mm, while muscle thickness was 62.78 mm. Using the ZP method, backfat and muscle thicknesses were somewhat higher than the same measures using the HGP7 device (15.97 mm and 73.65 mm, respectively).

Table 1 Measures of warm carcass weight, backfat and muscle thickness obtained using two different LMP estimation methods

Statistics	Warm carcass weight, kg	HGP7 device		ZP manual method	
		Backfat thickness, mm	Muscle thickness, mm	Backfat thickness, mm	Muscle thickness, mm
Mean	91.86	12.84	62.78	15.97	73.65
Minimum	65.40	6.60	35.40	4.00	57.00
Maximum	119.00	25.30	85.00	31.00	89.00
SEM	0.51	0.29	0.64	0.40	0.52
Standard deviation	5.91	3.33	7.41	4.71	6.40

SEM – standard error of the mean

Differences in LMP predicted by the two equations prescribed by Croatian regulations and EU dissection method are presented in Table 2. A significant difference between the three equations used can be observed. The highest LMP was predicted by the formula used for HGP7 device (60.56%) while the lowest was assessed by the equation for ZP method (57.66%). The LMP objectively determined by EU reference dissection method was 58.98%, being intermediate between LMP estimated with the other two methods. Compared to the results of the dissection trial performed in 2011, a slight increase of the LMP objectively determined by EU reference method has been observed (58.98% vs 57.17%; Kušec et al., 2011), showing a change in Croatian pig population which led to an overestimation of LMP using the HGP7 method and an underestimation using the ZP method.

Table 2 Lean meat percentage estimation of investigated pig carcasses using three different methods

Statistics	HGP7 method, %	ZP method, %	EU reference dissection, %
Mean	60.56 [a]	57.66 [c]	58.98 [b]
Minimum	50.07	51.55	46.42
Maximum	68.15	72.80	69.47
SEM	0.24	0.29	0.33
Standard deviation	2.81	3.38	3.85

Mean values with different letters differ significantly ($P < 0.05$).

SEM - standard error of the mean.

Classification of pig carcasses according to their LMP are presented in Figure 1. It can be noticed that there were differences in classification of the same carcasses depending on the applied formula. Surprisingly, the method for HGP7 device has classified 60% of the pig carcasses into the highest category ("S"), thus obviously overestimating the LMP of Croatian pig population. The EU reference method and the ZP method classified 34% and 21% of the carcasses into the "S" category, respectively. Interestingly, only EU reference dissection formula classified 2% of carcasses into the "R" category. Regardless the method used, none of the pig carcasses was classified into the "O" and "P" categories, which represent carcasses with the lowest LMP.

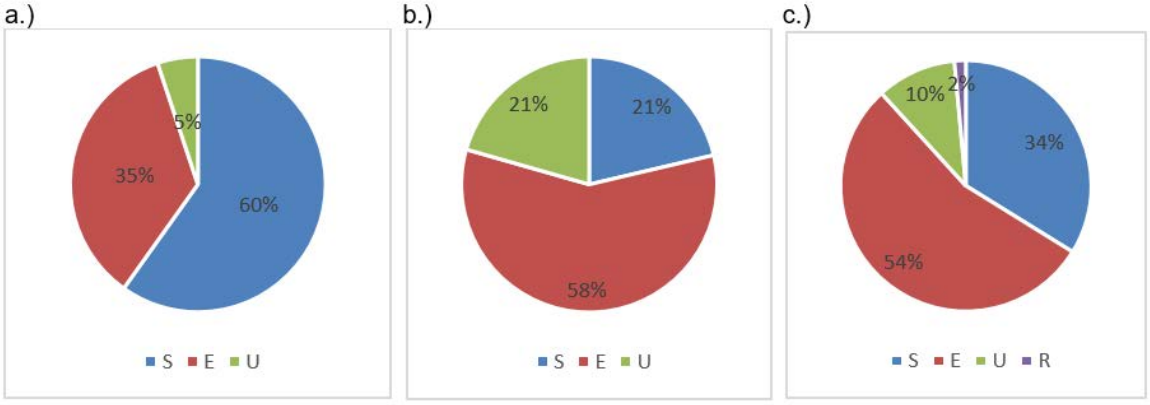

Figure 1 Distribution of the pig carcasses according to SEUROP classification (a. HGP7 method; b. ZP method; c. EU reference dissection method)

4 Conclusions

The use of national ZP and HGP7 formulae as well as the EU reference formula to estimate the LMP of pig carcasses showed discrepancies between resulting LMP in the Croatian pig population. HGP7 estimation method overestimates, whilst ZP method underestimates LMP of pig carcasses and consequently incorrectly classify the carcasses into the SEUROP categories. Therefore, there is a need to adjust the coefficients in formulae for LMP assessment at slaughter line in Croatia.

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