

## CARCASS AND MEAT QUALITY OF SELECTED FINAL CROSSBRED PIGS IN THE REPUBLIC OF CROATIA

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### SUMMARY

*The objective of this research was to compare the quality of carcass and meat of selected pigs in Croatia. Investigation was carried out on 80 pigs, divided into three groups. Pigs from 1<sup>st</sup> and 2<sup>nd</sup> groups were three-way crossbreeds between Large White and Swedish Landrace on the dam side and Pietrain (1<sup>st</sup> group) and German Landrace (2<sup>nd</sup> group) on the sire side. 3<sup>rd</sup> group was created from pigs crossbred between Large White and German Landrace of the dam side, and Pietrain on the sire side. Influence of crossbreeding on lean meat percentage, Fat/MLD ratio and portions of main parts in carcass (except for shoulder) was statistically significant ( $P < 0.001$ ). The highest portion of muscular tissue was obtained in the 3<sup>rd</sup> group (62.80%), followed by the 1<sup>st</sup> group (56.50%) and the 2<sup>nd</sup> one (52.33%). The 2<sup>nd</sup> group exhibited the best indicators of MLD technological properties ( $pH_{45}$ ,  $pH_{24}$ , W.H.C. and color). Carcasses with lower lean meat percentage had better meat quality traits than those with higher lean meat percentage.*

*Key-words: pigs, crossbreeds, slaughtering traits, technological traits, PSE*

### INTRODUCTION

Production of pig meat is based on crossbreeds, i.e. hybrid pigs. In crossbreeding in Croatia, main pig breeds for the dame line are Large White and Swedish Landrace, and lately also German Landrace. Pietrain and German Landrace are usually used as a sire line. Production characteristics of final crossbreeds depend on the traits of initial breeds. The increase of lean meat in carcass as well as good technological properties of meat with low percentage of meat defects are main requirements that pig producers are confronted with. The PSE (pale, soft, exudative) condition is the most important defect of pork meat. Proportions in the PSE defect vary in particular populations of slaughtered pigs. Gispert et al. (2000) stated the occurrence of PSE defect in 6.5% of pigs, Nanni Costa et al. (2002) in only 3%, and Borzuta et al. (2001) reported the same defect in 34% of pigs. Petričević et al. (2000) investigated Croatian crossbred pigs and determined the PSE of meat in 13.3-29.4%, which depended on the crossbreeding combination. They also noted that the increase of lean meat in carcass affected the decrease of meat quality. Pietrain pigs are known to be extreme lean, but also to have poorer meat quality. Crossing with Pietrain can lead to poor meat quality of offspring (Senčić et al., 2000; Kralik et al., 2004; Kušec et al., 2004). Šimek et al. (2004) also pointed out that the meat quality depended on the hybrid combination, emphasizing the positive effect of the Duroc breed and negative one of the Pietrain breed.

### MATERIAL AND METHODS

A total of 80 pigs of different crossbreeds were used for this investigation (as shown in Table 1). Pigs were not fed 12 hours prior to slaughtering. After primary slaughtering process, right and left halves were cut into main parts (ham, shoulder, loin, belly-rib part, neck) and into parts of less value (head, glands, legs, tail and kidneys), all according to Weniger *et al.* (1963). Afterwards, each part was divided into bones, muscular tissue and fatty tissue with skin. Weight of double chin and kidney fat were added to a total of fatty tissue. Portions of tissue were shown in relation to weights of cold carcasses.

