

DIFFERENCES IN SLAUGHTERING CHARACTERISTICS BETWEEN CROSSBRED PIGS WITH PIETRAIN AND DUROC AS TERMINAL SIRE

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ABSTRACT

In this paper results on investigation of 27 carcasses of crossbred pigs were presented. The pigs were divided into two groups regarding the breed of terminal sires: Pietrain group had 15 and Duroc group 12 carcasses. All dams were double crosses of Swedish Landrace and Large White. Pigs were slaughtered at approximate weight of 100 kg and important measures of carcass and meat quality were taken. Analyses showed that pigs from Pietrain group had longer carcasses ($P < 0.001$). No differences in conformation of hams were found as well as loin eye area between the groups ($P > 0.05$), but the pigs from Pietrain group had significantly lower fat area ($P < 0.05$) indicating higher meatiness of the pigs from this group proved by significantly lower fat/meat ratio ($P < 0.01$). Although no differences in the percentage of bones were found ($P > 0.05$) carcasses of Pietrain group had significantly higher percent of lean ($P < 0.001$) and less fat ($P < 0.01$) than the carcasses of the pigs with Duroc as terminal sire breed. With exception of initial pH value measured in ham, significant differences in all meat quality indicators were found between the groups and all of these were in favour of the meat originating from pigs crosses with Duroc as terminal sire. The distribution of meat into 5 quality classes showed that in Pietrain and Duroc group, 85% and 25% (respectively) of meat samples were described as PSE (pale, soft, exudative) and RSE (reddish-pink, soft, exudative) condition. Only 15% of the samples from Pietrain group was classified as RFN (red, firm, non-exudative); in this category 58.33% of the samples from Duroc group was distributed.

Key words: pigs / breeds / Pietrain / Duroc / crossbreeds / carcass traits / meat quality

RAZLIKE V KLAVNIH LASTNOSTIH MED PRAŠIČI KRIŽANCI TERMINALNIH PASEM PIETRAIN IN DUROC

IZVLEČEK

V prispevku so predstavljeni rezultati analize 27 klavnih trupov prašičev križancev. Prašiči so bili razdeljeni v dve skupini glede na terminalno pasmo očetov: v skupini pietrain je bilo 15 in v skupini duroc 12 klavnih trupov. Vse matere so bile križanke pasem švedski landrace in large white. Križanci so bili zaklani pri telesni masi približno 100 kg. Opravljene so bile meritve kakovosti klavnih trupov in mesa. Analize so pokazale, da so imeli prašiči iz skupine pietrain daljše klavne trupe ($p < 0,001$). Konformacija šunke in površina dolge hrbtne mišice se med skupinama nista razlikovali ($p > 0,05$). Prašiči v skupini pietrain so imeli značilno manjšo površino maščobe ($p < 0,05$), kar predstavlja boljšo mesnatost prašičev te skupine z značilno nižjim razmerjem maščoba/meso ($p < 0,01$). Med skupinama ni bilo razlik v odstotku kosti

($p > 0,05$). Prašiči iz skupine pietrain so imeli značilno večji odstotek čistega mesa ($p < 0,001$) in manj maščobe ($p < 0,01$) v primerjavi s prašiči iz skupine duroc. Med skupinama so bile ugotovljene značilne razlike za vse lastnosti kakovosti mesa, razen za začetno pH vrednost, izmerjeno v šunki. Vse lastnosti kakovosti mesa so bile v dobro skupine duroc. Razdelitev mesa v pet kakovostnih razredov je pokazala, da je bilo pri skupini pietrain 85% in pri skupini duroc 15% vzorcev mesa v kakovostnih razredih PSE in RSE. Samo 15% vzorcev mesa iz skupine piterain je bilo razvrščenih v kakovostni razred RFN, medtem ko je bilo pri skupini duroc v ta kakovostni razred razvrščenih 58,33% vzorcev mesa.

