Acta fytotechn zootechn, 24, 2021(Monothematic Issue: Problems and Risks in Animal Production): 71–74
http://www.acta.fapz.uniag.sk

Original Paper

The analysis of selected physical and technological parameters of pork quality depending on intesity of the pigs growth in fattening

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Article Details: Received: 2020-10-30 | Accepted: 2020-11-27 | Available online: 2021-01-31

https://doi.org/10.15414/afz.2021.24.mi-prap.71-74

The experiment was conducted to compare the differences in the physical and technological quality of pork meat with different growth intensity. The pigs were divided in accordance with the average daily gain values as followed: a) the fast-growing group (R1 $>\bar{x}$ AGD + 0.5 *SD*), b) the medium-fast-growing group (R2 = $\bar{x}$ AGD ± 0.5 *SD*) and c) slow-growing group (R3 $<\bar{x}$ AGD - 0.5 *SD*). For group of gilts, we found a statistically significant difference ($P \leq 0.05$) in the drip loss value between the fast-growing group and the medium-growing group and the fast-growing group compared to the slow-growing group of gilts. Between the fast-growing group and the medium-growing group, as well as between the fast-growing group and the slow-growing group of gilts, the differences in shear force value were statistically highly significant at the level of $P \leq 0.01$. At the same time, in the colour of meat in redness (a^* value) were found statistically significant differences between groups of barrows according to the growth rate at the level of $P \leq 0.05$ and between fast and slow-growing gilts at the level of $P \leq 0.01$ and medium and slow-growing gilts at the level of $P \leq 0.05$. In addition, in the meat yellowness (b^*) we also determined a statistically highly significant difference at the level of $P \leq 0.01$ between the fastest-growing group and medium fast-growing barrows and a significant difference at the level of $P \leq 0.05$ between the fast and slow-growing group of gilts.

Keywords: fattening pigs, growth intensity in pig, pork quality

1 Introduction

The whole fattening period is characterized by a dynamic growth process, while meat production is directly conditioned by the growth ability of fattening pigs. Growth ability is expressed as the average daily weight gain over a time period and is primarily affected by genetic basis interactions, nutritional factors, and environmental influences (Georgsson and Svendsen, 2002; Quiniou et al., 2002; Stupka et al., 2013). In the case of comparison the pork quality in the context of growth rate, we encounter in professional work the classification of slow, medium and fast growing pigs (He et al., 2016). While one group of authors (Li, 2015) detects a lower slaughter weight in slow-growing pigs and thus a lower market value, another group draws attention to the deteriorating quality of pork in fast-growing pigs (Oksbjerg et al., 2000). There are many studies documenting the influence of genetics, pre-slaughter effects and nutrition on pork quality indicators, but few scientific studies deal with the influence of growth intensity on physical quality indicators (Wagner, 2007; Zammerini, et al., 2009; Nissen et al., 2009). Therefore, questions arise as to what extent the intensity of growth contributes to the technological quality of pork. On the other hand, Wright (2017) describes changes in growth rates in pig populations as inherent and difficult to change. This author also states that biological variation exists for a reason. It is the basis of natural and artificial selection and as such is the basis for genetic improvement of performance traits.

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2 Material and methods

The basic aim of the study was to determine the differences in evaluated parameters of physical and technological parameters of pork quality of different fast-growing pigs of the Large White breed. The experiment was conducted in the Experimental Centre of livestock at the Department of Animal Husbandry, Slovak University of Agriculture in Nitra. In this experiment, 86 pigs of Large White divided according to the sex, were used. Based on the size of the average daily gain, the groups were formed within both sexes: a) the group with the fast growth (R1 $>\bar{x}$ ADG + 0.5 *SD*), b) the medium fast-growing group (R2 $= \bar{x}$ ADG ± 0.5 *SD*) and c) slow-growing group (R3 $< \bar{x}$ ADG - 0.5 *SD*). For each growth phase, all pigs were fed the same complete balanced feed mixtures.