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**Table 1. Origin and number (n) of final crossbreds**

Tablica 1. Porijeklo i broj (n) završnih križanaca

Crossbred <i>Križanci</i>	n	Dam lines – <i>Majčinska linija</i>	Sire lines – <i>Očeva linija</i>
1 <sup>st</sup> group <i>1. skupina</i>	30	Large White x Swedish Landrace (LWxSL) <i>Veliki jorkšir x švedski landras (VJxŠL)</i>	Pietrain – <i>Pietren (Pi)</i>
2 <sup>nd</sup> group <i>2. skupina</i>	20	Large White x Swedish Landrace (LWxSL) <i>Veliki jorkšir x švedski landras (VJxŠL)</i>	German Landrace (GL) <i>Njemački landras (NjL)</i>
3 <sup>rd</sup> group <i>3. skupina</i>	30	Large White x German Landrace (LWxGL) <i>Veliki jorkšir x njemački landras (VJxNjL)</i>	Pietrain - <i>Pietren (Pi)</i>

Initial pH values (pH<sub>45</sub>) were measured in *Musculus longissimus dorsi* (MLD) 45 minutes after exsanguinations. The length of carcass was measured from *os pubis* to the 1<sup>st</sup> rib. After 24 hours of cooling, cold carcass weight, backfat and MLD area (cm<sup>2</sup>), ultimate pH (pH<sub>24</sub>) values, water holding capacity (W.H.C.) and color of *m. longissimus dorsi* were measured. Backfat and muscle areas were measured by the geometric procedure (Comberg, 1978) and expressed as the fat/loin eye area ratio; W.H.C. was determined by using compression method of Grau and Hamm (1952), colour was observed by the Göfo device. All the data were statistically analyzed. ANOVA was calculated by STATISTICA, version 6.0 (StatSoft Inc., 2001) for Windows.

## RESULTS AND DISCUSSION

The carcass quality traits are presented in Table 2. Average weight of cold carcasses and average length of carcasses were not statistically significant among groups (P>0.05).

**Table 2. Carcass quality within each final crossbred ( $\bar{x} \pm s$ )**Tablica 1. Kakvoća polovica završnih križanaca ( $\bar{x} \pm s$ )

Trait - Svojstvo	1st group <i>1. skupina</i>	2 <sup>nd</sup> group <i>2. skupina</i>	3rd group <i>3. skupina</i>	Significance of differences <i>Značajnost razlika</i>
Cooled carcass weight, kg <i>Težina hladnih polovica, kg</i>	76.42±4.32	77.37±7.44	74.43±0.91	n.s.
Carcass length, cm <i>Dužina polovica, cm</i>	87.23±4.46	86.20±5.18	88.70±2.38	n.s.
Fat/MLD area ratio <i>Odnos slanina : meso u MLD-u</i>	0.48 <sup>b</sup> ±0.16	0.59 <sup>c</sup> ±0.17	0.30 <sup>a</sup> ±0.09	***
Ham – <i>But</i> , %	29.32 <sup>a</sup> ±1.52	28.63 <sup>a</sup> ±1.85	31.76 <sup>b</sup> ±1.26	***
Shoulder – <i>Plečka</i> , %	14.94±0.92	14.70±1.36	14.86±0.73	n.s.
Loin – <i>Leđa</i> , %	16.70 <sup>b</sup> ±1.38	16.42 <sup>b</sup> ±1.40	15.41 <sup>a</sup> ±0.93	***
Belly rib part – <i>Trbušno-rebarni dio</i> , %	18.73 <sup>b</sup> ±1.30	18.92 <sup>b</sup> ±1.93	17.31 <sup>a</sup> ±1.22	***
Neck – <i>Vrat</i> , %	8.24 <sup>a</sup> ±0.71	8.52 <sup>a</sup> ±1.14	9.31 <sup>b</sup> ±1.02	***
Less valuable parts, % <i>Manje vrijedni dijelovi</i> , %	12.07 <sup>b</sup> ±0.85	12.81 <sup>b</sup> ±0.97	11.37 <sup>a</sup> ±0.71	***
Tissue portion of carcasses – <i>Udjeli tkiva u polovicama</i> , %				
Muscle tissue – <i>Mišićno tkivo</i>	56.50 <sup>b</sup> ±4.02	52.33 <sup>a</sup> ±3.36	62.80 <sup>c</sup> ±3.69	***
Fatty tissue – <i>Masno tkivo</i>	26.12 <sup>b</sup> ±3.91	29.95 <sup>c</sup> ±4.15	19.20 <sup>a</sup> ±3.61	***
Bones – <i>Kosti</i>	10.39±0.76	10.28±0.91	9.89±0.88	n.s.

