# PORK CARCASS COMPOSITION AND THE MEAT QUALITY OF THE BLACK SLAVONIAN PIG – THE ENDANGERED BREEDS IN THE INDOOR AND OUTDOOR KEEPING SYSTEM

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# PORK CARCASS COMPOSITION AND THE MEAT QUALITY OF THE BLACK SLAVONIAN PIG – THE ENDANGERED BREEDS IN THE INDOOR AND OUTDOOR KEEPING SYSTEM

***Danijela Butko, Đ Senčić, Z Antunović, Marcela Šperanda, Z. Steiner***

Original scientific paper

## SUMMARY

***The research has been made on 20 Black Slavonian Pigs in both ways of keeping them (indoor, outdoor). The pigs have been fed up to 135 kg body weight. The pigs in the outdoor system have been held on a natural pasture ground. Other than pasture, the pigs have consumed, over the summer period, the food offered on stubble-fields after the harvest (barley, wheat) and over the winter times after corn harvest. They had only minimal corn consumption; mostly during the winter (average daily consumption was 0.15 kg). Dissection of cold (+4$^0$C) right sided pig body composition has been made by the modified Weniger et al (1963) method. The meat quality has been determined on a long back muscle sample (musculus longissimus dorsi- MLD) taken berween 13$^{th}$ and 14$^{th}$ rib. The pig carcasses in the outdoor system had a very significant (P<0.01) absolute and relative leg share, less belly-rib share and higher meat quantity. Commercially, more valuable parts-legs and back had a greater share of muscle tissue in pigs' carcasses in the outdoor system. The meat of the pigs in the outdoor system had no signifficant differences from the pigs in the indoor system, concerning the pH$_1$, pH$_2$, water holding capacity, colour and marbling. However, the meat of the pigs in the outdoor system had higher content of crude fat from the pigs in the indoor system.***

***Key-words: indoor, outdoor, Black Slavonian Pig, carcass quality, meat quality***

## INTRODUCTION

With the aim of keeping the genetic variability of the domestic pigs, the low-productive original breeds in certain countries are being saved from dying out. There have been reports about the characteristics of the local pig breeds, especially in the extensive ways of keeping by many authors (Pugliese et al., 2004 and 2003; Karoly et al., 2004, Đikić et al., 2004; Čandek- Potokar et al., 2003, Gentry et al., 2002a and b; Uremović et al., 2000; Mayoral et al., 1999; Serra et al., 1998; Legault et al., 1996). Black Slavonian Pig (Pfeiffer Pig) is an original Croatian breed made by planned breeds crossing: Mangulitza, Berkshire and Poland Chine at the end of the 19$^{th}$ and the beginning of 20$^{th}$ century in Slavonia (surroundings of the city of Osijek) on Karl Pfeiffer's land. Immediately after the second world war the Black Slavonian Pig was bred mostly in Slavonia and Vojvodina and took part at about 8% of the total number of swine in that Yugoslavia. Concerning the number of this breed (58 boars and 627 sows, CLC, 2005) there is a danger of dying out of this breed. Due to good immunity, skin with pigments and the ability of greater quantity of voluminously food consumption (pasture), this breed is favourable for the ecological pork meat production.
The aim of this research is to establish how the ways of keeping pigs (indoor, outdoor) influence the slaying quality of the Black Slavonian Pig and, relating to that, which breeding technology to apply for this breed's preserverance.

## MATERIAL AND METHODS

### *Animals, diets and keeping systems*

*Danijela Butko, BSc., Assistant., PhD. Đuro Senčić, Full Professor; PhD. Zvonko Antunović, Full Professor; PhD. Marcela Šperanda, Assistant Professor; PhD. Zvonimir Steiner, Ass. – Agriculture Faculty in Osijek, Trg sv. Trojstva 3, 31 000 Osijek, Croatia, E-mail: dbutko@pfos.hr*

The research has been conducted with 20 Black Slavonian Pigs in both ways of keeping them (indoor, outdoor). The sex proportion (male castrated and female) in pig groups was equal. The pigs have been fed up to 135 kg body mass. During the slaying times the pigs in the outdoor system were 540+/- 20 days old and those in the indoor system were 359+/- 20 days old. The pigs in the indoor system have been fed from 30 to 100 kg body mass *ad libitum* with fodders contained 14.0% crude proteins and 13.0 MJ ME/kg, and from 100-135 kg body mass with fodders contained 12.0% crude proteins and 13.0 MJ ME/kg. The pigs in the indoor system were held on the floor of 1.2 $m^2$ per animals. The pigs in the outdoor system have been held daily on a natural pasture ground. The pasture surface by one animal was 0.05 ha. The dominant flora on the pasture ground were: *Festuca pratensis, Festuca rubra, Poa pratensis, Alopecurus pratensis, Tripholium repens* and *Tripholium pratense*. At night and over bad weather conditions the pigs were under a shelter. Technology with small input has been applied. Other than pasture, the pigs have consumed, over the summer period, food offered on stubble-fields after the harvest (barley, wheat) and over the winter times after corn harvest. They had only minimal corn consumption, mostly during the winter (average daily consumption was 0.15 kg).

