

# TRAITS OF CARCASS VALUE IN DUROC PIG BREED DEPENDING ON SEX

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## Abstract

In pure pig breeds used for creation of final carcass hybrids in the Czech Republic a content of intramuscular fat (responsible for marbling) decreased during the process of selection on high meatiness. Duroc breed is mentioned as less affected by this process. The study evaluated 28 animals of Duroc breed, 14 hogs and 14 gilts and chosen traits were compared between sexes. Animals were slaughtered in average weight 102.1 kg with an average lean meat percentage 57.73 (hogs reached 57.61, gilts 57.84%). An average pH<sub>1</sub> was measured on a level of 6.11 (hogs 6.07, gilts 6.14 with a statistically conclusive difference among sexes,  $p \leq 0.05$ ). pH<sub>24</sub> reached values of 5.80 (hogs 5.74, gilts 5.86 with a statistically conclusive difference among sexes,  $p \leq 0.01$ ). Determined level of intramuscular fat was 1.67% (hogs reached 1.92% of intramuscular fat, gilts 1.42%). Values of pH<sub>1</sub> and pH<sub>24</sub> were on a really good level and showed good meat quality without tendency to some meat defect. Level of lean meat percentage corresponds with other authors. Level of an intramuscular fat content was lower than values mentioned by other authors, but close to an optimal level, so it is possible to confirm good quality of actual population of Duroc pig breed in the Czech Republic and recommend this breed for production of final carcass pig hybrids.

Keywords: pork, meat quality, carcass value, intramuscular fat

## INTRODUCTION

Pig breeding and pork meat production is one of the main pillars of Czech and European agriculture. For its tastiness and nutritional value belongs to the most popular food in a lot of countries. For a pork production it is necessary to create an ideal final carcass hybrid. This hybrid must be created from high quality pure breed pig populations with an excellent efficiency. Pig breeds used in programmes of hybridization already reached required meatiness so higher attention is aimed on qualitative traits of carcass value. Level of some traits of carcass value (as weight of carcass body, back fat thickness, loin eye area) was studied by Bečková *et al.* (1989). Arnoštová *et al.* (2001) studied meat quality in pure pig breeds and Jung-Seok *et al.* (2014) studied meat quality in Duroc and crossbred

pigs. Keller *et al.* (1995) studied an influence of sex on chosen quantitative traits of carcass value. High impact on taste and scent has especially intramuscular fat, which is responsible for marbling of meat. Most of the authors recommend at least 2.5% of intramuscular fat. The level of intramuscular fat content depends on method of determination – 2.5% of intramuscular fat detected by apparatus corresponds to 2.1% of intramuscular fat detected by ether extraction (Holková, Bečková, 1993). Yeong-Seok *et al.* (2016) studied comparison of meat quality of *longissimus* muscles from purebred pigs and three-way crossbred pigs. Glinoubol *et al.* (2015) studied effects of crossbreeding Duroc pigs with Pietrain on carcass and meat quality. Alonso *et al.* (2015) studied how the inclusion of Duroc breed in maternal line affects pork quality and fatty acid profile. Bahelka *et al.* (2007) studied the effect

of sex and slaughter weight on intramuscular fat content and its relationship to carcass traits of pigs. Font-I-Furnols *et al.* (2019) studied intramuscular fat content in different muscles, locations, weights and genotype-sexes. Pietruszka *et al.* (2015) studied relation between intramuscular fat level in the *longissimus* muscle and the quality of pig carcasses and meat. Pöldvere *et al.* (2015) studied effect of imported Duroc on meat quality of finishing pigs in Estonia. Franco *et al.* (2014) studied meat quality of the Celta pig crossbred with Duroc. According to Bečková (1998) most of pure pig breeds do not reach an optimal level of intramuscular fat content.

## MATERIALS AND METHODS

The study was aimed on pure sire pig breed Duroc, which is used for production of hybrid pigs in the Czech Republic. Together 28 animals were evaluated – 14 hogs and 14 gilts. The animals were slaughtered in slaughter weight 100–104 kg. These traits of carcass value were studied after slaughter of animals: slaughter weight, lean meat percentage,  $pH_1$ ,  $pH_{24}$  and content of intramuscular fat in MLLT (*musculus longissimus lumborum et thoracis*). Values of  $pH_1$  were measured 45 minutes after slaughter with pH-meter (WTW – pH 340i),  $pH_{24}$  24 hours post mortem, lean meat percentage was calculated by ZP method (two point method). A sample of muscle for analysis of intramuscular fat content was taken 24 hours post mortem from *musculus longissimus lumborum et thoracis* from the area of semi-final and final thoracic vertebra of analysed animals. The analysis of intramuscular fat content was done by ether extraction in a laboratory of Animal Breeding at Mendel University in Brno. Data were statistically evaluated by program Unistat (t-test and Pearson correlation).