Differences (a-c) between final crossbreds in the same line \*\*\*P≤0.001; n.s.= non significant

The most favorable Fat/MLD ratio was obtained in the 3<sup>rd</sup> group of the (LWxGL)xPi crossbreds. In comparison to the 3<sup>rd</sup> group, the 1<sup>st</sup> group of (LWxSL)xPi crossbreds exhibited less favorable ratio, and the least favorable ratio was obtained in the 2<sup>nd</sup> group of (LWxSL)xGL. Three-way crossbreds, having Pietrain as a sire line, had significantly higher portions of ham and neck (P<0.001), and smaller

portions of less valuable carcass parts (1<sup>st</sup> and 3<sup>rd</sup> group) than three-way crossbreds with German Landrace as a sire line (2<sup>nd</sup> group). With respect to carcass quality, results show that the crossbreeding combination of the 3<sup>rd</sup> group was the most successful one. When compared to the 2<sup>nd</sup> group, total dissection of carcass proved that pigs of the 1<sup>st</sup> and 3<sup>rd</sup> group had more muscular tissue (4.17% and 10.47%, respectively). Moreover, referring to the negative correlation between portions of muscular and fatty tissue in carcass, the 1<sup>st</sup> and 3<sup>rd</sup> group had respectively 10.75% and 6.92% less fatty tissue than the 2<sup>nd</sup> group ( $P < 0.001$ ). Differences in portions of bones among all groups were not statistically significant ( $P > 0.05$ ).

Quality indicators for all three groups are presented in Table 3. Values of pH<sub>45</sub> were measured 45 minutes *post mortem*. These values are used to predict quality and to classify meat in the production process. According to the average pH<sub>1</sub> value of meat in the 2<sup>nd</sup> group (6.07), it can be concluded that the meat quality is satisfactory, because it has the pH<sub>45</sub> value higher than 6.00, which is an indicator of normal technological quality, as of Blendl et al. (1991). Average pH<sub>45</sub> values of meat in the 1<sup>st</sup> and 3<sup>rd</sup> group (5.93 and 5.92, respectively) are approaching the border values, but are still lower than recommended, which labels those samples as “suspicious meat”. This needs to be taken into account when using this meat in production. Occurrence of dark, firm and dry meat (DFD) can be defined according to the ultimate pH values. Forrest (1998) reported that ultimate pH value of 6.2 and higher was an indicator of DFD meat. Based on the ultimate pH values, all three groups in our investigation exhibited normal values with no significant differences among them ( $P > 0.05$ ).

**Table 3. Pig meat quality indicators ( $\bar{x} \pm s$ )**  
*Tablica 3. Pokazatelji kakvoće svinjskog mesa ( $\bar{x} \pm s$ )*

Indicator – Pokazatelj	1st group <i>1. skupina</i>	2nd group <i>2. skupina</i>	3rd group <i>3. skupina</i>	Significance of differences <i>Značajnost razlika</i>
pH <sub>45</sub>	5.93±0.34	6.07±0.19	5.92±0.27	n.s.
pH <sub>24</sub>	5.62±0.17	5.70±0.11	5.66±0.11	n.s.
W.H.C. – <i>Sp.v.v.</i> , cm <sup>2</sup>	8.57 <sup>b</sup> ±1.77	7.79 <sup>a</sup> ±1.08	8.65 <sup>b</sup> ±1.29	*
Color (Göfo value) <i>Boja (Göfo vrijednost)</i>	55.80±4.94	56.60±6.10	54.58±3.07	n.s.