Ključne besede: prašiči / pasme / pietrain / duroc / križanci / klavne lastnosti / meso / kakovost

INTRODUCTION

Choosing a boar is very important issue in every breeding program because it can influence a variety of traits; from carcass to meat quality. The decision on which boar line to use is mainly reached on the basis of knowledge about the required qualities to be accomplished concerning desired product. Pietrain breed is very common in the programs aimed at production of carcasses with high percentage of lean meat but it is also well known that such produced meat often shows poor quality. Therefore, it is not recommended in the case when the meat is intended to be used in the production of dried/cured meat products which are highly appreciated by the market. For this reason, Duroc as a terminal sire breed is increasingly used in Croatia on order to supply the fatteners of such meat quality characteristics that will ensure the quality of end product without marked decrease of lean percentage in the carcass. This breed is commonly appreciated by its excellent growth rate, intramuscular fat content and other meat quality traits (Suzuki *et al.*, 2003). Carcass quality is evaluated on the basis of measured indicators such as carcass length, fat and loin eye area measured at the loin cut and other metric traits, while meat quality is most often assessed by specific meat quality indicators (initial and ultimate pH values, water holding capacity, colour etc.). On the basis of these traits meat can be further classified according to the future purpose. The main shortcoming of the pig meat in technological sense is so called PSE condition characterised by poor water holding capacity and undesirable colour. Kauffman *et al.* (1992) set up finer classification of the meat into 5 quality groups, namely PSE (pale, soft, exudative), RSE (reddish-pink, soft, exudative), RFN (red, firm, non-exudative), PFN (pale, firm, non-exudative) and DFD (dark, firm, dry). RFN meat is of particular interest because it has desirable, characteristic colour which can lead to the false conclusion about their quality since they had poor water holding capacity. Similarly, PFN meat has good water holding capacity and favourable pH_u values as any "normal" meat, but because of its pale colour could be unattractive to the consumers if sold as fresh meat. The aim of this paper was to investigate the influence of the two often used breeds of boars (Pietrain and Large White) on carcass composition and meat quality of pigs produced in Eastern Croatia.

MATERIALS AND METHODS

This study was performed on 35 randomly chosen carcasses of three way crossed castrated pigs divided into two groups regarding the breed of the terminal sire. The dams were all F1 cross: Swedish Landrace x Large White; 7 Pietrain and 7 Duroc boars were used as terminal sire. Pietrain group had 20 and Duroc group included 15 pigs. The pigs were housed in the same conditions and fed the same diet during the fattening period. At the average age of 186 days and approximately 100 kg live weight the pigs were slaughtered in one slaughter plant in eastern Croatia. At the slaughter line, the measurements of warm carcass weight, carcass length ("a" and "b"), ham length and circumference were taken from which ham index was calculated. Initial pH values (pH_i) were measured 45 minutes after the exsanguinations. The length of the carcass was

measured from *os pubis* to the 1st rib (a) and from *os pubis* to *atlas* (b). After 24 hours of cooling, cold carcass weight, backfat and loin eye area (cm²), ultimate pH (pH_u) values, water holding capacity (w.h.c.), consistency, drip loss and color of *m. longissimus dorsi* were taken. The percentages of main tissues (muscle, fat and bones) were determined by total dissection of the carcasses by the method of Weniger *et al.* (1963). Backfat and muscle areas were measured by geometric procedure (Comberg, 1978) and expressed as the fat/loin eye area ratio; water holding capacity (w.h.c.) was determined using compression method by Grau and Hamm (1952) and by measuring drip loss according to Kauffmann *et al.* (1992). The lightness of meat was measured by “Minolta CR-300” device at *m. longissimus dorsi* cut and expressed as CIE L* value.

The criteria for the classification of meat samples as proposed by Kauffman *et al.* (1992) are presented on Table 1.

