EVALUATION OF FATTENING PERFORMANCE, CARCASS TRAITS AND MEAT CHARACTERISTICS OF PRESTICE BLACK-PIED PIGS IN THE ORGANIC FREE- RANGE AND CONVENTIONAL SYSTEM.

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Abstract

The objective of this study was to estimate the differences in fattening performance, carcass traits and meat characteristics of Prestice Black-Pied (PBP) pigs and (BuxL)x(HxPn) crossbreed pigs (C) reared under organic free-range system or conventional indoor feeding system.

PBP pigs under conventional system were characterized by lower average daily gain and worse carcass traits (lower meat percentage and higher carcass fatness) compared to C pigs. In nutritional characteristic, meat of PBP pigs differed in the content of crude protein (it was lower) and in intramuscular fat content (it was higher) from C pigs. There was not found significant difference in n-6/n-3 PUFA ratio between PBP and C pigs.

PBP pigs under organic free range system had a similar growth performance, lower daily feed intake and lower weight of ham in comparison with C pigs. There was found differences in nutritional characteristic between PBP and C meat. PBP pigs achieved significantly ($P<0,05$) higher intramuscular fat content. The content of n-3 PUFA was higher in meat of PBP pigs than in C pigs.

In the both organic and conventional farming systems, PBP meat had lower content of hydroxyprolin which is accompanied with shorter duration of maturing time.

The aim of this evaluation is to find out the optimal rearing system for Prestice Black – Pied pigs. The most PBP population is reared under conventional indoor system and its pork products are sold as conventional. In these conditions, PBP breed can not compete with the modern pig breeds and final hybrids in growth and carcass characteristics.

It can be concluded that the organic free range system is much suitable for BPB breed than commercial rearing system. The organic system allows better expression of PBP genotype. This production system with the use of local breed could produce specific and high-quality products with the regional label.

Key Words*:* Prestice Black-Pied pigs, free-range system, conventional system, fattening performance, carcass traits, meat characteristic, polyunsaturated fatty acid

Prestice Black-Pied pig is Czech autochthonous breed from west region of the Czech Republic. This breed is reared in the close population which is included in National program for farm animal resources. The PBP, as other unimproved breeds, is characterised by a strong constitution and good maternity traits. The most PBP population is fattened under conventional indoor system and products are sold as conventional. In that conditions the PBP is characterized by lower daily gain and higher carcass fatness as well as lower leanness in comparison with the modern crossbreeds. In present time the PBP breeding is uneconomic and the size of effective population is decreasing. The survival of this breed, similarly to other local breeds, is strictly connected to a good assessment and exploitation of breed performances and market opportunities (Acciaioli et al,2002). The aim of this study is to find out better exploitation of PBP. In Europe there are same examples, when traditional local breed are reared outdoor in the extensive feeding and the final product have special label of local or regional product. There are studies focused to the influence of pasture and free range system on quality of meat (Lebret et al., 2008, Pugliese et al.,2006). But there are no studies about PBP under extensive production system. At the present time there are data about fattening performance, carcass traits of PBP in the conventional system, but nothing from excessive production system. No research has been done on the meat quality of the PBP. This study compares fattening performance, carcass traits and nutritional quality of PBP meat and meat of commercial crossbreed in two different production systems.

Material and Methods

There were realised two trials in two different farms characterized by a different system of rearing and feeding: Prestice Black-Pied (PBP) pigs and (BuxL)x(HxPn) crossbreed pigs (C) were reared under organic free-range system or conventional indoor feeding system.

On the organic farm with free-range system 36 fatteners per group were reared separately by genotype (PBP and C pigs) on the pasture (8000m^2 per group) with tarpaulin sheds. Animals were fed *ad libitum* by complete feed mixture accordance to Organic principle. The mixture was characterized by lower nutrition ratio, especially lower protein content, which is typical for organic feeding. The pigs had *ad libitum* access to water and pasture (based on lucerne with additional plants).

On the conventional farm 20 pigs per group (PBP and C pigs) were reared indoor in the separated pens with concrete and partly slatted floors. Pigs were fed with two commercial feed mixtures according to fattening period.

There were two separated groups which were fed *ad libitum* in both outdoor and conventional rearing system. Pigs had *ad libitum* access to water. The daily feed consumption and feed conversion ratio were monitored in each group. The feeding tests started at the age of three month (according to the usual age of weaning in the organic farm) and finished when the animal reached the target live weight about 110 kg. Before the beginning of the experiment the pigs were subjected to the same feeding and management (conventional pigs one month before and organic pigs two month before). Animals were weighted the first and the last day of feeding test. The pigs reached the slaughter weight at different time: The indoor pigs at the age 6 of months and outdoor pigs at the age of 7-8 months. The pigs within the each experiment were slaughtered at the same time (indoor in 120th days and outdoor in 145th days). For the dissection and carcass measurement 10 fatteners (barrows and gilts) were levied from each group. Dissection and carcass measurement were made 24 h after slaughter from the right side of carcass. (Beneš 1995). The main lean cuts (neck, loin, shoulder, ham) and separable fat (visceral: felt and subcutaneous fat: back and ham fat) were weighted and carcass lean cuts content and carcass fat content were calculated.