## RESULTS AND DISCUSSION

In this study 28 animals were evaluated – 14 hogs and 14 gilts of Duroc breed. An average slaughter weight was  $102.1 \pm 1.2683$  kg with minimum 100.0 kg and maximum 104.0 kg, in gilts ( $101.7 \pm 1.1387$  kg) and in hogs ( $102.6 \pm 1.2839$  kg). The differences among sexes were not statistically conclusive.

Gilts reached higher lean meat percentage. An average lean meat percentage of the breed was determined on a level of  $57.73 \pm 0.8687$  with a minimum 56.20% and maximum 58.80%, gilts reached  $57.84 \pm 0.9070\%$  and hogs  $57.61 \pm 0.8466\%$ . The difference among sexes was not statistically conclusive. The results correspond with results mentioned by William *et al.* (1990) and Pulkrábek *et al.* (1993, 1994, 1995) – these authors mention higher meatiness of gilts in comparison with hogs. Okrouhlá *et al.* (2005) studied differences between sexes in hybrid pigs and they did not find statistically conclusive differences. Bahelka *et al.* (2007) studied differences between sexes in hybrid pigs – gilts

reached 57.68% of lean meat (in weight 107.86 kg) in comparison to hogs (52.77% in weight 107.94 kg). An important difference between sexes in lean meat portion was found out by Andersson *et al.* (1995). Oliver *et al.* (1993) mention an average lean meat portion 47.39% in Duroc. Arnoštová *et al.* (2001) determined in Duroc breed lean meat percentage on a level of 53.97%, in hogs 53.62% and in gilts 54.21%. Jacyno *et al.* (2015) studied hybrid pigs (Pietrain × Duroc) × Polish Large White and they measured lean meat percentage on a level of 56.6%. Glinoubol *et al.* (2015) studied hybrid pigs Pietrain × Duroc and they determined lean meat percentage on a level of 59.9%.

An average value of  $pH_1$  was measured on a level of  $6.11 \pm 0.0790$  with a minimum 6.00 and maximum 6.25. Hogs reached an average value  $6.07 \pm 0.0545$  and gilts  $6.14 \pm 0.0852$  with a statistically conclusive difference among sexes ( $p \leq 0.05$ ). Value of  $pH_1$  was really good, higher in all cases over 5.8 without PSE defect. Oliver *et al.* (1993) mention an average  $pH_1$  6.39 in Duroc breed. Arnoštová *et al.* (2001) determined in Duroc breed  $pH_1$  on a level 6.70, in hogs 6.50, in gilts 6.90. Glinoubol *et al.* (2015) studied hybrid pigs Pietrain × Duroc and they determined  $pH_1$  on a level 6.47. Pöldvere *et al.* (2015) measured  $pH_1$  in hybrid pig combination (D × L) × (LW × L) an average value 5.84 and in D × (LW × L) an average value 6.00.

$pH_{24}$  reached values of  $5.80 \pm 0.1333$  with a minimum 5.60 and maximum 5.95, in hogs  $5.74 \pm 0.1134$ , in gilts  $5.86 \pm 0.1231$ . The difference between sexes was statistically conclusive ( $p \leq 0.01$ ). Jung-Seok *et al.* (2014) measured  $pH_{24}$  in a group of 200 Duroc gilts on a level 5.73. Oliver *et al.* (1993) mention an average value of  $pH_{24}$  in Duroc breed 5.74. Arnoštová *et al.* (2001) determined in Duroc breed  $pH_{24}$  on a level 5.60, in hogs 5.40, in gilts 5.80. Ingr (1996) recommends a level for  $pH_{24}$  lower than 6.20. Pietruszka *et al.* (2015) studied the effect of intramuscular fat on  $pH_1$  and  $pH_{24}$  in two groups of hybrid pigs. Group with lower content of intramuscular fat reached  $pH_1$  6.23 and  $pH_{24}$  5.46, group with higher content of intramuscular fat reached  $pH_1$  6.44 and  $pH_{24}$  5.48, the values were similar in both groups, regardless of IMF content. Yeong-Seok *et al.* (2016) measured  $pH_{24}$  in a group of 15 Duroc gilts and determined an average value on a level 5.63. Glinoubol *et al.* (2015) measured in hybrid pigs Pietrain × Duroc  $pH_{24}$  on a level 5.96. Pöldvere *et al.* (2015) measured  $pH_{24}$  in hybrid pig combination (D × L) × (LW × L) an average value 5.44 and in D × (LW × L) an average value 5.49.