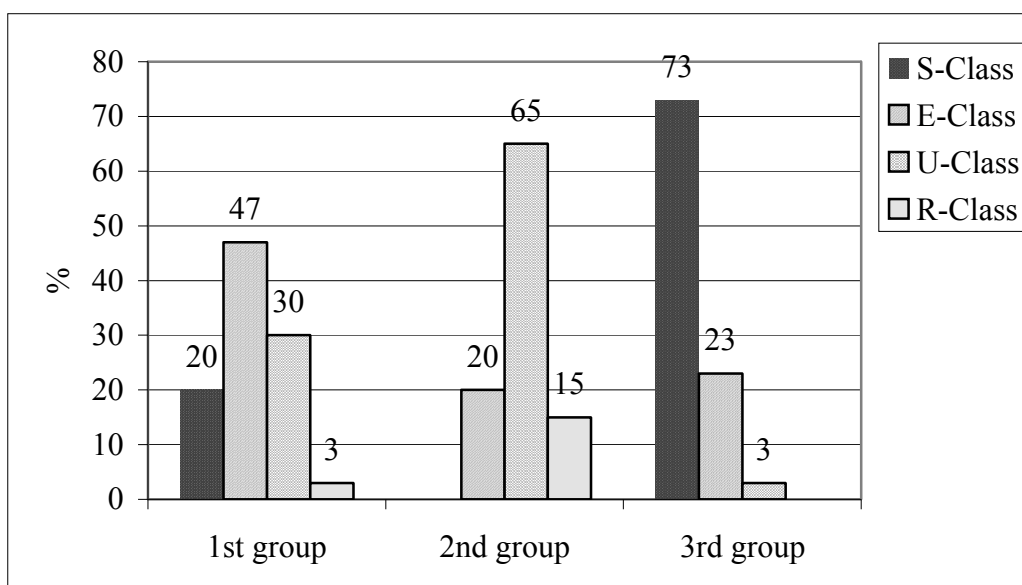
Differences (a-c) between final crossbreds in the same line \* $P \leq 0.05$ ; n.s.= non significant

Water holding capacity measured by the compression method between 4 cm<sup>2</sup> and 8 cm<sup>2</sup> is a characteristic of normal meat. Mean values calculated for all three groups, and shown in Table 3, indicate satisfactory meat quality of the 2<sup>nd</sup> group, while in the 1<sup>st</sup> and 3<sup>rd</sup> group the W.H.C. exceeds limited acceptable values.

Although there was no statistically significant difference established among investigated groups in respect to meat color ( $P > 0.05$ ), when measured according to Blendl et al. (1991), who used the border Göfo value of <55 for BMV, pig meat of the 1<sup>st</sup> and 2<sup>nd</sup> group (55.80 and 56.60, respectively) were of “normal” quality, and the meat quality of (LWxGL)xPi crossbreds in the 3<sup>rd</sup> group was poor (Göfo value = 54.58).

Classification of carcasses according to the S(EUROPE) system, based on the average lean meat (Pravilnik, 1999), resulted in the following: 2<sup>nd</sup> group was labelled as the U class, 1<sup>st</sup> group as the E class, and the 3<sup>rd</sup> group was labelled as the S class (Figure 1). Results of this research on the carcass quality correspond with the results previously obtained by Kralik et al. (2001, 2004), as well as by Kušec et al. (2004), referring to the high lean meat percentage in offspring if the crossbreeding process involved Pietrain pigs in the sire line.

Blendl et al. (1991) recommended classification in which the pH<sub>1</sub> value of up to 5.8 indicates PSE meat, values between 5.8 and 6.0 refer to “suspicious” meat, and values above 6.0 indicate “normal” meat. If the distribution of pH<sub>45</sub> values is performed according to the authors cited, the percentage of PSE meat in the 1<sup>st</sup> group was 3%, in the 3<sup>rd</sup> group 10%, while in the 2<sup>nd</sup> group PSE meat was not found. “Suspicious” meat was found in 30% of samples of the 1<sup>st</sup> group and in 16.7% of the 3<sup>rd</sup> group. Meat with normal pH<sub>45</sub> values was found in 67% of samples in the 1<sup>st</sup> group, in 100% of samples in the 2<sup>nd</sup> group and in 73.3% of samples in the 3<sup>rd</sup> group.