***Dissection***

Disection of cold (+4$^0$C) right sided pig body composition has been made by the modified Weniger *et al.* (1963) method. According to this modification, the muscle tissue of the head has not been inserted into the total muscle tissue quantity. The head, along with a tail and knuckles made less valuable parts, and so was a part of muscle tissue in the belly- rib parts, made into a hamburger bacon. The cold pig's halves length has been measured from the axis pubis to atlas and from the axis pubis to the 1$^{st}$ rib. The thickness of the back bacon and the surface of the cross-section *m. longissimus dorsi*-MLD was between 13$^{th}$ and 14$^{th}$ rib in hight.

***Quality meat analysis***

$PH_1$ value of meat has been determined 45 minutes *post mortem* and $pH_2$ value 24 hours *post mortem* with a contact pH meter Mettler Toledo after the meat had been exposed to +4$^0$ C. The meat quality has been determined on a long back muscle sample (*musculus longissimus dorsi*- MLD) taken berween 13$^{th}$ and 14$^{th}$ rib. Water holding capacity of meat has been determined by Grau and Hamm (1952) and the colour and marbling by the American NPPC method (National Pork Producers Council). The content of crude proteins in meat (MLD) has been determined by Kjehldahl method and it contained intramuscular fat, by the Soxhlet method.

***Statistical analysis***

Statistic processing of the results was done by a computer programe Statistica soft Inc (2001). Significance between the groups was determined by Student t-test of independing variables.

## RESULTS AND DISCUSSION

***Carcass quality***

The basic characteristics of Black Slavonian Pig carcasses from the indoor and the outdoor system are presented in the Table 1.

**Table 1. Basic characteristics of the pig carcass quality in indoor and outdoor keeping system**

| Indicators | Statistical size | Keeping systems | |
|---|---|---|---|
| | | Indoor (359 days old) | Outdoor (540 days old) |
| Body weight, kg | $\bar{x}$ | 135.00 | 135.60 |
| | s | 4.50 | 4.45 |
| Dressing, % | $\bar{x}$ | 82.96 | 82.44 |
| | s | 2.77 | 2.80 |
| Cold halves' weight, kg | $\bar{x}$ | 55.45 | 55.29 |
| | s | 1.86 | 1.88 |
| Halves' length[1], cm | $\bar{x}$ | 103.00 | 102.90 |
| | | 3.60 | 3.50 |

| | | | |
|---|---|---|---|
| | s | | |
| Halves' length[2], cm | $\bar{x}$ | 87.00 | 87.20 |
| | s | 3.50 | 3.45 |
| MLD surface, cm$^2$ | $\bar{x}$ | 32.00 | 33.00 |
| | s | 3.00 | 3.50 |
| Leg circumference, cm | $\bar{x}$ | 66.00* | 67.00 |
| | s | 1.50 | 1.50 |
| Leg length, cm | $\bar{x}$ | 35.00 | 35.50 |
| | s | 2.50 | 2.45 |
| Bacon thickness[3], cm | $\bar{x}$ | 5.50** | 5.00 |
| | s | 0.50 | 0.45 |

[1] Os pubis-atlas;[2] Os pubis-first rib, [3]13/14 rib; *P<0.05; ** P<0.01

Equal pigs' weight before slaying and cold halves' weight have made possible the right comparison of their slaying characteristics. There were no significant differences (P>0.05) between the pigs concerning the dressing, halves' lengths, cut surface of the long back muscle (MLD) and leg lengths, but not concerning the back bacon thickness. Pigs in the outdoor keeping system had statistically larger (P<0.05) leg circumference and very significant (P<0.01) much thinner bacon in comparison to the pigs in the indoor keeping system. Thinner back bacon was determined by Pugliese et al., (2003) in the outdoor keeping system of pigs. Gentry et al. (2002 b), however, determined a thicker bacon between the first and the last rib in those fed in the outdoor system over the summer, while at the pigs fed over the winter there were no significat differences (P>0.05) in the bacon thickness in the indoor and outdoor keeping system. The conformation of pig carcasses (Table 2) in the outdoor system differed in some measures from those in the indoor keeping system.