The actual acidity in the *Musculus longissimus thoracis* was determined 45 minutes *post mortem* directly on the carcass by injecting the Hanna HI 99161 instrument into the muscle between the last and penultimate thoracic vertebra. After the course of the rigor mortis, during 24 hours of cold storage at a temperature of 4 ˚C, the dissection of carcasses and sampling was performed for the determination of parameters of physical and technological quality of the meat. The color of the meat in the *Musculus longissimus thoracis* was determined from a sample taken during dissection 24 hours *post mortem* at the level between the last and penultimate thoracic vertebra in a section perpendicular to the muscle fibres direction. For the meat color measurement, represented as CIE *L** *a** *b** parameters, was used the CM-2600d spectrophotometer. In accordance with the Honikel methodology (1998), we determined the drip loss value in percentage (%). We used a 50 g sample of the *longissimus* muscle taken during dissection at the level between the last and penultimate thoracic vertebrae between 24 hours and 48 hours *post mortem*. Samples of muscle were hung in special plastic bags in the refrigerator at the temperature of 4–6 °C. The weight loss of water was expressed in %. The shear force value of pork was determined by the Warner-Bratzler method after 7 days of storage at a temperature of 4 ±1 °C. Thereafter, samples of meat were heated for 30 minutes to a temperature of 71+/-1 °C. The basic variability, statistical characteristics and differences between groups were calculated by the SPSS 11 software as analysis of variance.

3 Results and discussion

In the indicator of current acidity in MLT no statistically significant differences between the compared growth groups of pigs, were found. The effect of growth rate on pork acidity was discussed by Wagner (2007), who documented higher average pH values in favour of fast-growing pigs. In contrast, Zammerini et al. (2009) noted higher acidity in the slow-growing group of pigs. Consistent with our results, the effect of growth rate on pH values has not been demonstrated in the studies of Correa et al. (2006) but also Nissen et al. (2004), Nissen et al. (2009) and Suzuki et al. (2005). In the group of gilts, we found a statistically significant difference ($P \leq 0.05$) in the drip loss value between the fast-growing group and the medium-growing group and also the fast-growing group compared to the slow-growing group of gilts. Furthermore, the fastest-growing gilts also had the highest drip loss (7.61%) compared to a medium (5.35%) and slow-growing group of gilts (5.78%). The results of our experiment correspond to those of Wagner (2007), who reported higher values of drip loss value in favor of fast-growing pigs. Contrariwise, Correa et al. (2006) did not notice the effect of growth rate on drip loss value. The meat toughness analysed by the shear force indicator was lowest in the fast-growing group of gilts (3.73 kg/cm^2) compared to the medium-fast (5.03 kg/cm^2) and the slow-growing group (4.47 kg/cm^2). On the contrary, Wagner (2007) in his research stated that slower-growing pigs were characterized by the lowest values of shear force. In the study of Oksbjerg et al. (2000) and Duan et al. (2018) the growth rate did not affect the shear force of pork. The color of the meat in the *L** parameter expressing the meat lightness showed no statistically significant differences between the growth groups within individual sexes or in the whole group of pigs. Confirmation of the correlation between the average daily gain representing the growth rate and the color of the meat (*L** value) was provided by the study of Suzuki et al. (2005). Contrary to Hovenier (1993), many authors suggest that improving the growth rate increases the meat tenderness and leads to a lighter color, which according to Wagner (2007) indicates a deterioration in the pork quality. Correa et al. (2006), similarly as in the presented study, did not show any statistically significant differences in the meat lightness (*L**) in the context of growth rate. In the group of barrows, we found a statistically significant difference in the color of meat in the *a** value between fast-growing pigs with a value of 1.97 compared to the medium-fast group with a value of 6.55 and a slow-growing pig, for which a value of 6.07 was measured. The statistically significant differences between the observed groups of barrows were at the level of $P \leq 0.05$. In the group of gilts, similar findings were recorded; *a** value of 2.92 in the fast-growing group, compared to 4.62 in medium-growing gilts and 8.32 in slow-growing gilts. There was a statistically significant difference between the fast-growing group compared to the medium-growing group at the level of $P \leq 0.05$ and between the fast-growing and slow-growing group of gilts at the level of $P \leq 0.01$. The results obtained in our experiment were confirmed by Nissen et al. (2009) and Quentin et al. (2003) who recorded higher values of meat redness (*a**) in the group of fast-growing pigs. On the other hand, these results were inconsistent with those reported by Wagner (2007), who measured lower meat redness values in favor for slow-growing pigs. Similarly, Correa et al. (2006) did not observe the effect of growth intensity on the *a** color parameter. In the fastest-growing group of barrows was measured color parameter *b** value of 9.23, while this group shows a statistically highly significant difference between the medium-fast growing barrows (-0.49) at the level of $P \leq 0.01$ and a significant difference between slow-growing group of barrows (3.21) at the level $P \leq 0.05$. In the group of gilts, comparable results were found, while the highest value of *b** was measured in the group of fast-growing gilts (5.91) in comparison to slow-growing gilts (-0.86) and this difference was statistically significant at the level of $P \leq 0.05$. The stated results were also confirmed by study of Wagner (2007). In contrast, Quentin et al. (2003) documented higher values of *b** color parameter in the slow-growing group compared to the medium and fast-growing group. However, Brocks et al., Hulsegge and Merkus (1998) as well as Latorre et al. (2008) did not confirm the effect of growth intensity on meat yellowness at a statistically demonstrable level.