**Figure 1. Classification of carcasses (in %) according to the (S)EUROP system**

*Grafikon 1. Razvrstavanje polovica prema (S)EUROP sustavu*

Several authors reported on the lower qualitative traits of meat in crossbreds with Pietrain in the sire line, independent of the MHS status (Oliver et al., 1993; Hamilton et al., 2001; Senčić et al., 2000; Kralik et al., 2004; Kušec et al., 2004; Šimek et al., 2004). Frequent occurrence of PSE meat, as reported in our investigation, was observed also by Nanni Costa et al. (2002) and Gispert et al. (2000). Significantly higher percentage of PSE meat was reported by Borzuta et al. (2001) and Petričević et al. (2000).

There were significant differences in W.H.C. established among groups ( $P < 0.05$ ). These results support the reports of numerous authors who stated that increased meat percentage was followed by the decrease in meat quality (Petričević et al., 2000; Kralik et al., 2002).

When distributing the Göfo values according to criteria of Blendl et al. (1991), the most samples classified as “normal meat” (Göfo value  $> 55$ ) were found in the 2<sup>nd</sup> group (65%), followed by the 1<sup>st</sup> group (60%), while the 3<sup>rd</sup> group had the lowest portion of meat with good technological quality (52.6%). Poor quality of meat originating from three-way crossbreds with Pietrain as a terminal breed was reported by Senčić et al. (2000) and Kušec et al. (2004).

## CONCLUSION

Based on the presented results, the following can be concluded:

With respect to carcass quality, the (LWxGL)xPi was the best evaluated crossbreds. The pigs of this group had the most muscular tissue (62.80%), followed by the (LWxSL)xPi crossbreds. The lowest lean meat percentage (52.33%) was exhibited by the (LWxSL)xGL crossbreds. Differences in percentage of muscular tissue in carcass among investigated crossbreds were highly significant ( $P < 0.001$ ). The Fat/MLD area ratio was the most favorable in pigs with high lean meat percentage.

Cutting of carcasses into main parts (ham, loin, belly-rib part, shoulder and neck) resulted in the conclusion that there was highly significant difference ( $P < 0.001$ ) in the percentage of main parts among different crossbreds (except for shoulder), pointing out that more lean carcasses have higher percentage of ham.

The best technological quality of MLD was obtained in the (LWxSL)xGL crossbreds. In this group there was no occurrence of PSE meat. Other indicators, such as W.H.C. and colour, were also better in this group when compared to other two crossbreeding combinations. Carcasses with lower lean meat percentage had more favorable meat quality traits than those with high lean meat percentage.

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## KAKVOĆA TRUPOVA I MESA SELEKCIJIRANIH SVINJA U REPUBLICI HRVATSKOJ

### SAŽETAK

*Cilj ovog istraživanja bio je usporediti kakvoću polovica i mesa selekcioniranih svinja u Hrvatskoj. Istraživanje je provedeno na 80 svinja, podijeljenih u tri skupine. Svinje 1. i 2. skupine bile su trostruki križanci između velikog jorkšira i švedskog landrasa na strani majke te pietrena (1. skupina) i njemačkog landrasa (2. skupina) na strani oca, dok su 3. skupinu činili križanci velikog jorkšira i njemačkog landrasa na strani majke te pietrena na očevoj strani. Utjecaji križanja na postotni udio mesa, odnos slanina/meso u MLD-u i udjel osnovnih dijelova u trupu (izuzev plečke) bili su statistički značajni ( $P < 0,001$ ). Najviše mišićnog tkiva imala je 3. skupina (62,80%), zatim slijede 1. skupina (56,50%) i 2. skupina (52,33%). Najbolji*

*pokazatelji tehnološke kakvoće MLD-a ( $pH_{45}$ ,  $pH_{24}$ , Sp.v.v. i boja) utvrđeni su u 2. skupini svinja. Polovice s manjim postotkom mesa imale su bolja svojstva kakvoće mesa u odnosu na one s višim udjelom mesa.*

*Ključne riječi: svinje, križanci, klaonička svojstva, tehnološka svojstva, BMV*

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