Duroc breed is well-known because of a good content of intramuscular fat. Determined level of intramuscular fat in studied file of animals was  $1.67 \pm 0.7464$  with minimum 0.33% and maximum 3.31%. Higher values were reached by hogs ( $1.92 \pm 0.6428\%$ ) in comparison with gilts ( $1.42 \pm 0.7788\%$ ). The difference among sexes was not statistical conclusive. Basic statistical characterisations of studied traits of carcass value are shown in Tabs. I, II and III.

Altmann *et al.* (1990) mention a content of intramuscular fat on a level of 3.25% in Duroc breed. Even higher content is mentioned by Holková *et al.* (1993) – 3.53%. Most of the authors mention values higher than 2% of intramuscular fat (IMF). Hermes *et al.* (1997) determined in 186 pigs of Duroc breed in Australia an average content of IMF 2.47%. Yeong-Seok *et al.* (2016) determined in a group of 15 Duroc gilts an average content of IMF 2.83%. Jung-Seok *et al.* (2014) mention an average IMF content in a group of 200 Duroc gilts on a level of 2.98%. Alonso *et al.* (2015) found out in hybrid pigs L × (LW × D) a content of IMF 1.79% and in combination L × D 2.39% of IMF. Pöldvere *et al.* (2015) determined IMF content in hybrid pig combination (D × L) × (LW × L) on a level of 2.19% and in D × (LW × L) on a level of 2.71%. Franco *et al.* (2014) mention a content of IMF 3.96% in crossbred Celta pig × Duroc.

Gudermann (1996) mentions a content of IMF 2.14 and 2.38% in offspring after two boars of Duroc breed brought to Switzerland from Denmark. Oliver *et al.* (1993) mention 2.89% of IMF in Duroc breed. Micklich *et al.* (2002) compared IMF of several German pig breeds and Duroc breed reached the highest values. Jacyno *et al.* (2015) studied hybrid pigs (Pietrain × Duroc) × Polish Large White and they determined 2.5% of intramuscular

fat. Glinoubol *et al.* (2015) determined in hybrid pigs Pietrain × Duroc 2.85% of intramuscular fat. Koucký *et al.* (1993) studied an influence of sex on traits of carcass value. Hogs reached higher content of intramuscular fat in comparison with gilts. Pietruszka *et al.* (2015) studied the effect of intramuscular fat on lean meat percentage in hybrid pigs. Animals with higher content of intramuscular fat (3.08%) had a lower lean meat percentage (54.79%) in comparison with animals with lower content of intramuscular fat (2.05) and lean meat percentage 58.63. Okrouhlá *et al.* (2009) studied differences in intramuscular fat content between sexes in hybrid pigs and gilts reached higher values than hogs. Bahelka *et al.* (2007) studied differences between sexes in hybrid pigs – gilts reached 2.00% of intramuscular fat in comparison to hogs with 2.49% of intramuscular fat.

Statistically conclusive correlations were calculated (in studied group regardless of gender): mean dependence  $r = 0.5687$  ( $p \leq 0.01$ ) between percentage of lean meat and slaughter weight, mean dependence  $r = 0.6271$  ( $p \leq 0.001$ ) between lean meat percentage and  $pH_1$ , mean negative dependence  $r = -0.5131$  ( $p \leq 0.01$ ) between percentage of intramuscular fat and value of  $pH_1$ , mean negative dependence  $r = -0.4944$  ( $p \leq 0.01$ ) between percentage of intramuscular fat and value

I: Basic statistical characterizations of studied traits in studied group regardless of gender

|           | n  | Mean  | Variance | Standard deviation | Coefficient of Variation (%) | Min.  | Max.  |
|-----------|----|-------|----------|--------------------|------------------------------|-------|-------|
| SW (kg)   | 28 | 102.1 | 1.6085   | 1.2683             | 1.24                         | 100.0 | 104.0 |
| LM (%)    | 28 | 57.73 | 0.7547   | 0.8687             | 1.50                         | 56.20 | 58.80 |
| $pH_1$    | 28 | 6.11  | 0.0062   | 0.0790             | 1.29                         | 6.00  | 6.25  |
| $pH_{24}$ | 28 | 5.80  | 0.0178   | 0.1333             | 2.30                         | 5.60  | 5.95  |
| IMF (%)   | 28 | 1.67  | 0.5571   | 0.7464             | 44.72                        | 0.33  | 3.31  |

