

## **THE COMPARISON OF FATTENING RESULTS, SLAUGHTER VALUE AND MEAT QUALITY OF PIG CROSSBREEDS PULAWSKA X POLISH LARGE WHITE AND POLISH LANDRACE X POLISH LARGE WHITE**

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**Abstract.** The experiment was carried out on two groups of fatteners crossbreeds Pul x PLW (group I - 20 heads) and PL x PLW (group II – 20 heads). The fattening was conducted for 99 days in a period when the average body weight of pigs ranged from 30.5 to 105 kg and it was divided into two periods that lasted 53 and 46 days, respectively. Pigs of both groups were fed with the same mixtures based on wheat and barley (first period of fattening – 12.99 MJ ME, 170 g crude protein, 9.60 g lysine) and only barley (second period of fattening – 12.49 MJ ME, 150 g crude protein, 8.37 g lysine) supplemented with protein concentrate. The PL x PLW pigs had better daily weight gain, feed conversion ratio and were slightly more fleshiness and less fatty compared to Pul x PLW pigs. Pigs of group I, despite worse results of slaughter value, were characterized by better meat quality and more crude protein and intramuscular fat in *longissimus* muscles. The fat contained significantly ( $P \leq 0.05$ ) more  $\alpha$ -linolenic acid (C18:3). *Longissimus* and *adductor* muscles in the I group had better water holding capacity and lower drip loss, but significance difference only in *longissimus* muscles were noticed.

**Keywords:** breed, fatteners, meat quality, productive and slaughter results

### **INTRODUCTION**

Currently, in pigs production, particular attention become attached to fattening profitability as well as meat quality improvement. Both of these aspects depend from genetic factors (breed, crossing schema, gender), environments (nutrition, welfare, age and slaughter body weight), but also from interaction between those [Lenartowicz and Kulisiewicz 2000, Pisula and Florowski 2006, Florowski et al. 2006 b, Milczarek and Osek 2009, Orzechowska et al. 2009]. Selection, crossing of breed and line, nutrition appropriate could be used to carcass composition modification. Nowadays, mass production of fatteners uses

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highly-meat breeds, which obtain good fattening results, but their meat is often of poor quality. Local breeds, especially Pulawska and Zlotnicka are distinguished by high pork quality and they can be used in production of fatterer crossbreeds [Florowski et al. 2006 a].

The aim of the study was to comparison of fattening results, slaughter value and meat quality of crossbreeds of Pulawska (Pul) x Polish Large White (PLW) and Polish Landrace (PL) x Polish Large White (PLW) pigs.

## MATERIAL AND METHODS

The experiment was carried out on 40 of fatteners crossbreeds Pulawska x Polish Large White (20 heads group I) and Polish Landrace x Polish Large White (20 heads group II). The pigs obtained from crossing sows with the same boar. During lasting of this experiment animals were kept in pens (20 heads), on deep litter. The fattening was conducted for 99 days and it was divided into two periods that lasted 53 and 46 days, respectively. Feed were provided *ad libitum*. Pigs of both groups were fed with the same mixtures (Table 1) based on wheat and barley and only barley supplemented with protein concentrate. Diets were formulated to meet nutritional requirements [Polish Norms of Pig Nutrition 1993].

In the last day of fattening, directly after transport to meat plant all animals were slaughtered, according to valid technology (electrical stunning, bleeding out lying position). Next, the carcass fleshiness was estimated and 45 minutes after slaughter first recording of acidity ( $\text{pH}_1$ ) of the longest back muscles was measured. The measurement was made between the last vertebra breast and the first lumbar. After this the carcasses were weighted and chilled for 24 hours in temperature 0–4°C, next again the carcasses were weighed and acidity ( $\text{pH}_{24}$ ) of meat were estimated. On the right halves length of carcass and back fat thickness in 5 places were measured. Samples of *longissimus* and *adductor* muscles were taken in order to the physicochemical features evaluation. In both muscles estimated contents of basic nutrients as well as the composition and share of fatty acids in lipid fraction [AOAC 1990]. Water holding capacity of muscles were determined according to Grau and Hamm's [1953] method with Pohja and Ninivarra's modifications [1957], based on the amount of free water (expressed in %) lost by the sample of meat placed on the filter paper and kept under pressure between two glass plates. Infiltration of the surface area ( $\text{cm}^2$ ) was measured and calculated planimetr amount of free water, assuming that the associated infiltration 1  $\text{cm}^2$  10 mg muscle juice absorbed by filter paper. Moreover, drip loss after 48 hour from slaughter were determined according to Prange et al. [1977]. Colour brightness ( $\text{CIE L}^*$ ) of meat by Hunter system with using chromameter CR-310 Minolta. According to the methodology described by Baryłko-Pikielna [1975] taste quality of *longissimus* and *adductor* muscles were evaluated by a group of 7 people on a 5-point Tilgner scale [1957].