Table 1. Classification of meat into 5 conditions according to Kauffman *et al.* (1992)

	L*	Drip, %	pH ₂₄
Pale, soft, exudative, (PSE)	>50	>5	<6.0
Reddish-pink, soft, exudative (RSE)	42–50	>5	<6.0
Reddish-pink, firm, non-exudative (RFN)	42–50	<5	<6.0
Pale, firm, non-exudative (PFN)	>50	<5	<6.0
Dark, firm, dry (DFD)	<42	<5	>6.0

The differences between two groups were tested by one-way ANOVA procedure and homogeneity of variance by Levine’s test using STATISTICA (data analysis software system), version 6.0 (StatSoft Inc., 2001) for Windows; graph was made by Microsoft Excel 2002.

RESULTS AND DISCUSSION

Differences in carcass traits

In the aim to compare carcass traits of examined groups of pigs with different terminal sires, metric characteristics were measured. Ham index (ratio between ham length and ham circumference) and fat/loin eye area ratio were calculated; the traits obtained in such manner are presented on Table 2.

From the Table 2 can be seen that the mean weight of the pig carcasses was about 80 kg with no apparent differences between the investigated groups of pigs. However, the carcasses from the Pietrain group were significantly longer ($P<0.001$) in both manners of measurement. The hams of the same group were longer and had higher circumference ($p<0.001$), but there were no significant difference between the groups regarding the ham index, which describes the conformation of the hams. The measurements of fat area and loin eye area at the MLD cut as well as their ratio point out the higher meatiness of the pig carcasses from the Pietrain group. Although there were no significant difference between the groups in loin eye area, fat area found in Duroc group was significantly higher ($P<0.05$), which is the reason for better fat area/loin eye area ratio ($P<0.01$) in the carcasses of pigs from Pietrain group.

Table 3 presents the results of total dissection of the carcasses originating from both groups. It is evident that carcasses from examined groups had similar percentages of bones, while muscle tissue and fat significantly differed. Carcasses of the Pietrain group had significantly higher percent lean ($P<0.001$) and less fat ($P<0.01$) than the carcasses of the pigs with Duroc as terminal sire breed.

Table 2. Carcass traits of crossbred pigs with Pietrain and Duroc as terminal sire lines and the difference between them

Trait	Statistical indicator	Pietrain	Duroc	Significance
Warm carcass weight, kg	Mean	80.70	80.93	P>0.05
	Standard error	1.58	1.65	
Carcass length "A", cm	Mean	88.60	80.17	P<0.001
	Standard error	0.69	0.62	
Carcass length "B", cm	Mean	103.90	94.03	P<0.001
	Standard error	0.85	0.84	
Ham length, cm	Mean	33.30	30.37	P<0.001
	Standard error	0.28	0.36	
Ham circumference, cm	Mean	75.10	68.97	P<0.001
	Standard error	0.66	0.54	
Ham index	Mean	0.44	0.44	P>0.05
	Standard error	0.003	0.005	
Loin eye area, cm ²	Mean	46.74	43.42	P>0.05
	Standard error	1.33	1.57	
Fat area, cm ²	Mean	14.66	19.02	P<0.05
	Standard error	1.00	1.0	
Fat area / Loin eye area ratio	Mean	0.32	0.45	P<0.01
	Standard error	0.02	0.04	

Table 3. Results of total dissection of the pig carcasses from Pietrain and Duroc group and the difference between them

Tissue percentage	Statistical indicator	Pietrain	Duroc	Significance
Lean	Mean	62.11	56.86	P<0.001
	Standard error	0.2	1.0	
Fat	Mean	20.08	24.94	P<0.01
	Standard error	0.1	1.9	
Bones	Mean	9.94	9.97	P>0.05
	Standard error	0.0	0.2	

This results supports findings of Edwards *et al.* (2001) and Rozycki (2003) who found that Pietrain sired pigs have a higher percentage carcass lean with less backfat thickness at market weight when compared to pigs sired Duroc boars. Contrary to our study, Edwards *et al.* (2003) found that Duroc sired pigs had significantly longer carcasses. The authors also reported higher carcass weights of Duroc progeny, while no difference to that respect was observed in present study. Our results support the findings of Nieuwhof *et al.* (1991) and Ellis *et al.* (1996) who reported higher fatness of Duroc when compared to Pietrain pigs.

