

INFLUENCE OF IMPORTED PIGS BREEDS TO LITHUANIAN WHITE PIGS MEAT PRODUCTION AND QUALITY**

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Abstract. Pig breeding in Lithuania has still remained a traditional branch of agriculture. Pork meat in meat production balance of the country makes over 40 %. Many authors stated that in case of favorable conditions for crossbreeding combinations it becomes possible to improve successfully pigs' meat properties and meat quality (*Michalska et al*, 2000; *Žaiadilov et al*, 2005; *Iionov*, 2005; *Jukna et al*, 2005; *Suslina et al*, 2005; *Dziaugys et al*, 1997). In order to improve pork meat quality in Lithuania it seems important to know which breeds of pigs are most purposeful for breeding with Lithuanian White pigs. The report presents the data about the crossing of Lithuanian White (LW) pigs with the Landraces (L), Yorkshires (Y) and boars of Large White breed. The most effective for the growth rate of crossbreeds are considered to be boars of Landraces and Yorkshires breeds ($p < 0.05 - < 0.001$). Forage expenditure on the weight gain decreased only reproducers of Landraces breed ($p < 0.001$). Crossbreeding led to the decreased amount of fat in LW pigs behind the terminal rib by 6.76–8.16 mm ($p < 0.01 - < 0.001$), 6.7–8.44 cm increased the area of cross-section of the longest dorsal muscle ($p < 0.001$) and by 2.83–4.2 % increased the muscularity of the carcass ($p < 0.01 - > 0.05$). The studied boars of the imported breeds also affected some meat quality parameters of Lithuanian White pigs. Drip loss of the crossbreeds of Yorkshires and Large White breed tended to be by 2.89–3.2 % lower than in Lithuanian White pigs ($p < 0.05 - < 0.001$). The meat of all crossbreeds tended to be harder than in Lithuanian White pigs ($p < 0.05 - < 0.01$) and the tendency of lower water coherence capability ($p < 0.001 - > 0.05$) was also observed. The effect of crossbreeding on the other quality parameters in pigs was less considerable.

Keywords: pig, breed, purebred, crossbred, meat production, meat quality.

Introduction

Pork meat has made quite considerable part of meat industry balance recently. The number of pigs has been constantly increasing. Pork meat makes up to 39.4 % of world meat production balance, in Europe – 49.3 % (*Мысик, 2006*). Pork meat is considered to be quite high in calories, distinguished by good gustatory properties, rich in high-valued protein with considerable amount of irreplaceable amino-acids, mineral substances and vitamins. It contains lower amount of protein collagen and elastin if to compare to other animals. Pork meat quality can be characterized by numerous parameters the value and variability of which greatly depends on endogenous and exogenous factors (*Заяс, 1981; Мысик, 2006; Бурмистров и др., 2005*). Pig breeding in Lithuania has still remained a traditional branch of agriculture. Pork meat in meat production balance of the country makes over 40 %. Increased demand of high muscular pork meat requires faster improvement of meat characteristics of existing breeds of pigs and rational crossbreeding combinations. Lithuanian White pigs has still remained as a main breed. They are distinguished by good reproductive properties, high milk production, good fattening, undemanding for feeding, insusceptible to stress, ability to adapt to local conditions (*Klimas, 2002*).

In many highly developed pig-breeding countries meat quality is improved by innerbreeding and interbreeding heterosis. The energy of the crossbred pigs in pig breeding has been observed for more than 150 years and many hypothesis have been created in order to clarify this phenomenon (*Герасимов и др., 2006*). The creation and maintenance of heterosis effect through the number of successive generations has been the main task for selectors. However, when the interbreeding is applied, manifestation of heterosis is observed not in every case even when conditions for full manifestation of genotype are carefully observed. This phenomenon greatly depends on the genetic peculiarities of the breeds used (*Нечеева и др., 2006*). Many authors stated that in case of favorable conditions for crossbreeding combinations it becomes possible to improve successfully pigs' meat characteristics and meat quality (*Michalska et al, 2000; Жаиадилов, 2005; Попов, 2005; Jukna et al, 2005; Suslina et al, 2005; Dziaugys et al, 1997*).

In order to improve pork meat quality in Lithuania it seems important to know which breeds of pigs are most purposeful for breeding with Lithuanian White pigs.

The aim of this research was to study the effect of Landraces, Large

White and Yorkshires on meat quality and meat characteristics of Lithuanian White pigs.

