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PIG CARCASS CLASSIFICATION IN SLOVAKIA – NEW FORMULAS FOR TWO POINT METHOD AND MEASURING INSTRUMENTS[1]

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Abstract: The objective of this study was to construct new regression formulas for optical (Fat-O-Meater), ultrasound (Ultrafom) equipment and two-point method (TP) in pig carcass classification in Slovak Republic. Dissections of four main cuts (shoulder, loin, ham, belly) of pig carcasses (n = 123) were performed. The measurements of backfat and muscle depths using probes and/or hand ruler (TP) were taken from the carcasses 45 min post mortem. Lean meat content estimated using different methods and determined from dissections was equal (55.54 %). There were calculated new regression formulas using the multiplied regression analysis. The suitability of new formula for FOM equipment was verified on 75 895 pigs under working conditions of slaughterhouse. Lean meat contents estimated using original and new formula were 54.75 and 55.40 %. There was higher proportion of pigs in the class E using new formula (57.6 %) comparing to original formula (41.1 %). On the other hand, the proportion of pigs in the classes S, U and R was lower using new formula (15.8, 21.3 and 3.3 %) than that of original (18.5, 31.3 and 6.9 %).

Key words: pig carcass classification, regression formulas, classification methods

Introduction

The estimation of lean mean content in pig carcasses by means of S-EUROP system and following fair payment based on the weight and composition of the carcass pigs is the main objective of classification. Using this system leads to progressive increasing of lean meat content (*Kovač a Malovrh, 1998, Pulkrábek et al., 1999*). Correct regression formulas for classification equipments and/or two-point method have a big importance (*Pulkrábek et al., 2000; Demo et al., 2001; Daumas, 2003; Bahelka et al., 2004*). The requirements on accuracy of regression formulas are laid out in the Commission regulation N° 3127/94 and means of dissection according to the method by *Walstra* and *Merkus (1996)*. Regression formula for optical and ultrasound equipments and/or two point method was used in Slovakia almost ten years. For this reason the new formulas have constructed.

Material and Methods

Dissection of four main cuts (shoulder, loin, ham, belly) of pig carcasses (n = 123) by method of *Walstra* and *Merkus (1996)* was done.The measurements of backfat thickness and muscle depth using optical (Fat-O-Meater), ultrasound (Ultrafom) probes and hand ruler (Two-point method - TP) were taken 45 min after slaughter of pigs. Composition of experimental pigs according to the hybrid combination, sex, backfat thickness and half carcass weight is shown in Table 1, 2 and 3.

Table 1. Composition of experimental pigs according to breeding combination and sex

Hybrid combination	Gilts	Barrows	Total
(LW x L) x Y	24	25	49
(LW x L) x (Y x P)	20	20	40
(LW x L) x (H x P)	12	12	24
(L x D) x Y	5	5	10
Total	61	62	123

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Table 2. Splitting of experimental pigs according to backfat thickness

Backfat thickness between 2nd and 3rd last rib (mm)	Gilts	Barrows	Total
<16	17	6	23
17 – 22	26	17	43
23 – 28	11	25	36
>28	7	14	21
Total	61	62	123

Table 3. Splitting of experimental pigs according to half carcass weight

Half carcass weight (kg)	Gilts	Barrows	Total
<40	7	9	16
40,1 – 45,0	25	21	46
45,1 – 50,0	21	23	44
>50	8	9	17
Total	61	62	123

Following carcass traits were evaluated:

- carcass weight, (kg)
- backfat thickness measured by means of probe (FOM, Ultrafom) between 2/3 last rib, 70 mm laterally from the middle line, (mm)
- muscle depth at the same point measured by means of probe (FOM, Ultrafom), (mm)
- backfat thickness with skin measured above middle of *musculus gluteus medius*, (mm) – TP
- muscle depth between cranial top of *musculus gluteus medius* and dorsal edge of spinal chord canal, (mm) – TP.

After 24 hours of chilling the dissection of left carcass side and calculation of lean meat content using method of *Walstra* and *Merkus (1996)* was performed. There was used multiplied linear regression *(SAS, 1999-2000).* Accuracy of new regression formulas must comply *EÚ Regulation (ECC 3127/94).* Standard deviation (sd) may not exceed 2.5 % and coefficient of determination (R^2) has to be higher than 0.64. Verification of new formula for FOM equipment was done using data from given slaughterhouse (n = 75,895) for eight months 2004 . Pigs with carcass weight from 60 to 110 kg were taken into account. The carcasses were classified by FOM equipment with original formula. On the base of measured backfat thickness and muscle depth the lean meat content was calculated using new regression formula and compared to lean meat content estimated by original formula.