Table 1 The basic statistics of pork quality traits by growth intensity and sex in Large White breed

Traits in MLT	R1	R2	R3	R1	R2	R3
	barrows	barrows	barrows	gilts	gilts	gilts
	$n = 21$	$n = 11$	$n = 12$	$n = 9$	$n = 14$	$n = 19$
	$\bar{X} \pm SD$	$\bar{X} \pm SD$	$\bar{X} \pm SD$	$\bar{X} \pm SD$	$\bar{X} \pm SD$	$\bar{X} \pm SD$
pH1 – log molc. (H+)	6.24 ±0.15	6.24 ±0.11	6.27 ±0.09	6.17 ±0.11	6.19 ±0.08	6.25 ±0.13
Drip loss MLT %	6.34 ±2.69	6.20 ±2.57	5.96 ±2.84	7.61 ±2.89^{a}	5.35 ±1.76^{b}	5.78 ±2.26^{b}
Shear force (WB) (kg/cm)	4.37 ±0.77	4.16 ±1.34	4.23 ±0.84	3.73 ±1.13^{A}	5.03 ±0.65^{B}	4.74 ±0.56^{B}
Colour 24 h CIE *L**	58.41 ±1.79	58.20 ±2.08	57.55 ±4.24	57.75 ±3.06	56.63 ±1.48	57.70 ±1.10
Colour 24 h CIE *a**	1.97 ±4.49^{a}	6.55 ±5.51^{b}	6.07 ±4.52^{b}	2.92 ±3.10^{Aa}	4.62 ±4.33^{a}	8.32 ±4.36^{Bb}
Colour 24 h CIE *b**	9.23 ±6.07^{Aa}	-0.49 ±7.71^{B}	3.21 ±7.52^{b}	5.91 ±8.97^{a}	1.34 ±7.22	-0.86 ±6.43^{b}

Traits in MLT	R1	R2	R3
	all	all	all
	$n = 30$	$n = 25$	$n = 31$
	$\bar{X} \pm SD$	$\bar{X} \pm SD$	$\bar{X} \pm SD$
pH1 – log molc. (H+)	6.21 ±0.14	6.20 ±0.09	6.26 ±0.11
Drip loss MLT %	6.72 ±2.76	5.72 ±2.14	5.84 ±2.45
Shear force (WB) (kg/cm)	4.17 ±0.92^{a}	4.64 ±1.08^{b}	4.54 ±0.71
Colour 24 h CIE *L**	58.21 ±2.21	57.32 ±1.90	57.64 ±2.99
Colour 24 h CIE *a**	2.25 ±4.30^{A}	5.47 ±4.87^{B}	7.44 ±4.48^{B}
Colour 24 h CIE *b**	8.23 ±7.07^{A}	0.53 ±7.34^{B}	0.71 ±7.04^{B}

A, B – d-fferent letters indicate significant differences between groups at $P \leq 0.01$; a, b – different letters indicate significant differences between groups at $P \leq 0.05$

4 Conclusions

Based on our findings, we could state that we found a higher drip loss value expressed in % in the fast-growing gilts in comparison to the medium or slow-growing gilts. Concurrently, the meat from fast-growing gilts was more tender compared to the pork from medium or slow-growing group of pigs. The meat colour parameters indicate that the fast-growing pigs tend to produce meat with a lower red and higher of green colour intensity. In addition the group of fast-growing pigs produces meat with a higher yellow and a lower blue colour proportions.

