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Comparison of carcass and meat quality of purebred, F_1 and three-way crossbred pigs

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ABSTRACT

This study was performed on 88 pig carcasses evenly distributed into four groups regarding the origin: Large White (LW) and Swedish Landrace (SL) purebreds; LW×SL and (LW×SL) × Pi crossbred pigs. At approximately 100 kg live weight the pigs were slaughtered in one slaughter plant in eastern Croatia. In the slaughterhouse, carcass and meat quality traits were measured. It was found that three-way crossbred pigs had higher dissectional lean percentage (P<0.05) than both purebreds. Two-way crossbred pigs had the shortest carcass length. The highest ham circumference (P<0.05) had three-way crossbred pigs; these pigs had also significantly higher (P<0.05) MLD surface, compared to other pig groups. The highest fat surface and the most undesirable (P<0.05) fat/muscle ratio at MLD cut had LW purebred pigs which significantly differed (P<0.05) from other pig groups. Three-way crossbreds and SL purebreds had lower pH45 values than LW purebred and two-way crossbred pigs. LW purebreds had significantly higher pH24 value than other groups (P<0.05). Both purebred pigs had more favorable (P<0.05) WHC than three-way crosses; two-way crossbred pigs had intermediary values of this trait. Generally, three-way crossbred pigs with Piétrain as terminal sire had the leanest carcasses with the lowest meat quality.
(Keywords: pigs, carcass, meat quality, traits)

INTRODUCTION

Proper knowledge on the characteristics of breeds involved in the breeding program is essential to the decision making within the pork production and marketing systems (*Edwards et al*., 2003). Croatian pork production is based on final hybrids of initial pig breeds included in the breeding program. The most used breeds within this program are Large White and Swedish Landrace for the production of F1 sows utilizing hybrid vigor in the aim of production of large litters characterized by advantageous fitness. On the side of the sire the most common used breed is Piétrain, ensuring the production of carcasses with high lean meat percentage. The production traits of final hybrids are strongly influenced by initial breeds used in program. Previous investigations proved that different breeds have a predetermined predisposition toward superiority in specific aspects of pork quality which may have inversed effect on other traits; e.g. involvement of Piétrain breed as terminal sire results in high lean production, but with reduced quality of meat (*Sonesson et al*., 1998; *Edwards et al*., 2003; *Šimek et al*., 2003; *Kralik et al*., 2004; *Kušec et al*., 2004).

In that respect, the aim of present study is to investigate the carcass and meat quality traits of the breeds used most often in Croatian pig breeding program: Large

White (LW), Swedish Landrace (SL) purebreds; their F1 generation two-way crosses (LW×SL), and three-way crossbred pigs representing typical fattener pigs in Croatia; (LW×SL) × Pi (Piétrain).

MATERIALS AND METHODS

This study was performed on 88 carcasses of four pig groups (22 pigs in each group): 1st group=Large White (LW), 2nd group=Swedish Landrace (SL) purebreds; 3rd group LW x SL and the 4th group=(LW x SL) x Pi. 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 of 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). The lean meat percentage (M%) in carcasses was obtained by "two points" and instrumental method according to Croatian Regulations (N.N. Nr. 119/1999) using the following formulas:

"Two points" method:

$$M\% = 47.978 + 26.0429\frac{F}{M} + 4.5154\sqrt{M} - 2.50181\log_{10} F - 8.4212\sqrt{F}$$

F: the minimum thickness of visible fat (including rind) on the midline of the split carcass in millimetres, covering the lumbar muscle (*M. glutaeus medius*),

M: the visible thickness of the lumbar muscle on the midline of the split carcass in millimetres, measured at the shortest connection between the front (cranial) end of the lumbar muscle and the upper (dorsal) edge of the vertebral canal.