The lean meat content and proportion of pig carcasses in the classes of EUROP system were calculated.

Results and Discussion

Tendency of pig carcass classification in Slovak Republic in 1999 – 2003 is documented in Table 4. Average carcass weight in those years was 87.4 – 89.9 kg. Lean meat content estimated using measuring equipments was increasing from 50.9 % in 1999 to 53.1 % in 2003. Proportion of pig carcasses in the classes S, E and U has increased since 1999. *Pulkrábek et al. (2003)* stated higher lean meat content (54.36 %) at processing conditions of Czech Republic. *Kovač and Malovrh (1998)* evaluated meat performance of pigs in Slovenia in 1996-1998. They determined increasing lean meat content from 51.94 % in 1996 to 52.51 % in 1998.

Table 4. Results of pig carcass classification using measuring equipments in Slovakia

Trait	1999		2000		2001		2002		2003	
	x	s	x	s	x	s	x	s	x	s
Carcass weight (kg)	89.9	4.91	88.0	4.80	87.4	4.91	89.3	4.96	88.4	4.86
Lean meat content (%)	50.9		51.8		51.6		52.4		53.1	
Number of classified pigs	196,815		151,717		162,215		178,854		195,386	
S	3.87		4.62		4.28		5.34		6.13	
E	10.26		13.22		14.56		15.11		16.42	
U	36.12		37.81		38.92		39.27		39.75	
R	33.97		38.37		35.55		35.22		33.23	
O	17.63		5.06		5.81		4.15		3.61	
P	1.15		0.92		0.88		0.91		0.86	

Table 5. Basic variation-statistical parameters of evaluated traits

Trait	$\bar{x}$	min.	max.	s
Half carcass weight (kg)	45.42	36.62	54.72	4.21
Lean meat content – dissection (%)	55.54	44.74	64.60	4.68
Lean meat content – FOM (%)	55.54	44.60	62.95	4.06
Lean meat content – Ultrafom (%)	55.54	43.87	62.33	3.91
Lean meat content – TP (%)	55.54	42.80	60.56	3.70

Basic statistics of traits in experiment are given in Table 5. Lean meat content determined by dissection and estimated using new formulas was the same (55.54 %). New formulas for optical and ultrasound equipment and/or two-point method are following:

a) for optical probe:

$$Y = 60.6813 – (0.7186 \times F_{FOM}) + (0.1155 \times M_{fom})$$

where Y – estimated lean meat content (%),

F_{fom} – backfat thickness in given point of measurement (mm),

M_{FOM} – muscle depth in the same point as F_{FOM}

Coefficient of determination $R^2 = 0.7488$ and standard deviation sd = 2.3376 were calculated.

b) for ultrasound probe:

$$Y = 61.2145 – (0.7846 \times F_{ULTRA}) + (0.1361 \times M_{ULTRA})$$

where Y, F_{ULTRA} and M_{ULTRA} are the same as in previous point

Coefficient of determination $R^2 = 0.7441$ and sd = 2.3125 were calculated.\

c) for TP method:

$$Y = 62.3108 – (0.7856 \times F) + (0.0478 \times M) – (0.0431 \times M/F) + (0.8445 \times \sqrt{F})$$

where Y – estimated lean meat content (%)

F, M – backfat thickness and muscle depth measured in loin area (mm)

Coefficient of determination R^2 was 0.7817 and sd = 2.2861.

Table 6. Correlations between observed traits

Trait	2.	3.	4.	5.	6.
1. backfat thickness, 2/3 last rib	-0.10	-0.84	-0.97	-0.96	-0.86
2. muscle depth, 2/3 last rib	-	0.30	0.35	0.30	0.20
3. lean meat content – dissection		-	0.87	0.86	0.92
4. lean meat content - FOM			-	0.83	0.87
5. lean meat content – Ultrafom				-	0.85
6. lean meat content - TP					-

Correlations between backfat thickness and lean meat content determined by dissection or estimated using equipments and TP method were statistically significant and negative (r = -0.84 to -0.97) and higher than those between muscle depth and lean meat contents described above (0.20 – 0.35). These results agree with data of *Pulkrábek et al. (2004).* Correlations between lean meat content determined by dissection and estimated lean meat contents were positive and statistically significant (r = 0.86 – 0.92).