The samples of *Musculus Longissimus Dorsi* (MLD) were used for meat quality analyses (IMF, crude protein, hydroxyproline and fatty acid composition). Intramuscular fat content was determined by ether extraction, according to ČSN ISO1444 (576020). Crude protein content was determined according to method Foss Tecator: Kjeldahl AN300 ČSN ISO1871 (560020). Determination of hydroxyproline, which is the most common technique for collagen determination, was conducted according to method by Bethien-Diemair (1963).

The lipid fraction was isolated by the method according to Folch et al. (1957), the preparation of the fatty acid methyl esters was done in accordance with CSN ISO 5509, fatty acid methyl esters were analyzed by gas chromatography (6890N Agilent Technologies) according to CSN ISO 5508. The gas chromatograph was equipped with DB-23 cyanopropyl-methylpolysiloxane column (60m x 0.25 mm x 0.25 μm).

Content of total saturated, monounsaturated and polyunsaturated fatty acids was calculated from detected fatty acids.

Data were statistically analyzed for each trial in the Statistical Analysis System SAS 2007 in statistical software R by model 1 with fixed effect of group, sex and interaction in between group and sex and model 2 with fixed effect of group and sex. The alpha level ≤ 0,05 had been set up to determinate significance.

Table 1. Nutrition composition of diets

	ORGANIC diets	CONVENTIONAL diets	
nutrients	KS2	A2	CDP
Crude Protein %	11,1	16,6	14,9
ME	11,3	12,2	12,5

Results and Discussion

Fattening performance

The pigs reached the slaughter live weight (110 kg) in different age, conventional pigs at the age of 6 month and organic pigs nearly two months later. In the intensive system, the productive potential of PBP breed was characterized by lower average daily gain: 20% lower than crosbreed pigs (C), lower daily feed intake which is accompanied with worse feed conversion ratio. This is in agreement with long term observation and also with characteristics of European unimproved breeds. On the contrary, PBP pigs in the organic free-range system showed similar average daily weight gain, lower daily feed intake but better feed conversion ratio in comparison with C pigs.

Carcass characteristic

Table 3 reports carcass characteristics. In conventional system the PBP pigs showed lower weight of carcass and also lower weight of every monitoring main lean cut than crossbreed pigs of the same age. The carcasses of PBP pigs were characterized by lower lean meat content and higher fat content. Although the average weight of PBP carcass was lower than C pigs, the PBP group had in the same age higher carcass fat ratio (% of separable fat in the carcass). These results confirm the ability for strong fat deposition of the unimproved pigs, as already reported by Labrouse et al. (2000). In organic free-range system the PBP group differed in the weight of ham and consequently in lower carcass lean meat content than C pigs. Those results are in agreement with observations in European native pig breed such as Cinta Senese and Nero Siciliano in Italy (Acciaioli et al., 2002; Pugliese et al., 2003) or the Spanish Iberian breed (Serrano et al., 2008).

Table 2. Fattening performance

		ORGANIC		CONVENTIONAL	
		Crossbreed (C)	**PBP**	**Crossbreed (C)**	**PBP**
Body weight at slaughter	kg	112	107	114	92
Age at slaughter	day	206	206	186	186
Daily weight gain	kg	0,57	0,55	0,86	0,65
Daily feed intake	kg	2,84	2,65	2,36	2,05
Feed conversion ratio	kg/kg	5,10	4,80	2,74	3,15

Table 3. Carcass characteristics

		ORGANIC		CONVENTIONAL	
Average weight of lean cuts from half carcass composition		crossbreed	PBP	crossbreed	PBP
Half carcass composition	kg	41,70	40,22	43,66*	36,30*
Weight of ham	kg	7,48*	6,52*	9,09*	6,73*
Weight of shoulder	kg	4,08	3,84	5,55*	4,83*
Weight of neck	kg	3,51	3,33	4,08*	3,32
Weight of loin	kg	4,09	3,96	5,31*	4,27*
Carcass lean cuts content	kg	19,16*	17,65*	24,03*	19,14*
Carcass lean cuts ratio	%	45,97*	43,92*	55,05*	52,70*
Carcass fat content	kg	6,87	6,93	5,36	5,34
Carcass fat ratio	%	16,43	17,22	12,28*	14,73*

*P≤0,05

Carcass lean cuts content: weights of main cuts: neck, loin, shoulder, ham
Carcass fat content: weights of separable visceral and subcutaneous fat pads
Carcass lean cuts ratio: weight of main cuts/weight of carcass
Carcass fat ratio: weight of separable visceral and subcutaneous fat/weight of carcass