Acknowledgments

This publication was supported by the Operational Programme Integrated Infrastructure within the project: Sustainable smart farming systems taking into account the future challenges 313011W112, cofinanced by the European Regional Development Fund and project KEGA 015SPU-4/2019.

References

Brocks, L. et al. (1998). Histochemical characteristics in relation to meat quality properties in the Longissimus lumborum of fast and lean growing lines of Large White pigs. *Meat Science*, 50(4), 411–420. DOI: 10.1016/s0309-1740(98)00053-9

Correa, J.A. et al. (2006). Effects of slaughter weight on carcass composition and meat quality in pigs of two different growth rates. *Meat Science*, 72(1), 91–99. DOI: 10.1016/j.meatsci.2005.06.006

Duan, Y. et al. (2018). Effects of slaughter weight and growth rate on the *longissimus* muscle metabolic characteristics, and pork sensory quality in pigs of two sexes. *Canadian Journal of Animal Science*, 98(2), 213–220. https://doi.org/10.1139/cjas-2017-0032

Georgsson, L. and Svendsen. J. (2002). Degree of competition at feeding differentially affects behavior and performance of group-housed growing-finishing pigs of different relative weights. *Journal of Animal Science*, 80(2), 376–383. https://doi.org/10.2527/2002.802376x

He, Y. et al. (2016). Identifying factors contributing to slow growth in pigs. *Journal of Animal Science*, 94(5), 2103–2116. https://doi.org/10.2527/jas.2015-0005

Hovenier, R. (1993). *Breeding for meat quality in pigs.* Landbouwuniversiteit: Wageningen University & Research.

Latorre, M.A. et al. (2008). The relationship within and between production performance and meat quality characteristics in pigs from three different genetic lines. *Livestock Science*, 115(2–3), 258–267. https://doi.org/10.1016/j.livsci.2007.08.013

Li, Y. 2015. Indicators of Slow Growing Pigs. Swine Scientist. Retrieved October 10, 2020 from https://wcroc.cfans.umn.edu/sites/wcroc.cfans.umn.edu/files/indicators_of_slow_growing_pigs_2015.pdf

Nissen, P.M. et al. (2004). Within litter variation in muscle fiber characteristics, pig performance, and meat quality traits. *Journal of Animal Science*, 82(2), 414–421. DOI: 10.2527/2004.822414x

Nissen, P.M. et al. (2009). Pig meat quality predicted by growth rate at farm level. *Acta Agriculturae Scandinavica, Section A – Animal Science*, 59(3), 167–172. https://doi.org/10.1080/09064700903254265

Oksbjerg, N. et al. (2000). Long-term changes in performance and meat quality of Danish Landrace pigs: a study on a current compared with an unimproved genotype. *Animal Science*, 71(Part: 1), 81–92.

Quentin, M. et al. (2003). Growth, carcass composition and meat quality response to dietary concentrations in fast-, medium- and slow-growing commercial broilers. *Animal Research*, 52(1), 65–77. DOI: 10.1051/animres:2003005

Quiniou, N. et al. (2002). Variation of piglets' birth weight and consequences on subsequent performance. *Livestock Production Science*, 78(1), 63–70. DOI: 10.1016/S0301-6226(02)00181-1

Stupka, R. et al. (2013). *Chov zvířat.* Praha : Powerprint.

Suzuki, K. et al. (2005). Genetic parameter estimates of meat quality traits in Duroc pigs selected for average daily gain, *longissimus* muscle area, backfat thickness, and intramuscular fat content. *Journal of Animal Science*, 83(9), 2058–2065. DOI: 10.2527/2005.8392058x

Wagner, C. (2007). *Influence of selection for improved growth rate on pork quality.* Iowa: Iowa State University.

Wright, Ch. (2017). Variation in Pig Growth Rate and Live Weight. The pig site. Retrieved October 10, 2020 from https://www.thepigsite.com/articles/variation-in-pig-growth-rate-and-live-weight

Zammerini, D. et al. (2009). *Effect of pig growth rate and health status on meat eating quality*. Cambridge University Press, 2009(1), 103. DOI: https://doi.org/10.1017/S1752756200029422