The results of estimation of lean meat content in pigs under condition of slaughterhouse using Fat-O-Meater equipment with original and new regression formula respectively are given in Table 7. Slaughter pigs reached average slaughter weight 109 kg. Lean meat content estimated using new formula was slightly higher than that using original formula (55.40 and 54.75 %). *Pulkrábek et al. (2003)* found similar lean meat content under processing conditions of Czech Republic (54.36 %). *Dikić et al. (1999)* analysed meat performance of inland and imported pigs in Croatia and determined lean meat content 53.70 and/or 56.23 %.

Table 7. Lean meat content according to original and new formula

Class	New formula – Y_1			Original formula – Y_2			Difference $Y_1 - Y_2$
	n	Slaughter weight (kg)	Lean meat content (%)	n	Slaughter weight (kg)	Lean meat content (%)	
S	12 011	104.17	61.63	14 043	104.43	61.45	+ 0.18
E	43 740	108.71	57.46	31 183	108.73	57.33	+ 0.13
U	16 132	112.27	53.13	23 756	111.04	52.90	+ 0.23
R	2 490	115.87	48.35	5 213	113.38	48.23	+ 0.12
O	242	118.79	43.32	432	116.27	43.49	- 0.17
P	1 280	108.83	38.78	1 268	108.71	38.64	+ 0.14
Total	75 895	109.01	55.40	75 895	109.01	54.75	+ 0.65

Table 8. Pig carcass classification in SEUROP system

Class	New formula – Y_1		Original formula – Y_2		Difference $Y_1 - Y_2$
	n	%	n	%	
S	12 011	15.8	14 043	18.5	- 2.7
E	43 740	57.6	31 183	41.1	+ 16.5
U	16 132	21.3	23 756	31.3	- 10.0
R	2 490	3.3	5 213	6.9	- 3.6
O	242	0.3	432	0.5	- 0.2
P	1 280	1.7	1 268	1.7	0
Total	75 895	100.0	75 895	100.0	

The biggest differences between pigs classified according to new and original formula were in the classes E and U (Table 8). Higher proportion of pigs in the class E and lower in the class U (57.6 and 21.3 %) was found using new formula whereas using original formula that was opposite (57.6 vs 41.1 %, and 21.3 vs 31.3 %). Smaller differences were also found in the classes S and R. *Pulkrábek et al. (2004)* found proportion of pigs in the classes S, E and U 8.6, 36.6 and 41.1 %.

Conclusion

New regression formulas of measuring instruments and two-point method for the classification in Slovak Republic comply to EU legislation. Original regression formula for Fat-O-Meater underevaluetid pigs with lean meat content 55.0 % and more. New formula had higher prediction ability than original and from this reason it is suitable for pig carcass classification in Slovak Republic.

KLASIFIKACIJA TRUPOVA SVINJA U SLOVAČKOJ – NOVE FORMULE ZA METOD DVE TAČKE I NOVE MERNE INSTRUMENTE

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Rezime

Cilj ovog rada je stvaranje novih regresionih formula za optičku (Fat-O-Meater), ultrazvučnu (Ultrafom) opremu i metod "Two-point" (TP) u klasifikaciji svinjskih trupova u Slovačkoj Republici. Disekcija četri glavna dela trupa (plećka, slabina, but, potrbušina) (n = 123) je izvedena. Mere dubine leđne slanine i mišića korišćenjem lenjira i/ili ručnog lenjira (TP) 45 min post mortem su zete sa trupa. Vrednost sadržaja mesa ocenjena korišćenjem dve različite metode i određivana nakon disekcije je bila jednka (55.54 %). Nove formule za merne instrumente i TP metod su izračunate korščenjem multiple regresione nalaize. U poptpunosti su usaglašene sa UE propisima. Pogodnost nove formule za FOM opremu je proverena na 75 895 svinja u radnim uslovima u klanici. Sadržaj mesa utvrđen korišćenjem nove formule je bio 54.75 i 55.40 %, respektivno. Udeo svinja u klasi E je bio veći korščenjem nove formule (57.6 %) u poređenju sa originalnom formulom (41.1 %). Nova formula je imala bolju sposobnost predviđanja nego originalna i zbog toga je pogodna za klasifikaciju trupova svinja u Republici Slovačkoj.

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