Differences in meat quality traits

After slaughter, the most important meat quality traits were measured and the results are shown in table 4. Measured indicators point out better overall meat quality of crossbreeds with Duroc as terminal sire breed. Mean pH_i values of the meat from the Pietrain group measured in MLD was close to the border established for PSE condition (Hofmann, 1994), while those found

in the meat of Duroc group were significantly higher ($P < 0.001$) and indicated “normal” quality of pork. The same measure taken in ham indicated normal quality of meat in both crosses although they were higher in Duroc group. However, this difference was not significant ($P > 0.05$). Based on ultimate pH values (pH_u), it can be concluded that the meat of Pietrain group of pigs had significantly lower values ($P < 0.01$), close to the value proposed as border for PSE condition by van Laack (2000). Values of pH_u measured in the ham were to some extent higher in both groups; the difference between them was highly significant ($P < 0.001$). Difference between two groups in drip loss was also significant ($P < 0.01$); mean value found in Pietrain group was above the border value separating “normal” from PSE condition of the meat. Water holding capacity (WHC) measured by compression method was favourable in both groups, again significantly higher ($P < 0.001$) in the offspring of Pietrain as a terminal sire. Measurement of lightness expressed as CIE L^* values indicated significantly paler meat of Pietrain crosses ($P < 0.001$) compared to Duroc sired crossbred pigs.

Higher pH_i values of Duroc sired pigs compared to Pietrain progeny were also found by Lattore *et al.* (2003); Tibau *et al.* (1997) found these values to be higher in Duroc progeny than in both Large White and Pietrain sired pigs. Our results on pH_u values are in agreement with findings of Lattore *et al.* (2003), Edwards *et al.* (2003) and Garcia-Macias *et al.* (1996), but not with Armero *et al.* (1999) and Olivier *et al.* (1994). Later authors did not find significant differences between Duroc and several white crossbreds in ultimate pH values.

Table 4. Meat quality traits of crossbred pigs with Pietrain and Duroc as terminal sire lines and the difference between them

Meat quality trait	Statistical indicator	Pietrain	Duroc	Significance
pH_i (MLD)	Mean	5.81	6.17	$P < 0.001$
	Standard error	0.06	0.04	
pH_i (ham)	Mean	6.08	6.23	$P > 0.05$
	Standard error	0.09	0.08	
pH_u (MLD)	Mean	5.71	5.82	$P < 0.01$
	Standard error	0.02	0.04	
pH_u (ham)	Mean	5.79	5.99	$P < 0.001$
	Standard error	0.03	0.05	
Drip loss (%)	Mean	6.61	4.58	$P < 0.01$
	Standard error	0.49	0.53	
W. h. c. (cm^2)	Mean	8.84	7.73	$P < 0.001$
	Standard error	0.18	0.29	
CIE - L^*	Mean	52.28	46.16	$P < 0.001$
	Standard error	0.60	0.85	

The results on drip loss percentage from present study agree well with the results of Edwards *et al.* (2003) and Rozycki (2003). In our investigation CIE- L^* values were significantly lower in Duroc sired pigs which is in disagreement with findings of Edwards *et al.* (2004) who reported no differences between two sire breeds.

The distribution of meat examined in both groups of pigs into quality classes according to Kauffman *et al.* (1992) is presented on Figure 1.