SW – slaughter weight

LM – lean meat percentage

IMF – intramuscular fat

\*  $p \leq 0.05$

\*\*  $p \leq 0.01$

\*\*\*  $p \leq 0.001$

II: Basic statistical characterizations of studied traits in hogs

|           | n  | Mean   | Variance | Standard deviation | Coefficient of Variation (%) | Min.  | Max.  |
|-----------|----|--------|----------|--------------------|------------------------------|-------|-------|
| SW (kg)   | 14 | 102.6  | 1.6484   | 1.2839             | 1.25                         | 100.0 | 104.0 |
| LM (%)    | 14 | 57.61  | 0.7167   | 0.8466             | 1.47                         | 56.20 | 58.50 |
| $pH_1$    | 14 | 6.07*  | 0.0030   | 0.0545             | 0.90                         | 6.00  | 6.15  |
| $pH_{24}$ | 14 | 5.74** | 0.0129   | 0.1134             | 1.98                         | 5.60  | 5.90  |
| IMF (%)   | 14 | 1.92   | 0.4132   | 0.6428             | 33.46                        | 1.00  | 3.31  |

SW – slaughter weight

LM – lean meat percentage

IMF – intramuscular fat

\*  $p \leq 0.05$

\*\*  $p \leq 0.01$

\*\*\*  $p \leq 0.001$

of  $pH_{24}$ , mean negative dependence  $r = -0.5982$  ( $p \leq 0.001$ ) between slaughter weight and value of  $pH_{24}$  and high dependence  $r = 0.8820$  ( $p \leq 0.001$ ) between values of  $pH_1$  and  $pH_{24}$  (Matoušek *et al.*, 1997 mention  $r = 0.133$ ). Pietruszka *et al.* (2015) found negative dependence  $r = -0.61$  ( $p \leq 0.01$ ) between content of intramuscular fat and lean meat percentage in hybrid pigs and statistically not conclusive dependence between content of intramuscular fat and  $pH_1$  (0.15) and between a content of intramuscular fat and  $pH_{24}$  (-0.03).

Jacyno *et al.* (2015) studied hybrid pigs (Pietrain  $\times$  Duroc)  $\times$  Polish Large White and they found a negative dependence between content of intramuscular fat and lean meat percentage  $r = -0.71$  ( $p \leq 0.01$ ). Bahelka *et al.* (2007) studied differences between sexes in hybrid pigs and found in whole set of pigs not statistically conclusive differences between slaughter weight and lean meat percentage ( $r = 0.03$ ), slaughter weight and content of intramuscular fat ( $r = -0.15$ ) and between lean meat percentage and content of intramuscular fat ( $r = -0.53$ ).

In hogs these statistically conclusive correlations were calculated: high dependence  $r = 0.7279$  ( $p \leq 0.01$ ) between lean meat percentage and slaughter weight, mean negative dependence  $r = -0.6001$  ( $p \leq 0.05$ ) between slaughter weight and value of  $pH_{24}$  and high dependence  $r = 0.8940$

( $p \leq 0.001$ ) between values of  $pH_1$  and  $pH_{24}$ . Bahelka *et al.* (2007) studied differences between sexes in hybrid pigs and found in hogs not statistically conclusive differences between slaughter weight and lean meat percentage ( $r = -0.09$ ), slaughter weight and content of intramuscular fat ( $r = -0.01$ ) and between lean meat percentage and content of intramuscular fat ( $r = -0.46$ ).

In gilts these statistically conclusive correlations were calculated: mean dependence  $r = 0.5788$  ( $p \leq 0.05$ ) between lean meat percentage and slaughter weight, high dependence  $r = 0.7711$  ( $p \leq 0.01$ ) between lean meat percentage and value of  $pH_1$ . Next mean negative dependence  $r = -0.5374$  ( $p \leq 0.05$ ) between content of intramuscular fat and  $pH_1$ , mean negative dependence  $r = -0.6114$  ( $p \leq 0.05$ ) between content of intramuscular fat and  $pH_{24}$ , high dependence  $r = 0.8356$  ( $p \leq 0.001$ ) between  $pH_1$  and  $pH_{24}$ . Correlations among traits are shown in Tabs. IV, V and VI. Bahelka *et al.* (2007) studied differences between sexes in hybrid pigs and found in gilts not statistically conclusive differences between slaughter weight and lean meat percentage ( $r = 0.21$ ), slaughter weight and content of intramuscular fat ( $r = -0.36$ ) and between lean meat percentage and content of intramuscular fat ( $r = -0.34$ ).