**Table 2. The conformation of pig carcasses in the outdoor and indoor keeping system**

| Half share | Statistical size | Keeping systems | | | |
|---|---|---|---|---|---|
| | | indoor | | outdoor | |
| | | kg | % | kg | % |
| Leg | $\bar{x}$ | 12.61** | 22.75* | 13.36 | 24.16 |
| | s | 0.83 | 1.50 | 0.82 | 1.49 |
| Back part | $\bar{x}$ | 10.26 | 18.50 | 10.27 | 18.57 |
| | s | 1.03 | 1.65 | 1.04 | 1.67 |
| Shoulder | $\bar{x}$ | 7.91 | 14.27 | 8.24 | 14.90 |
| | s | 0.74 | 1.36 | 0.77 | 1.42 |
| Neck | $\bar{x}$ | 5.71 | 10.30 | 5.70 | 10.31 |
| | s | 0.59 | 1.17 | 0.60 | 1.18 |
| Belly-rib part | $\bar{x}$ | 12.82** | 23.12** | 11.53 | 20.85 |
| | s | 1.51 | 2.57 | 1.36 | 2.32 |
| Double chin | $\bar{x}$ | 1.87 | 3.37 | 1.66 | 3.00 |
| | s | 0.52 | 0.93 | 0.46 | 0.83 |
| Grease | $\bar{x}$ | 0.72** | 1.30* | 0.92 | 1.66 |
| | s | 0.18 | 0.32 | 0.24 | 0.41 |
| Less valuable parts | $\bar{x}$ | 3.54 | 6.39 | 3.61 | 6.53 |
| | s | 0.31 | 0.59 | 0.32 | 0.60 |
| Cold halves' weight | $\bar{x}$ | 55.45 | 100.00 | 55.29 | 100.00 |
| | s | 1.86 | | 1.88 | |

*P<0.05; ** P<0.01

The carcasses of those in the outdoor system had absolutely and relatively higher leg and kidney fat share (grease) but less belly-and-rib share in comparison to those in the indoor keeping system. In a view of other carcass shares (back, shoulders, neck, double chin, less value parts), significant differences (P>0.05) between the analyzed groups of pigs not have been found. Pugliese et al. (2003) found out that pigs' carcasses from the outdoor keeping system had a significantly higher relative leg share (P<0.01), shoulders and kidney fat and a much less share of the back bacon compared to the

pigs' carcasses from the indoor keeping system. The composition of the commercially most valuable carcass and leg parts including the back parts also had differences between the analyzed groups of pigs. The pigs' carcasses in the outdoor system had a statistically much higher share of the muscle tissue and a less share of the fat tissue (Table 3) in legs and the back part.
No significant differences have been detected by in the muscle, faty and bone tissue shares in the shoulders of pigs between the outdoor and indoor keeping system (Table 3).
Total quantity of the muscle tissue and halves have been absolutely and relatively statistically much higher in pigs in the outdoor system pigs (Table 4).
Bee et al. (2004), Lahrmann et al. (2004), Stern et al. (2003) and some other authors have indicated the higher meat quantity of pigs in the outdoor keeping system.

**Table 3. Tissue shares in pig's legs, back parts and shoulders in the indoor and outdoor keeping system**

| Joint of carcass | Tissue | Statistical size | Kepping system | | | |
|---|---|---|---|---|---|---|
| | | | Indoor | | Outdoor | |
| | | | kg | % | kg | % |
| Leg | Muscle | $\bar{x}$ | 6.53** | 51.78** | 7.44 | 55.69 |
| | | s | 0.60 | 2.70 | 0.76 | 2.87 |
| | Fat | $\bar{x}$ | 4.29 | 34.03** | 4.11 | 30.76 |
| | | s | 0.47 | 3.75 | 0.49 | 3.70 |
| | Bone | $\bar{x}$ | 1.79 | 14.19 | 1.81 | 13.55 |
| | | s | 0.28 | 3.20 | 0.26 | 2.99 |
| Back part | Muscle | $\bar{x}$ | 3.62** | 35.28** | 4.15 | 40.41 |
| | | s | 0.58 | 1.90 | 0.61 | 2.08 |
| | Fat | $\bar{x}$ | 5.18* | 50.52** | 4.65 | 45.28 |
| | | s | 0.82 | 5.70 | 0.86 | 5.78 |
| | Bone | $\bar{x}$ | 1.46 | 14.20 | 1.47 | 14.31 |
| | | s | 0.20 | 1.80 | 0.19 | 1.82 |
| Schoulder | Muscle | $\bar{x}$ | 4.45 | 56.26 | 4.71 | 57.16 |
| | | s | 0.55 | 2.75 | 0.59 | 2.86 |
| | Fat | $\bar{x}$ | 2.26 | 28.57 | 2.36 | 28.64 |
| | | s | 0.28 | 3.55 | 0.31 | 3.65 |
| | Bone | $\bar{x}$ | 1.20 | 15.17 | 1.17 | 14.20 |
| | | s | 0.09 | 1.35 | 0.11 | 1.44 |