Instrumental method:

$$M\% = 54.456\text{-}0.75027(F) + 0.21181(M)$$

F: the thickness of backfat (including rind) in millimetres, measured at 7 cm off the midline of the split carcass, between the second and third last ribs,

M: the thickness of the muscle in millimetres, measured at the same time and in the same place as F.

After 24 hours of cooling, cold carcass weight, backfat and loin eye area (cm^2), ultimate pH (pH_{24}) values, water holding capacity (w.h.c.) 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) 24 hours after cooling. 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). The color of the meat was measured photometrically by means of Göfo device (Göttingen) at *m. longissimus dorsi* cut, 24 hours after cooling.

RESULTS AND DISCUSSION

Carcass and meat quality traits of two different purebreds as well as of two- and three-way crossbred pigs were investigated in this study. Carcass traits of pigs originating from mentioned groups of pigs are presented on *Table 1*.

Table 1

Carcasses traits of investigated pigs

Indicator	Groups				P value
	1 (LW) $\overline{X} \pm s$	2 (SL) $\overline{X} \pm s$	3 (SL×LW) $\overline{X} \pm s$	4 (/LW×SL/×P) $\overline{X} \pm s$	
Weight of warm carcasses (kg)	83.09±3.56	81.05±5.66	80.50±10.12	81.06±5.13	0.550
Fat thickness by „TP“ method (mm)	19.83±8.04	18.40±4.98	19.62±5.42	16.94±5.04	0.362
Muscle thickness by „TP“ method (mm)	61.00±5,48	62.13±3,93	64.31±4,70	64.97±5,66	0.166
Lean meat percentage by „TP“ method (%)	51.75±4,74	52.46±3,58	51.98±3,24	53.93±4,07	0.298
Lean meat percentage by dissection (%)	52.61^{b}±3.27	53.25^{b}±3.25	55.27^{ab}±3.82	56.38^{a}±3.92	0.021
Lean meat percentage by instrumental method (%)	53.85±4.55	53.01±3.28	54.51±4.55	54.65±4.54	0.657
Carcass length – a (cm)	89.67^{a}±2.42	87.09^{ab}±4.61	84.59^{b}±5.75	87.76^{a}±4.38	0.045
Carcass length - b (cm)	104.33^{ab}±2.73	105.67^{a}±4.03	100.86^{b}±4.84	103.00^{ab}±4.74	0.019
Ham length (cm)	29.41±2.52	30.64±0.79	29.91±1.51	30.41±1.50	0.065
Ham circumference (cm)	69.55^{b}±1.41	68.50^{b}±2.76	69.86^{ab}±3.58	71.26^{a}±2.85	0.004
Ham index	0.42±0.04^{a}	0.45±0.02^{b}	0.43±0.02^{a}	0.43±0.02^{a}	0.011
MLD surface (cm^2)	33.76^{b}±4.64	35.59^{b}±5.67	37.46^{b}±6.04	41.84^{a}±7.50	<0.001
Surface of MLD belonging fat (cm^2)	24.81^{a}±5.87	18.66^{b}±4.25	20.40^{b}±7.15	19.74^{b}±4.73	0.002
Fat/MLD surface ratio	0.75^{a}±0,22	0.53^{b}±0,13	0.56^{b}±0,23	0.49^{b}±0.16	<0.001

Means within row with different superscript (a, b) differ at P<0.05.

Statistically significant differences between examined groups of pigs were established in lean percentage determined by dissection (P=0.021), carcass length “a” and “b” (P=0.045 and P=0.019, resp.), ham circumference and index (P=0.004 and P=0.011, resp.), MLD and belonging fat surface (P<0.001 and P=0.002, resp.), as well as fat/meat ratio at MLD cut (P<0.001).