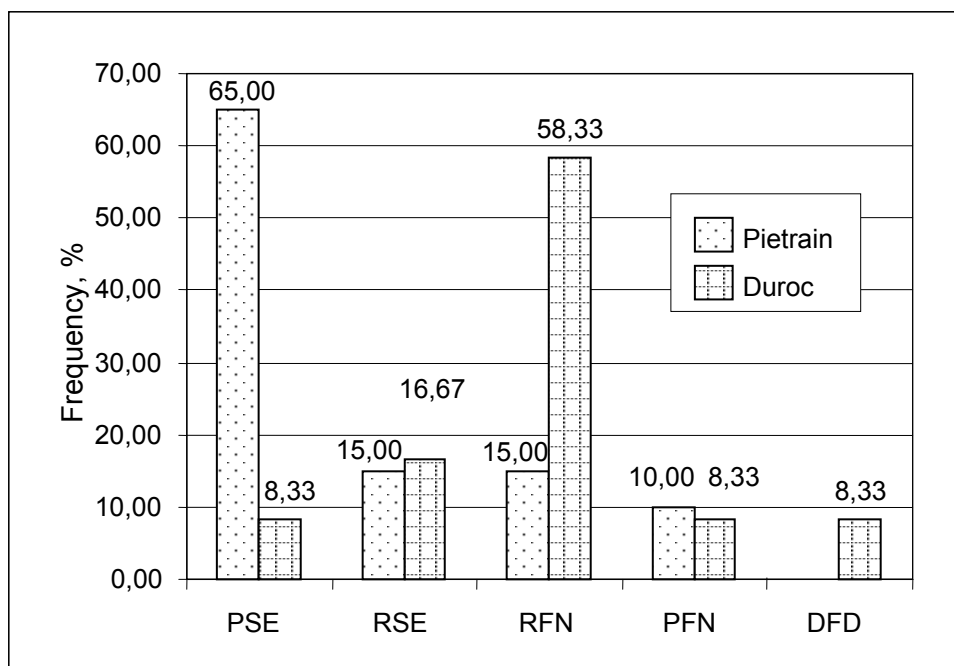


Figure 1. The distribution of the meat samples of crossbred pigs with Pietrain and Duroc as terminal sire lines according to quality conditions

When view at in this manner, it can be observed that only 15% of the pigs from Pietrain group had meat with favourable quality (RFN), while in the Duroc group this proportion is markedly higher (58.33%). In the meat of pigs from Pietrain group, the percentage of cases with severely disordered relation of colour and water holding capacity followed by undesirably low pH_u (PSE meat) was very high (65%); percentage of Duroc originated meat samples with such characteristics was low (8.33%). In Pietrain group was also recorded 15% of the samples with desirable, characteristic colour of the pork, but at the same time with poor water holding capacity which qualifies them as RSE meat; slightly more of such cases were found in the Duroc group (16.67%). The rest of the meat samples (10%) can be described as pale, firm, non-exudative meat (PFN) which has good water holding capacity and favourable pH_u values, but due to its pale colour might be unappreciated on the market of fresh meat; it was found 8.33% of such cases in Duroc group. Finally, 8.33% of the meat samples from Duroc group was characterised as dark firm and dry meat (DFD), while none of the samples from Pietrain group showed this property.

CONCLUSION

On the basis of the investigation on carcass and meat quality traits of crossbred pigs originating from Pietrain and Duroc as terminal sire breed, following can be concluded:

- Although no differences in carcass weight are found, pigs from Pietrain group were characterised by longer carcasses; their hams had significantly higher circumference ($P < 0.001$), but were also significantly longer which resulted in similar ham indexes ($P > 0.05$); there were no differences in muscle area between the groups but the pigs from Pietrain group had significantly lower fat area indicating higher meatiness of the pigs from this group proved by significantly lower fat area /loin eye area ratio.

- The carcasses from investigated groups had similar percentages of bones; carcasses of Pietrain group had significantly higher percent lean and less fat than the carcasses of the pigs with Duroc as terminal sire breed.
- Investigated meat quality traits pointed out better overall meat quality of crossbreeds with Duroc as terminal sire breed. With exception of initial pH value measured in ham, significant differences in all meat quality indicators were found between the groups and all of these were in favour of the meat originating from pigs crosses with Duroc as terminal sire.
- The distribution of meat into 5 quality classes confirmed poorer meat quality of Pietrain offspring since 85% of the samples were classified as PSE and RSE meat while in Duroc group the frequency of samples in these two classes was 25%. Only 15% of the samples from Pietrain group could be classified as the meat with “normal” traits (RFN); in Duroc group the frequency of RFN condition was much higher (58.33).

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