### III: Basic statistical characterizations of studied traits in gilts

|           | n  | Mean   | Variance | Standard deviation | Coefficient of Variation (%) | Min.  | Max.  |
|-----------|----|--------|----------|--------------------|------------------------------|-------|-------|
| SW (kg)   | 14 | 101.7  | 1.2967   | 1.1387             | 1.12                         | 100.0 | 104.0 |
| LM (%)    | 14 | 57.84  | 0.8226   | 0.9070             | 1.57                         | 56.20 | 58.80 |
| $pH_1$    | 14 | 6.14*  | 0.0073   | 0.0852             | 1.39                         | 6.00  | 6.25  |
| $pH_{24}$ | 14 | 5.86** | 0.0152   | 0.1231             | 2.10                         | 5.60  | 5.95  |
| IMF (%)   | 14 | 1.42   | 0.6066   | 0.7788             | 54.98                        | 0.33  | 2.56  |

SW – slaughter weight

LM – lean meat percentage

IMF – intramuscular fat

\*  $p \leq 0.05$

\*\*  $p \leq 0.01$

\*\*\*  $p \leq 0.001$

### IV: Coefficients of correlations between chosen traits of carcass value in studied group regardless of gender

| Trait     | LM (%)   | $pH_1$    | $pH_{24}$  | IMF (%)   |
|-----------|----------|-----------|------------|-----------|
| SW (kg)   | 0.5687** | -0.2182   | -0.5982*** | 0.2422    |
| LM (%)    |          | 0.6271*** | 0.2572     | -0.3239   |
| $pH_1$    |          |           | 0.8820***  | -0.5131** |
| $pH_{24}$ |          |           |            | -0.4944** |

SW – slaughter weight (kg)

LM – lean meat percentage (%)

IMF – intramuscular fat (%)

\*  $p \leq 0.05$

\*\*  $p \leq 0.01$

\*\*\*  $p \leq 0.001$

V: Coefficients of correlations between chosen traits of carcass value in hogs

| Trait            | LM (%)   | pH <sub>1</sub> | pH <sub>24</sub> | IMF (%) |
|------------------|----------|-----------------|------------------|---------|
| SW (kg)          | 0.7279** | -0.1886         | -0.6001*         | 0.1276  |
| LM (%)           |          | 0.4432          | 0.0103           | -0.1834 |
| pH <sub>1</sub>  |          |                 | 0.8940***        | -0.2448 |
| pH <sub>24</sub> |          |                 |                  | -0.2039 |

SW – slaughter weight (kg)

LM – lean meat percentage (%)

IMF – intramuscular fat (%)

\* p ≤ 0.05

\*\* p ≤ 0.01

\*\*\* p ≤ 0.001

VI: Coefficients of correlations between chosen traits of carcass value in gilts

| Trait            | LM (%)  | pH <sub>1</sub> | pH <sub>24</sub> | IMF (%)  |
|------------------|---------|-----------------|------------------|----------|
| SW (kg)          | 0.5788* | -0.0227         | -0.4898          | 0.2355   |
| LM (%)           |         | 0.7711**        | 0.3867           | -0.3600  |
| pH <sub>1</sub>  |         |                 | 0.8356***        | -0.5374* |
| pH <sub>24</sub> |         |                 |                  | -0.6114* |

SW – slaughter weight (kg)

LM – lean meat percentage (%)

IMF – intramuscular fat (%)

\* p ≤ 0.05

\*\* p ≤ 0.01

\*\*\* p ≤ 0.001

## CONCLUSION

All together 28 animals of Duroc breed were slaughtered in average weight 102.1 kg in this study. They reached an average lean meat percentage 57.73 (hogs reached 57.61, gilts 57.84%) which corresponds with finding of other authors. A meat quality expressed by values of pH<sub>1</sub> and pH<sub>24</sub> was good and without any defect – values of pH<sub>1</sub> and pH<sub>24</sub> were measured on a level of 6.11, respective 5.80 (hogs 6.07, resp. 5.74, gilts 6.14, resp. 5.86 with a statistically conclusive difference among sexes, p ≤ 0.05, resp. p ≤ 0.01). A content of intramuscular fat was determined on a level of 1.67 %, when hogs reached a little bit higher value 1.92% compared to gilts (1.42%). These values are lower than values mentioned by other authors, but they are close to an optimal level. Duroc breed is a healthy and popular breed used in sire position for creating of final carcass pig hybrids and its actual Czech population shows a good quality. Customer's demand for tasty meat is growing and Duroc breed can satisfy it. It is possible to recommend this breed for utilization in programs of hybridization in the Czech Republic.

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