*P<0.05, **P<0.01

**Table 4. Tissue shares in pig's halves in the indoor and outdoor keeping system**

| Tissue | Statistical size | Keeping systems | | | |
|---|---|---|---|---|---|
| | | Indoor | | Outdoor | |
| | | kg | % | kg | % |
| Muscle | $\bar{x}$ | 21.34** | 38.50** | 22.66 | 41.00 |
| | s | 1.27 | 2.30 | 1.69 | 2.37 |
| Fat | $\bar{x}$ | 24.29* | 43.81* | 22.64 | 40.96 |
| | s | 2.32 | 4.20 | 2.31 | 4.24 |
| Bone | $\bar{x}$ | 6.28 | 11.30 | 6.38 | 11.54 |
| | s | 0.43 | 0.79 | 0.49 | 0.86 |

*P<0.05, ** P<0.01

***Meat quality***
The quality marks of the pig's meat in the indoor and outdoor keeping system are presented in the Table 5.

**Table 5. Pig meat quality estimates from the indoor and outdoor keeping system**

| Indicators | Keeping systems | | | |
|---|---|---|---|---|
| | Indoor | | Outdoor | |
| | $\bar{x}$ | s | $\bar{x}$ | s |
| pH1 | 6.60 | 0.25 | 6.70 | 0.30 |
| pH2 | 5.70 | 0.30 | 5.80 | 0.30 |
| Water holding capacity, cm² | 4.50 | 1.80 | 3.98 | 2.00 |
| Colour (1-6) | 4.00 | 1.00 | 4.00 | 1.50 |
| Marbling (1-10) | 4.00 | 1.50 | 4.50 | 1.60 |
| Water, % | 72.50** | 0.35 | 71.65 | 0.30 |
| Crude proteins, % | 21.30 | 0.45 | 21.25 | 0.35 |
| Crude fat, % | 4.95** | 0.38 | 5.90 | 0.35 |
| Ash, % | 1.25 | 0.05 | 1.20 | 0.06 |

** P<0.01

Significant differences (P>0.05) between the analyzed pig groups concerning the pH value, water holding capacity (the discharge of meat juice on a filter paper) and the colour of the long back muscle (MLD) have not been detected. In the researches of Stern et al. (2003), most of the technological meat quality estimates ($pH_1$, inner reflection, filter-paper moisture, the loss of mass by cooking) were similar. Lahrmann et al. (2004) did not determine differences between the indoor and the outdoor groups concerning the pH of meat. Gentry et al. (2004) found outthat the outdoor keeping system can influence the colour of meat and the type of muscle fibres. In the Bee et al. researches (2004), the percentage of water loss was higher in musculus longissimus dorsi and the brighter parts of m. semitendinosus in pigs from the outdoor keeping system. In the same research, the final pH has been lower in *m. rectus femoris* and *m. semitendinosus* in the outdoor keeping system pigs. The results of their researches suggest that keeping pigs outdoor enhances the aerobic capacity of glicolitic muscles but it has a lesser side-effect to the quality of meat. The meat of pigs kept in the outdoor system had a statistically much less water (P<0.01) and more intramuscular fat, in relation to the meat kept in indoor system.

## CONCLUSION

The keeping system (outdoor and indoor) significantly influenced the composition and conformation of carcasses as well as the quality of meat of the Black Slavonian pig. The pig carcasses in the outdoor system had a very significant (P<0.01) absolute and relative higher leg share, less bell-rib share and higher meat quantity. Commercially more valuable parts-legs and back had a greater share of muscle tissue in pigs' carcasses in the outdoor system. The meat of the pigs in the outdoor system had no significat differences from the pigs in the indoor system, concerning the $pH_1$, $pH_2$, water holding capacity, colour, marbling, but it had a greater content of the crude fat.

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