THE PREDICTION OF LEAN MEAT CONTENT IN PIG CARCASSES BEFORE EVISCERATION USING THE UFOM-300 APPARATUS

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Abstract

According to the Czech legislation, two authorised methods may be applied for grading pig carcasses with the classification apparatus UFOM 300. These methods were used to evaluate the set of pig carcasses (n=844). Measurements on the carcass were performed both before and after evisceration. The differences between obtained characteristics were not significant when the entire set of carcasses was analysed. Similar results were also observed in the most frequent carcass weight category 80 – 100 kg and in quality grade E. The greatest differences in lean meat content were found in the weight category 100 – 120 kg and in quality grade R characterised by the lean meat content ranging from 45 to 49.9 %.

Key Words: Pig, apparatus UFOM 300, lean meat content, accuracy of measurement.

The grading of pig carcasses based on the SEUROP system has been obligatorily performed in the Czech Republic since the 1st April 2001. The carcasses are graded according to the content of lean meat and carcass weight. The lean meat content is estimated on the basis of the measurements of fat and muscle thickness which are then entered into regression equations. The equations for authorised grading methods have been developed according to the lean meat contents directly determined by detailed carcass dissections (Walstra and Merkus, 1996). Six grading methods are currently authorised in the Czech Republic (EC/2005/1/ES, EC/2006/383/ES). For each of them, a specific regression equation has been derived (Pulkrábek et al., 2004; Vítek et al., 2008). The development of regression equations for lean meat content estimation was described previously (Engel et al., 2003; Engel and Walstra, 1993; Daumas et al., 1998). New methods of the lean meat content estimation in pig carcasses were evaluated by Collewet et al. (2005), Romvári et al. (2006) and Margeta et al. (2007). The results of the pig carcass grading by different methods in the Czech Republic in the period from 2004 to 2007 were analysed by Kvapilík et al. (2009). Carcass measurements are carried out by authorised apparata on specific carcass sites. In some slaughterhouses, skin from the back of the carcass is removed during the carcass dressing process, and grading must be carried out before evisceration (and before skin removal). Only the non-invasive ultrasound apparatus UFOM – 300 can be used in these slaughterhouses (Regulation of MZe No. 194/2004, Regulation of MZe No. 324/2005). The method of application is the same as when the measurement is carried out on eviscerated carcasses.

The objective of the study was to assess the accuracy of measurements with the UFOM – 300 apparatus on pig carcasses before evisceration in comparison to the measurements carried out on the same carcasses, but when standard presentation was used. The UFOM – 300 apparatus is used for pig carcass grading before evisceration in six slaughterhouses and is thus applied for 15.5 % of the pig carcasses graded in the Czech Republic.

Material and Methods

A total of 844 carcasses of pig final hybrids commonly used in the Czech Republic were included in the analysis. Measurements were carried out in the standard conditions of a commercial slaughterhouse. Thickness of fat and muscle was measured by the UFOM – 300 apparatus on the loin, 70 mm off the midline of the carcass between the second and third last rib. As provided in the Commission Decision EC/2005/1/ES, the following regression equation was used: $y = 64.64865 – 0.76656S + 0.06425M$. The measurements were first taken on the carcasses before evisceration ($UFOM_1$) and then on left halves after the process of carcass dressing ($UFOM_2$). Bristles were removed from the skin before measurements. The UFOM – 300 (SFK Technology, Denmark) is a non-invasive ultrasound apparatus. Sound pulses are sent into the carcass and when they meet a significant interface between tissue of varying density, e.g. between fat and muscle, an echo is reflected and captured by the sensors. The time delay between the pulse and the echo is converted to the actual distance. The procedures MEANS and GLM of SAS version 9.1 were used for the statistical analysis.

Results and discussion

In the first step, the entire dataset was analysed (Table 1). The results consist of the measurements of fat and muscle thickness and the calculated lean meat content.

Significant differences (P<0.05) were found between the measurements of fat and muscle thickness. However, an important result is that the lean meat contents determined were similar between both measurements. The results of pig carcass grading with the use of UFOM – 300 before evisceration in the period from 2004 to 2007 were analysed by Kvapilík et al. (2009). The reported fat thickness, muscle thickness and lean meat content were 17.1 mm, 56.2 mm and 56.2 %. Compared to our results, they observed similar lean meat content, higher fat and lower muscle thickness.

Table 1. Basic characteristics and differences of UFOM – 300 measurements on the carcass before and after evisceration

Characteristic	Number of individuals	Fat thickness (mm)		Muscle thickness (mm)		Lean meat content (%)		Carcass weight (kg)	
	n	LSM	SE	LSM	SE	LSM	SE	LSM	SE
$UFOM_1$	844	16.11[a]	0.162	59.72[A]	0.226	56.14	0.130	91.15	0.409
$UFOM_2$		15.55[b]	0.162	56.94[B]	0.226	56.39	0.130		
Difference of means		0.56		2.78		-0.25		-	

$UFOM_1$: UFOM – 300 measurements on the carcass before evisceration
$UFOM_2$: UFOM – 300 measurements on the carcass after evisceration
[a, b] Means within a column with different superscripts significantly differ (P<0.05).
[A, B] Means within a column with different superscripts significantly differ (P<0.01).