Three-way crossbred pigs had higher lean percentage (P<0.05) determined by dissection, compared to purebreds. Second group consisted from F1 two-way crossbred pigs showed intermediary leanness and did not differ significantly from other examined groups of pigs. Third group (F1 crossbred pigs) had the shortest carcass length (length “a”=84.59 cm and length “b”=100.86 cm). The carcasses of pigs from this group were significantly shorter (P<0.05) from the 1st and 4th group (length “a”) and from second group (length “b”). The highest ham circumference had three-way crossbred pigs (71.26 cm) which statistically differed (P<0.05) from purebreds (69.55 and 68.50 cm); these pigs had also significantly higher (P<0.05) MLD surface, compared to other groups of investigated pigs. The highest fat surface at MLD cut (24.81 cm^2) had LW purebred pigs which significantly differed (P<0.05) from other pig groups; the same group of pigs also had the most undesirable (P<0.05) fat/muscle ratio at MLD cut.

Table 2 shows meat quality traits of pigs from investigated groups. From presented results, the strong influence (P<0.01) of breed on initial and ultimate pH values and water holding capacity (WHC) can be observed.

Table 2

Meat quality traits of investigated pigs

Indicator	Groups				P value
	1 (LW) $\bar{x} \pm s$	2 (SL) $\bar{x} \pm s$	3 (SLxLW) $\bar{x} \pm s$	4 (/LWxSL/xP) $\bar{x} \pm s$	
pH_{45}	$6.32^{a} \pm 0.37$	$6.04^{b} \pm 0.35$	$6.29^{a} \pm 0.27$	$5.96^{b} \pm 0.34$	<0.001
pH_{24}	$5.84^{a} \pm 0.23$	$5.72^{b} \pm 0.21$	$5.73^{b} \pm 0.19$	$5.63^{b} \pm 0.17$	0.003
W.H.C. (cm^2)	$7.61^{b} \pm 2.05$	$8.45^{b} \pm 2.05$	$8.60^{ab} \pm 1.85$	$9.52^{a} \pm 1.73$	0.004
Colour (Göfo value)	59.68±12.91	60.45±7.40	59.18±7.95	56.41±5.27	0.292

Means within row with different superscript (a, b) differ at P<0.05.

Higher values of pH45 were recorded for the pigs from the 1st and 3rd group (6.32 and 6.29, resp.) than for those from group 2 and 4 (6.04 and 5.96, resp.); the differences were statistically significant (P<0.01). Pigs from the 1st group had significantly higher pH24 value (5.84) than those from other groups (p<0.05). Purebred pigs (groups 1 and 2) had more favorable (P<0.05) WHC than three-way crosses. Two-way crossbred pigs had intermediary values measurements of this trait, and did not differ between the purebreds nor the three-way crossed pigs. No significant influence of the breed was found on the color of meat measured by Göfo device.

The value of pig carcasses increases with higher muscularity and lower fatness level, as pointed out by other authors (*Fisher et al*., 2003; *Kolstad*, 2001). These authors also reported on difference between genotypes in mentioned characteristics which is supported by present study. The differences in lean meat percentage between the groups of investigated pigs regarding to methods of estimation (TP and instrumental) were not statistically significant, which could be expected since the differences in muscle and fat measures were insignificant as well. However, the differences in lean percentage between the groups of pigs were significant when carcasses were dissected into main tissues. This discrepancy between dissectional leanness and estimated lean percentage suggests that current methods for carcass classification of pigs at the slaughter line should be checked on accuracy. According to many authors, the meat quality decreases with the increase of carcass leanness and related traits (*Sonesson et al*., 1998; *Kralik et al.*, 2001; *Kušec et al*., 2004; *Šimek et al*., 2004). In present study, three-way crossbred pigs with Piétrain as terminal sire line proved to have the leanest carcasses with obviously lower overall quality of meat which supports the findings of mentioned investigators.

CONCLUSION

The following conclusions can be drawn on the basis of present study:

Three-way crossbred pigs (SL×LW) x Pi had higher dissected lean percentage (P<0.05), compared to purebreds. Two-way crossbred pigs (SL×LW) had intermediary leanness and did not differ significantly from other examined groups of pigs (P>0.05). The differences between the groups of pigs in lean percentage estimated by "TP" and instrumental method were not statistically significant. The discrepancy between dissectional leanness and estimated lean percentage by both methods suggests that current methods for carcass classification of pigs at the slaughter line should be checked on accuracy of prediction.