Material and methods

Two groups of pigs containing 20 piglets each were formed for the experiments (each group consisted of the same number of castrated boars and gilts): the control group consisting of Lithuanian White (LW) and three experimental: LW x Landraces (LWxL), LW x Yorkshires (LWxJ), LW x Large White (LWxLWW). The maternal breed of all investigated breeds was Lithuanian White while paternal breed – boars of imported breeds. 5 offspring's of each breed boars were taken for the examination. 2 month old experimental piglets were collected in the station of pigs control fattening in Baisogala and they were grown under the same standardized condition until they reached the weight of 95–100 kg. Standard concentrated forage, the energetic value of which was 13,4 MJ AE, crude protein made 16 % of ration dry matter, was used for feeding pigs. At the end of the experiment were calculated the age at the weight of 100 kg, an average daily weight gain and forage expenditure per kg of weight gain.

The control slaughtering was made at the slaughtering house of the station when pigs reached the required weight. During the control slaughtering were measured weight of the carcass, muscularity, length of the halves of the carcasses, fat thickness behind the last rib. The samples for meat quality investigation were taken from the longest dorsal muscle (*musculus longissimus dorsi*) between the 12th and the last rib 24 h after slaughtering. The samples were kept in the fridge at + 4°C temperature. 24 hours after slaughtering at the Laboratory of Meat Quality of Lithuanian Veterinary Academy were measured pH (by a pH-meter), meat color according to the method CIE-LAB, measuring meat lightness L^* , redness of the color (a^*), yellowness of the color (b^*), the amount of dry matter drying the sample at the temperature of 105°C to the constant weight, the amount of fat according to the Soxlet method, the amount of protein according to Kjeldal, amount of ash – by burning meat organic matter at the temperature of 600–800°C, meat drip loss according to the decrease of the sample weight during the period of 24 hours while keeping it in special string bags at the temperature of + 4°C. 48 h after slaughtering were determined water holding capacity by the method of Grau and Hamm, hardness by Warner-Brazler method, cooking loss – boiling meat for 30 min. at the circular bath.

The data of the experiments were evaluated statistically using statistic

package R2.01.

Reliability of the differences among the groups was defined according to the Student, data are considered to be statistically reliable when $p < 0,05$.

Results and discussion

The data of the experiments clearly demonstrated better growth of the offspring of imported boar breeds. Their daily weight gain was by 62–127 g higher, and the weight of 100 kg they reached by 10–20 days earlier ($p < 0.05$ – < 0.001) than purebred (table 1). The effect of imported boars on forage expenditure per weight unit was different. The lowest forage expenditure per weight unit were in LWxL group. They used by 3.29 MJ AE per weight unit less, while the other groups – by 0.44–0.88 MJ AE more than LW pigs ($p < 0.001$). The length of carcass halves tended to be similar except LWxY where LWxY carcass parts were by 5.17 cm shorter than in LW pigs ($p < 0.001$). Highest thickness of fat behind the last rib were in LW pigs.

Table 1. Meat characteristics of experimental pig breeds

Indexes	Breed			
	LW	LWxL	LWxJ	LWxLWW
Age at 100 kg weight, d.	188±3.75	168±3.12***	173±4.87*	178±3.16*
Daily weight gain, g	731±27.02	858±28.45**	849±36.14*	793±22.54
Forage expenditure per 1 kg weight gain., MJ AE	34.32±0.08	31.02±0.14***	34.76±0.12***	35.20±0.09***
Length of the carcass half, cm	97.70±0.99	97.2±0.72	92.51±0.85***	97.53±0.52
Fat thickness behind the last rib., mm	25.16±1.51	18.40±1.23**	17.83±1.48***	17.00±1.17***
Area of the longest dorsal muscle, cm ²	28.16±1.05	36.60±0.78***	34.86±1.25***	35.53±0.60***
Ham weight, kg	10.99±0.31	11.20±0.18	11.08±0.26	11.27±0.15
Muscularity, %	49.75±0.95	52.82±0.87*	53.95±0.96**	52.58±1.76

$p < 0.05^*$; $p < 0.01^{**}$; $p < 0.001^{***}$

This parameter was by 6.76–8.16 mm higher than in the offspring of imported boars ($p < 0.01$ – < 0.001). The lowest ham weight was in LW pigs, however this difference was inconsiderable if to compare to the other groups of pigs. Dorsal muscles were better developed in crossbreds. The cross-section area of the longest dorsal muscle (*musculus longissimus dorsi*)

behind the last rib in them was by 6.7–8.44 cm larger than in purebreds ($p < 0.001$). Muscularity of the carcasses of all crossbreds was by 2.83–4.2 % higher than in purebreds ($p < 0.01 \rightarrow 0.05$).

