PREDICTION OF PIG BELLY COMPOSITION USING THE DATA FROM THE GRADING PROCESS

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Abstract

The objective of this study was to use the data obtained during the process of pig carcass grading to develop prediction equations for the prediction of pig belly composition. Pig carcasses were selected from the population of pigs commercially fattened in the Czech Republic and slaughtered under standard abattoir conditions. A total of 390 carcasses of pigs equally represented by gilts and barrows were used. Within the grading process, lean meat content (x_1), cold carcass weight (x_2), fat and skin thickness in the P_2 point (x_3), and muscle thickness in the P_2 point (x_4) were determined. Twenty-four h *post mortem*, belly joints were dissected and the proportions of different tissues were determined. Particular emphasis was placed on the content of lean meat as well as intermuscular and subcutaneous fat proportions. The average carcass lean meat content and cold carcass weight were 56.86±0.211 % and 90.21±0.551 kg, respectively. The average lean meat content in the belly was 54.37±0.297 %. The following equation was derived to estimate the belly lean meat content (y): $y = -17.49519 + 1.27842\ x_1 - 0.00912\ x_2$ with the accuracy parameters $r = 0.92$ and $s_e = 2.38$. Prediction equations for intermuscular and subcutaneous fat proportions were also developed. Furthermore, similar equations were derived separately for different genders. A higher accuracy of estimates was detected for gilts.

Key Words: Pig; carcass; classification; belly composition; regression equation.

Pig producers consider the quality of carcasses as one of the factors determining the efficiency of pig operations. The knowledge of the lean meat content of carcasses but also of different carcass joints are important for the processing industry. Except for the main carcass joints (ham, loin, shoulder, and neck), the belly is also positively perceived by consumers due to its price and culinary characteristics (Pour and Pourová, 2004). These consumer preferences reflect in the effort of the processing industry to assess the existing variation in the quality of bellies. Based on its composition, the belly can either be further processed or used directly for grilling, and thus the profitability may be increased by as much as 70 % (Tholen *et al.*, 1998).

A growing concern for the pig belly is associated with the increased effort to investigate the methods of its evaluation. This is rather difficult due the compositional attributes of the belly in which individual layers of fat and muscle mingle into each other (Pfeiffer *et al.*, 1993). Under experimental conditions, the sophisticated methods of computer tomography and magnetic resonance imaging (Tholen *et al.*, 2003) as well as VIA methods (Branscheid *et al.*, 1999) have been applied. Detailed anatomical dissections are often used as a direct reference method to determine the contents of different tissues in the belly. However, the dissections are not only extremely laborious and time consuming, but they also cause a considerable damage of the joint associated with the reduction of its value.

After the accession of the Czech Republic to EU, abattoirs are obliged to perform the grading of pig carcasses in accordance with current legislative requirements. It is also possible to use the grading data for the prediction of belly composition.

The objective of this study was to use the data from pig carcass grading to develop equations for the prediction of pig belly composition.

Material and Methods

Pig carcasses were selected for the use in this study at the grading point of abattoirs. The pigs were commercially fattened and supplied to the abattoir by different suppliers. The most frequent hybrid combinations were used. The analysed group consisted of 390 left carcass sides with both gilts and barrows equally represented (195 gilts and 195 barrows).

During the grading process, standard measurements of fat and muscle thickness were performed at the P_2 point, carcass lean meat content and cold carcass weight were determined, and the gender of pigs was recorded for experimental purposes. The P_2 point is located on the carcass side between 2nd and 3rd last ribs 70 mm laterally from the midline section.

Twenty-four h *post mortem*, left sides were cut in accordance with Walstra and Merkus (1996). The belly with bones was then dissected into muscle, intermuscular fat, bones, and subcutaneous fat with skin. The results of dissections were expressed in absolute values (g) and as proportions of different tissues of the belly with bones (%).Regression equations were derived to predict the composition of the belly using the procedures MEANS and REG of SAS (SAS Institute Inc., 2002).

The notation and description of variables used in proposed prediction equations are as follows:
y - Dependent variable
x_1 - Carcass lean meat content (%)
x_2 - Cold carcass weight (kg)
x_3 - Fat with skin thickness in P_2 (mm)
x_4 - Muscle thickness in P_2 (mm)

Equations were derives with as much prediction ability and simplicity as possible and their accuracy was assessed using correlation coefficients (r), coefficients of determination (R^2) and standard error of estimate (s_e).

Results and Discussion

Basic statistics of the data evaluated (n = 390) are presented in Table 1.

The average cold carcass weight and lean meat content were 90.21 ± 0.551 kg and 56.86 ± 0.211 %, respectively. These results are similar to the overall results of the pig carcass grading in the Czech Republic in 2011 (the lean meat content 56.83 % in S and U grades). In contrast, the lean meat contents in barrows and pigs reported by Bahelka *et al.* (2011) were lower (47.21 and 51.41 %, respectively).