Nutritional and technological quality of MLD

In both productive systems the PBP group had higher content of IMF (in conventional system no significant), which was accompanied with better juiciness and better sensory traits of meat. That tendency of local breed to have higher intramuscular fat content than improved breeds is well known (Labroueet al., 2000; Estévezet al., 2003; Franci et al., 2005). There was also found significant difference in the level of hydroxyproline which was in PBP group lower in both productive systems in comparison with C pigs. This result indicates lower content of collagen, important indicator of meat quality (Koucký, 1991) which could affect the duration of tenderness process in pork (Wheeler et al. 2000). C group in conventional system showed higher level of crude protein than PBP. It could be explained by strong ability for protein deposition in the muscles under optimal feeding conditions.

Fatty acid composition in MLD

Fatty acid content in meat is an important nutritional characteristic which has been paid attention in contemporary research because of its influence for human health. There has been an interest in manipulating the lipid

composition of pork to produce the healthier meat, i.e. with increased n-3 PUFA (polysaturated fatty acid) level and decreased n-6:n-3 PUFA ratio (Legrandet al., 2002, Wood et al., 2004)

Fatty acid composition of pork can be easily manipulated through the feeding regime, the main factor influencing the n-6:n-3 PUFA ratio (De Smet et al.,2004). Feeding sources rich in n-3 PUFA, such as rapeseed oil and especially crushed linseed have been shown to increase the n-3 PUFA content in intramuscular fat (Legrant et al.,2002, Wilfard et al.,2004, Václavková a kol, 2007) and reduce the n-6:n-3 ratio. Also the effect of grazing on n-6:n-3 PUFA ratio is similar and has been reported in many studies (Nielsen et al., 2001, Bee a kol. 2004,Lebretet al., 2008).

Content of MUFA (monounsaturated fatty acids), SFA (saturated fatty acids) and PUFA is influenced by level of intramuscular fat (IMF). Higher IMF content is associated with higher concentration of SFA and MUFA and lower concentration of PUFA (Cameron et al. 1991, Alonso et al., 2010). In our study we recorded fatty acid composition of *Musculus Longissimus Dorsi* with regard to the n6:n3 PUFA ratio.

There were not significant differences between PBP and C groups, except higher content of MUFA in C group in conventional system. In organic system the PBP group differed in content of MUFA, PUFA n3, PUFA n6, PUFA n6:n3 ratio. PBP group was characterized by higher level of MUFA (which could be due higher carcass fatness and higher content of IMF), higher level of PUFA n3 with lower PUFA n6 and lower PUFA n6:n3 ratio in comparison with C group. These differences could be explained by more intensive grazing or ability for better utilization of pasture in PBP pigs.

Table 4. Nutritional and technological quality of MLD

		ORGANIC		CONVENTIONAL	
		crossbreed	PBP	crossbreed	PBP
IMF	g/kg	20,5*	27,6*	15,2	17,3
Crude protein	g/kg	213,4	213,8	219,8*	212,2*
Hydroxyprolin	g/kg	0,57*	0,48*	0,52*	0,43*

*P≤0,05

Table 5. Fatty acid content in MLD

MLD Relative content		ORGANIC		CONVENTIONAL	
		crossbreed	PBP	crossbreed	PBP
Σ SFA	%	40,56	41,11	39,91	40,84
Σ PUFA	%	59,44	58,89	60,09	59,16
Σ MUFA	%	47,38*	48,70*	48,13*	45,14*
Σ PUFA n3	%	0,98*	1,08*	1,20	1,32
Σ PUFA n6	%	10,97*	9,01*	10,68	12,59
Ratio n6:n3 PUFA		11*	8*	9	10

*P≤0,05

SFA-saturated fatty acids, MUFA - monounsaturated fatty acids, PUFA - polyunsaturated fatty acids

Conclusion

From the results it could be concluded, that in the contemporary conditions the alternative free range system with extensive feeding could be better for Prestice Black-Pied breed that conventional one. In conventional system the PBP pigs had worse fatness and carcass traits and no important significant differences in meat characteristic (except content of hydroxyproline) were found. The conditions in free-range system allow better expression of PBP genotype, its strong constitution, ability for intensive grazing and good utilization of pasture. The PBP breed under free range system showed similar growth performance with better feed conversion ratio and lower carcass leanest than crossbreed pigs. The meat of PBP pigs was characterized by higher content of IMF, higher PUFA n3 and lower PUFA n3:n6 ratio in IMF in comparison with crossbreed pigs. With respect to these results, there is possibility to produce products with additional value (with beneficial impact on human health) and with some special label, such as regional product. It could be chance how to save Prestice Black-Pied breed for the future. For the more details consecutive investigations should be done.

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