In order to define the effect of breed on particular parameters of meat production data dispersive analysis was carried out, which evidently demonstrated that the most considerable effect of the breed was on the longest dorsal muscle area – 60.58 % and on the fat thickness behind the last rib - 42.91 %. The effect of the breed on the other parameters of meat was the following: 24.81 % – on ham weight, 11.19 % – on daily weight gain, 9.19 % – on forage expenditure, 6.49 % - on the muscularity of the carcass. Investigations of meat quality elucidated some differences between purebreds and crossbreds (table 2). The amount of dry matter in the meat of LW pigs was by 0.95–1.79 % higher than in crossbreds ($p < 0.05 \rightarrow 0.05$).

Table 2. Meat quality of investigated pigs breeds

Indexes	Breed			
	LW	LWxL	LWxJ	LWxLWW
Dry mater, %	26.57±0.67	25.21±0.19	25.62±0.22	24.78±0.24*
Protein, %	23.79±0.60	22.81±0.22	22.78±0.19	22.17±0.24*
Fat, %	1.62±0.11	1.21±0.11**	1.70±0.09	1.52±0.06
Asch, %	1.16±0.01	1.19±0.02	1.14±0.02	1.10±0.02**
pH	5.45±0.02	5.45±0.05	5.47±0.03	5.49±0.02
Color				
L*	53.22±0.61	53.21±1.43	51.83±0.77	52.79±0.61
a*	14.88±0.32	14.68±0.42	14.46±0.21	14.16±0.19
b*	6.74±0.37	5.65±0.57	5.27±0.36**	5.20±0.17***
Drip loss, %	9.29±1.03	9.14±1.60	6.40±0.62*	6.09±0.29***
Water holding capacity, %	58.20±1.15	54.95±2.04	55.78±1.05	49.44±0.85***
Tenderness, kg/cm ²	1.41±0.11	2.14±0.29*	1.99±0.14**	1.98±0.16**
Cooking loss, %	27.45±0.64	28.23±0.58	28.45±0.86	30.07±0.32***

$p < 0.05^*$; $p < 0.01^{**}$; $p < 0.001^{***}$

These data obtained during our experiment contradict to the data of *V. Gerasimov et al* (2006), when having studied quite large amount of the data of pig crossbred combinations, they stated that the amount of dry matter in the meat of crossbreds is by 1.33–4.2 % higher than in purebreds. This fact only confirms the effect of breeds compatibility on particular parameters of the offspring in the case of crossbreeding. The amount of protein was also higher in the meat of LW pigs. The most considerable difference of this parameter was found in comparison to LWxLWW crossbreds and it made

1.62 % ($p < 0.05$). Intramuscular fat in meat increase meat nutritional value and gustatory properties. However, high amount of fat suppresses production of stomach juice and protein digestibility (Заяс, 1981). Animal fat contains vitamins A, E and D which are necessary for the human organism. Soluble in fat compounds provide pork meat with specific taste (Valsta et al, 2005). In meat of all studied groups of pigs the amount of intracellular fat is rather inconsiderable. The lowest amount of this fat was found in LWxL meat. This difference made 0.41 % ($p < 0.01$) if to compare to the LW. Differences of meat pH between purebreds and crossbreds were rather inconsiderable as well. Tendency of darker meat was observed in LWxY and LWxLWW. Color a^* in the meat of all groups of pigs was very similar. Color b^* in all groups of crossbreds was lower than in purebreds ($p < 0.001 \rightarrow 0.05$). Increased meat drip loss has been one of the problems of pig breeding nowadays. This parameter was the highest in LW and LWxL pigs. Meat drip loss in LWxY and LWxLWW pigs was by 2.89–3.2 % lower than in LW pigs ($p < 0.05 \rightarrow 0.001$).

Meat water holding capacity is considered to be a very important technological characteristic defining meat availability for high quality products (Barton-Garde et al, 2001). Meat water holding capacity in crossbreds was by 3.25–8.79 % lower than in purebreds. However, statistically reliable difference was found only in LWxLWW crossbreds ($p < 0.001$). Meat hardness is an important quality parameter as well. Tender meat is tastier, easily digested and better assimilated in the organism. Meat hardness is determined by the muscle tissue and its protein structure (Заяс, 1981). Meat hardness was higher in all crossbreds if to compare to the purebreds LW ($p < 0.05 \rightarrow 0.01$).

Meat cooking loss during thermal processing is an important gastronomic parameter. The less weight loss during boiling, the more valuable the meat is. In our experiment the lowest boiling loss was in LW pigs, the highest – in LWxLWW pigs. The difference made 2.62 % ($p < 0.001$).