Table 2. Basic characteristics and differences of UFOM – 300 measurements on the carcass before and after evisceration in different weight categories

Carcass weight	Number of measure-ments	Method	Fat thickness (mm)		Muscle thickness (mm)		Lean meat content (%)	
	n		LSM	SE	LSM	SE	LSM	SE
60 -69.9 kg	38	$UFOM_1$	11.47	0.380	57.95[A]	1.087	59.58	0.328
		$UFOM_2$	11.12	0.380	50.27[B]	1.087	59.28	0.328
		Difference	0.35		7.68		0.3	
70 – 79.9 kg	117	$UFOM_1$	13.06	0.331	59.38[A]	0.558	58.45	0.269
		$UFOM_2$	12.96	0.331	53.06[B]	0.558	58.12	0.269
		Difference	0.1		6.32		0.33	
80 – 89.9 kg	236	$UFOM_1$	14.60	0.258	60.21[A]	0.403	57.32	0.209
		$UFOM_2$	14.29	0.258	56.51[B]	0.403	57.32	0.209
		Difference	0.31		3.7		0	
90 – 99.9 kg	247	$UFOM_1$	17.19	0.294	60.21 [A]	0.393	55.34	0.239
		$UFOM_2$	16.73	0.294	58.31[B]	0.393	55.57	0.239
		Difference	0.46		1.9		-0.23	
100–109.9 kg	161	$UFOM_1$	18.65 [a]	0.344	59.62	0.534	54.18 [a]	0.286
		$UFOM_2$	17.49[b]	0.344	59.36	0.534	55.05[b]	0.286
		Difference	1.16		0.26		-0.87	
110 –120 kg	45	$UFOM_1$	20.89	0.696	57.27	0.980	52.32	0.576
		$UFOM_2$	19.07	0.696	58.84	0.980	53.81	0.576
		Difference	1.82		-1.57		-1.49	

$UFOM_1$: UFOM – 300 measurements on the carcass before evisceration
$UFOM_2$: UFOM – 300 measurements on the carcass after evisceration
[a, b] Means within a column for a given carcass weight category with different superscripts significantly differ (P<0.05).
[A, B] Means within a column for a given carcass weight category with different superscripts significantly differ (P<0.01).

The differences between obtained values within six carcass weight categories by 10 kg are presented in Table 2. As measured by both methods, the lean meat content was reduced with the increasing carcass weight, which is in agreement with the studies by Pulkrábek (2003) and Vítek et al. (2006). The lean meat contents predicted by both methods were similar in all the carcass weight categories with the exception of the weight interval 100 – 109.0 ($P<0.05$). The measurements of fat thickness also significantly differed ($P<0.05$) in this interval. The greatest differences were observed in muscle thickness with significant differences in the weight categories up to 99.9 kg. Numerically the greatest differences in lean meat content were found in the heaviest pig carcasses (100 – 109.9 and 110 – 120 kg). A positive finding is that the smallest lean content differences were observed in the carcasses falling into the most frequented weight category 80 – 100 kg. The carcasses from this category are also preferred by the processing industry. For instance, 65 % of all pig carcasses fell into this weight category in 2010 (Pulkrábek et al., 2011).

The data were also analysed with respect to SEUROP grades based on the carcass lean meat content (Table 3). The greatest differences in fat and muscle thickness measurements and lean meat content were observed in the carcasses of R grade. On the contrary, the smallest differences in fat thickness and lean meat content were found in the most frequent carcass grade E (58.3 % of all carcasses in the dataset). The difference between predicted lean mean contents in E carcasses was insignificant. This result is important due to the fact that 58 % carcasses of the pigs slaughtered in the entire CR were graded as E (Pulkrábek et al., 2011).

Table 3. Basic characteristics and differences of UFOM – 300 measurements on the carcasses of different grades before and after evisceration

Quality grade Carcass lean meat content	Number of measurements	Method	Fat thickness (mm)		Muscle thickness (mm)		Lean meat content (%)	
	n		LSM	SE	LSM	SE	LSM	SE
S above 60%	99	$UFOM_1$	11.42 ^{A}	0.229	63.03 ^{A}	0.634	59.94 ^{a}	0.180
		$UFOM_2$	10.01 ^{B}	0.229	59.45 ^{B}	0.634	60.80 ^{b}	0.180
		Difference	1.41		3.58		-0.86	
E 55 – 59.9%	492	$UFOM_1$	14.40 ^{A}	0.118	60.88 ^{A}	0.277	57.52	0.095
		$UFOM_2$	13.62 ^{B}	0.188	57.36 ^{B}	0.277	57.89	0.095
		Difference	0.78		3.52		-0.37	
U 50 - 54.9%	187	$UFOM_1$	20.90 ^{A}	0.211	56.63 ^{a}	0.441	52.27 ^{A}	0.174
		$UFOM_2$	19.99 ^{B}	0.211	56.29 ^{b}	0.441	52.94 ^{B}	0.174
		Difference	0.91		0.34		-0.67	
R 45 – 49.9%	66	$UFOM_1$	22.32 ^{A}	0.311	54.89 ^{A}	0.874	51.07 ^{A}	0.269
		$UFOM_2$	25.67 ^{B}	0.311	51.97 ^{B}	0.874	48.31 ^{B}	0.269
		Difference	-3.35		2.95		2.75	

$UFOM_1$: UFOM – 300 measurements on the carcass before evisceration
$UFOM_2$: UFOM – 300 measurements on the carcass after evisceration
$^{a, b}$ Means within a column for a given quality grade with different superscripts significantly differ ($P<0.05$).
$^{A, B}$ Means within a column for a given quality grade with different superscripts significantly differ ($P<0.01$).

Conclusion

The comparison of UFOM – 300 measurements on the carcasses before and after evisceration demonstrated that the differences are insignificant when the entire dataset is analysed. Similar results were also obtained for the carcasses in the most frequent weight category 80 – 100 kg and quality grade E. On the contrary, the greatest differences were observed in the carcasses of the weight categories 100 – 109.9 and 110 – 120 kg as well as in the carcasses graded as R. Further analyses are needed for these categories to confirm the results obtained.

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