First, regression equations were derived to predict the proportions of tissues in the belly with bones in all the carcasses evaluated:

- **Lean meat content in the belly with bones (%):**

$y = – 17.49519 + 1.27842\ x_1 – 0.00912\ x_2$
$r = 0.92 \qquad R^2 = 0.8464 \qquad s_e = 2.38$

- **Proportion of intermuscular fat in the belly with bones (%):**

$y = 59.43583 – 0.79941\ x_1 + 0.04782\ x_2$
$r = 0.81 \qquad R^2 = 0.6486 \qquad s_e = 2.61$

- **Proportion of subcutaneous fat with skin in the belly with bones (%):**

$y = 54.92345 – 0.59477\ x_1 – 0.01356\ x_2$
$r = 0.71 \qquad R^2 = 0.5056 \qquad s_e = 2.42$

- **Proportion of the total fat in the belly with bones (%):**

$y = 108.56673 – 1.36270\ x_1 + 0.09697\ x_3 + 0.08847\ x_4$
$r = 0.93 \qquad R^2 = 0.8587 \qquad s_e = 2.43$

When predicting the tissue composition of the belly, it is evident that the most important predictor variables are carcass lean meat content and carcass weight. It is in agreement with the correlation coefficients between the lean meat contents in the carcass and the belly ranging from r = 0.6 to r = 0.8 as reported by Vališ *et al.* (2005).

As the equations were derived on the basis of the large database of belly dissection results, prediction equations for several composition traits were also proposed separately for gilts and barrows. It is associated with the current discussion on the possibility to fatten both genders separately. This strategy has already been applied in several pig operations. Indeed, gilts had higher lean meat contents in the belly than barrows (Stupka *et al.*, 2004 and others). Therefore, our objective was to increase the prediction ability of the equations derived for different genders.

Prediction equations for gilts:

- **Lean meat content in the belly with bones (%):**

$y = – 17.29086 + 1.26605\ x_1$
$r = 0.93 \qquad R^2 = 0.8612 \qquad s_e = 2.22$

- **Proportion of the total fat in the belly with bones (%):**

$y = 104.58967 – 1.29842\ x_1 + 0.14510\ x_3 + 0.07471\ x_4$
$r = 0.94 \qquad R^2 = 0.8768 \qquad s_e = 2.34$

Prediction equations for barrows:

- **Lean meat content in the belly with bones (%):**

$y = – 15.36721 + 1.24464\ x_1 – 0.01528\ x_2$
$r = 0.88 \qquad R^2 = 0.7678 \qquad s_e = 2.49$

- **Proportion of the total fat in the belly with bones (%):**

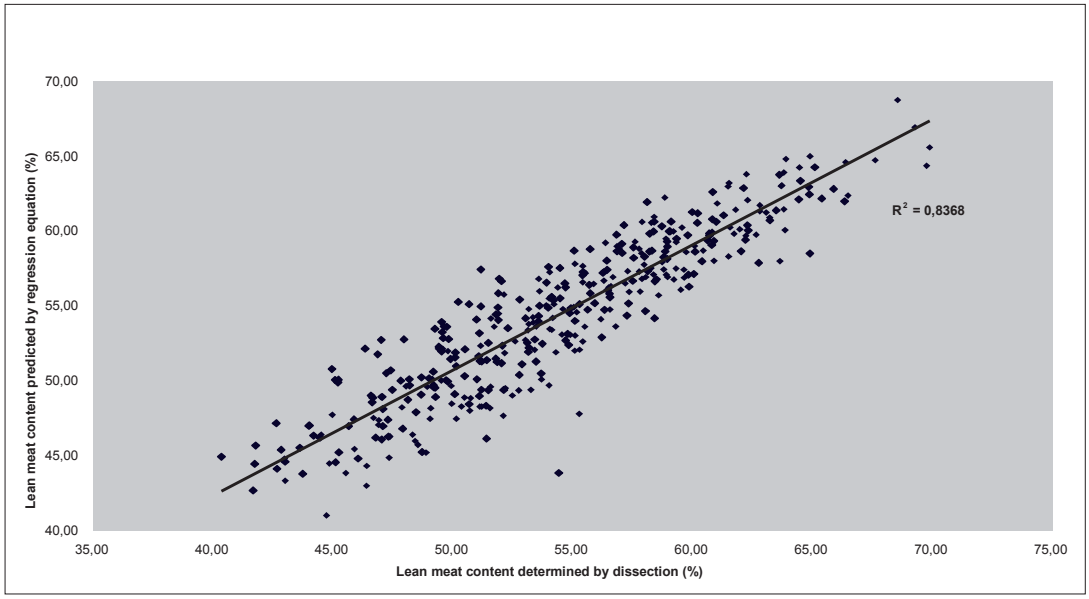
$y = 107.22066 – 1.35265\ x_1 + 0.07979\ x_3 + 0.11176\ x_4$
$r = 0.90 \qquad R^2 = 0.8067 \qquad s_e = 2.50.$

Whereas the accuracy of the prediction equations for gilts was increased compared to the equation for the entire group, the opposite tendency was observed in barrows. The parameters of accuracy (r = 0.8; s_e = 2.5) required for the prediction of the carcass lean meat content were achieved in almost all the proposed equations.

Table 1. Basic statistics of the evaluated data

Trait	$\bar{x} \pm s_{\bar{x}}$
Carcass weight (kg)	90.21 ± 0.551
Lean meat content (%)	56.86 ± 0.211
Belly proportion of carcass weight (%)	9.79 ± 0.047
Proportion of the belly with bones weight (%):	
- muscle	54.37 ± 0.297
- intermuscular fat	18.30 ± 0.222
- subcutaneous fat with skin	19.88 ± 0.174
- bones	7.45 ± 0.053

Figure 1. The relationship between the predicted and real lean meat contents



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