F1 crossbred pigs (SL×LW) had the shortest carcass length which significantly differed ($P<0.05$) from the SL purebreds and three-way crossbred pigs (length "a") as well as from LW purebred pigs (length "b").

The highest ham circumference had three-way crossbred pigs (71.26 cm) which statistically differed ($P<0.05$) from purebreds (69.55 and 68.50 cm).

Fourth group of pigs (/SL×LW/ × Pi) had significantly higher ($P<0.05$) MLD surface, compared to other groups of investigated pigs; the highest fat surface at MLD cut (24.81 cm^2) had LW purebred pigs ($P<0.05$); the same pigs also had the most undesirable ($P<0.05$) fat/muscle ratio at MLD cut.

Statistically significant differences ($P<0.01$) were found in pH45 measurements between investigated groups of pigs; three-way crossbred pigs (/SL×LW/ × Pi) and SL purebreds had the lowest values of this trait (5.96 and 6.04, resp.) compared to LW purebred and SL×LW crossbred pigs (6.32 and 6.29, resp.).

Large White purebred pigs had significantly higher pH24 value (5.84) than those from other groups ($p<0.05$) while both purebred pigs (LW and SL) had more favorable ($P<0.05$) WHC than three-way crosses. In this respect, two-way crossbred pigs did not differ between the purebreds nor the three-way crossed pigs, having intermediary values measured for this trait.

It can be generally concluded that three-way crossbred pigs with Piétrain as terminal sire line had the leanest carcasses with the lowest overall quality of meat.

REFERENCES

Comberg, G. (1978). Schweinezucht. Verlag Eugen Ulmer, Stuttgart.

Edwards, D.B., Bates, R.O., Osburn, W.N. (2003). Evaluation of Duroc-vs Pietrain-sired pigs for carcass and meat quality measures. J. Anim. Sci., 81.1895-1899.

Fisher, A.V., Green, D.M., Whittemore, C.T., Wood, J.D, Schofield, C.P. (2003). Growth of carcass components and its relation with conformation in pigs of three types. Meat Sci., 65. 639-650.

Grau, R., Hamm, R. (1952). Eine einfache Methode zur Bestimmung der Wasserbindung im Fleisch. Die Fleischwirtschaft, 4. 295-297.

Kolstad, K. (2001). Fat deposition and distribution measured by computer tomography in three genetic groups of pigs. Livest. Prod. Sci., 67. 281-292.

Kralik, G., Petričević, A., Kušec, G., Hanžek, D., Gutzmirtl, D. (2004). Pokazatelji kvalitete svinjskih trupova i mesa. Krmiva. 46. 227-236.

Kušec, G., Kralik, G., Petričević, A., Margeta, V., Gajčević, Z., Gutzmirtl, D., Pešo, M. (2004). Differences in slaughtering characteristics between crossbred pigs with Pietrain and Duroc as terminal sire. Acta agriculturae slovenica. 1. 121-127.

Pravilnik o utvrđivanju kategorija i klasa svinjskih trupova i polovica. Narodne novine br. 119/1999.

Sonneson, A.K., De Greef, K.H., Meuwissen, T.H.E. (1998). Genetic parameters and trends of meat quality, carcass composition and performance traits in two selected lines of Large White pigs. Livest. Prod. Sci., 57. 23-32.

Šimek, J., Grolichova, M., Steinhauserova, I., Steinhauser, L. (2004). Carcass and meat quality of selected final hybrids of pigs in the Czech Republic. Meat Sci., 66. 383-386.

Weniger, H.J., Steinhauf, D., Pahl, G. (1963). Musculare Topography of carcasses. BLV Verlagsgesellschaft, München.

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