In order to determine the effect of breed on the particular parameters of meat quality data dispersive analysis was carried out. The results of the analysis revealed the most considerable effect of the breed on water drip loss – 49.91 %, meat color b^* – 28.5 %, drip loss – 23.74 %, hardness – 23.33 %, the amount of protein – 18.66 %, the amount of dry matter – 18.25 %, meat cooking loss – 17.54 %, the amount of ash – 11.23 %, color a^* – 5.38 %, color L^* – 5.38 %, the amount of intramuscular fat – 4.41 %, meat pH – 1.24. Paternal breed effected meat drip loss. The lowest drip loss was found in the

descendants of Yorkshires and Large White boars. The effect of crossbreeding on the other meat quality parameters of Lithuanian Large White pigs was less considerable.

Conclusions

The analysis of the experimental data led to the following conclusions:

1. Boars of all investigated imported breeds (Landraces, Yorkshires, Large White) can be used for crossbreeding with Lithuanian White pigs. The growth rate of crossbreds is most considerably increased by boars of Landraces and Yorkshires breeds ($p < 0.05$ – < 0.001). Forage expenditure on weight gain decreased only boars of Landrace breed ($p < 0.001$).

2. Crossbreeding resulted in thinner fat behind the terminal rib - 6.76–8.16 mm ($p < 0.01$ – < 0.001), by 6.7–8.44 cm increased the cross-section area of longest dorsal muscle ($p < 0.001$) and by 2.83–4.2 % increased muscularity ($p < 0.01$ – > 0.05).

3. Boars of imported breeds also affected some other meat quality parameters of Lithuanian White pigs. Meat drip loss of Yorkshires and Large White crossbreds was by 2.89–3.2 % lower than in Lithuanian White ($p < 0.05$ – < 0.001). Meat of all crossbreds tended to be harder than of Lithuanian White pigs ($p < 0.05$ – < 0.01) and water holding capacity tended to be lower ($p < 0.001$ – > 0.05). The effect of crossbreeding on other meat quality parameters was less considerable.

UTICAJ UVEZENIH RASA SVINJA NA PROIZVODNJU I KVALITET MESA LITVANSKE BELE SVINJE

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Rezime

U radu su predstavljene podaci o ukrštanju litvanske bele svinje (LW) sa nerastovima rase landras (L), jorkšir (J) i velike bele svinje. Prasad u ogleđnoj i kontrolnoj grupi su gajna do uzrasta od 2 meseca (20 potomaka od 5 nerastova) I dok nisu dostigli težinu od 95 do 100 kg u uslovima standardizovane ishrane u stanici za kontrolnu ishranu svinja u mestu

Baisogala. Na kraju oglada svinje su zaklane i urađeno je ispitivanje kvaliteta mesa (*musculus longissimus dorsi*) (hemijski sastav, pH, boja L*, a*, b*, sposobnost držanja vode, čvrstoća, kalo kuvanja). Podaci su statistički obrađeni i ocenjivani, i urađena je disperzivna analiza podataka. Na osnovu eksperimentalnih podataka može se zaključiti da se sve rase kojima su pripadali uvezeni nerastovi mogu uspešno koristiti za ukrštanje sa LW svinjama. Najefikasniji sa stanovišta brzine porasta meleza su nerastovi landras i jorkšir ($p < 0,05$ – $< 0,001$). Utrošak krmiva za prirast je smanjen samo u slučaju landras rase ($p < 0,001$). Ukrštanje je uticalo na smanjenje količine masti kod svinja LW iza krajnjeg rebra 6.76–8.16 mm ($p < 0,01$ – $< 0,001$), za 6.7–8.44 cm se povećala površina poprečnog preseka najdužeg dorzalnog mišića ($p < 0,001$) i za 2.83–4.2 % se povećala muskuloznost trupa ($p < 0,01$ – $> 0,05$). Ispitivani nerastovi rase uvezenih u litvaniju su takođe uticali na neke parametre kvaliteta mesa litvanske bele svinje. Gubitak vode kod meleza sa jorkširom i velikom belom svinjom je bio za 2.89–3.2 % manji nego kod litvanskih belih svinja ($p < 0,05$ – $< 0,001$). Meso svih meleza je bilo čvršće nego meso litvanske bele svinje ($p < 0,05$ – $< 0,01$), takođe je registrovana tendencija slabije sposobnosti vezivanja vode ($p < 0,001$ – $> 0,05$). Uticaj ukrštanja na ostale parametre kvaliteta je bio manje značajan.

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