Table 1. Composition and nutritive value of mixtures

Tabela 1. Skład i wartość pokarmowa mieszanek

Specification – Wyszczególnienie	Mixtures – Mieszanki	
	first period of fattening pierwszy okres tuczu	second period of fattening drugi okres tuczu
Raw materials, % – Surowce, %		
Wheat – Pszenica	42.00	–
Barley – Jęczmień	43.00	88.50
Concentrate* – Koncentrat*	15.0	11.50
Nutritive value per 1 kg of mixture: Wartość pokarmowa 1 kg mieszanki:		
Metabolizable energy, MJ Energia metaboliczna, MJ	12.99	12.49
Crude protein, g – Białko ogólne, g	170	150
Lys, g	9.60	8.37
Met + Cys, g	5.18	4.77
Thr, g	6.06	5.54
Tryp, g	1.82	1.65
Ca, g	7.92	6.06
P available, g – P strawny, g	2.98	2.52
Na, g	1.58	1.24

\* Concentrate contained: metabolizable energy – min. 11.61 MJ · kg<sup>-1</sup>, crude protein – min. 400 g · kg<sup>-1</sup>, crude fibre – max. 70 g · kg<sup>-1</sup>, lys – min. 43 g · kg<sup>-1</sup>, met + cys – min. 9.9 g · kg<sup>-1</sup>, thr – min. 20 g · kg<sup>-1</sup>, tryp – min. 5 g · kg<sup>-1</sup>, Ca – min. 49.7 g · kg<sup>-1</sup>, P available – min. 11.1 g · kg<sup>-1</sup>, Na – min. 10 g · kg<sup>-1</sup>.

\* Koncentrat zawierał: energia metaboliczna – min. 11,61 MJ · kg<sup>-1</sup>, białko ogólne – min. 400 g · kg<sup>-1</sup>, włókno surowe – max. 70 g · kg<sup>-1</sup>, lys – min. 43 g · kg<sup>-1</sup>, met + cys – min. 9,9 g · kg<sup>-1</sup>, thr – min. 20 g · kg<sup>-1</sup>, tryp – min. 5 g · kg<sup>-1</sup>, Ca – min. 49,7 g · kg<sup>-1</sup>, P strawny – min. 11,1 g · kg<sup>-1</sup>, Na – min. 10 g · kg<sup>-1</sup>.

The results were statistically analysed using one-factor analysis of variance and significance of differences between means was determined by Student's t-test.

## RESULTS AND DISCUSSION

In the day of the experiment beginning body weight of weaners both groups were similar (Table 2). After 53 days of fattening pigs Pul x PLW weighted by 1.80 kg less than LW x PLW crossbreeds. In the second period of fattening body weight difference increased to 5.2 kg. The second group of pigs had higher by 75 g (9.4%) average daily gain and difference was statistically significance ( $P \leq 0.05$ ). Higher daily gain influenced on quantity feed conversion per 1 kg body weight, less by 8 and 4% in the first and second period of fattening respectively in comparison with animals I group. In whole period of fattening Pul x PLW crossbreeds obtained good daily weight gain (736 g), fact Stasiak et al. [2003] showed less 635 g daily gain for Pul x PLW pigs. Also POLSUS [Blicharski et al. 2012] carried out the usefulness evaluation of pigs proved less daily gain for breeds, gilts and

young boars: Pulawska – 607 and 575 g, Polish Large White – 698 and 638 g, Polish Landrace – 696 and 640 g.

The value of slaughter is described by different features, inter alia: dressing percentage. It is depended from a lot of factors such as: breed, gender, slaughter body weight as well as overfeeding before slaughter. Value of dressing percentage is from range 73.52 to 84.30% [Frankiewicz et al. 1999, Tereszkiwicz et al. 2004, Barowicz et al. 2006, Milczarek and Osek 2009]. In this experiment cold dressing percentage was similar and it was containing in given range. However, in comparison with results obtained on the same crossbreeds by Frankiewicz et al. [1999] and Stasiak et al. [2003] that were less.

Table 2. Rearing and post-slaughter results of fatteners  
Tabela 2. Wyniki przyżyciowe i poubojowe tuczników

Specification – Wyszczególnienie	Groups – Grupy		SEM
	I	II	
Body weight, kg – Masa ciała, kg			
initial – początkowa	30.50	30.55	1.35
after first period of fattening – po pierwszym okresie	66.59	68.39	2.51
after fattening – końcowa	103.39	108.59	3.10
Daily gains, g – Przyrost dobowy, g			
first period – pierwszy okres	681	714	27.81
second period – drugi okres	799 b	874 a	15.25
whole period – cały okres	736	788	29.66
FCR, kg feed · kg BWG <sup>-1</sup>			
first period – pierwszy okres	2.61	2.40	–
second period – drugi okres	3.07	2.94	–
whole period – cały okres	2.84	2.66	–
Body weight before slaughter, kg			
Masa ciała przed ubojem, kg	103.58	106.59	2.79
Cold carcass weight, kg – Masa tuszy zimnej, kg	77.45	79.23	2.45
Dressing percentage, % – Wydajność rzeźna, %	74.82	74.27	0.47
Meatiness, % – Mięsność, %	52.82	54.20	0.82
Carcass length, cm – Długość tuszy, cm	79.8	81.1	0.76
Mean backfat thickness from 5 measurment, mm			
Średnia grubość słoniny z pięciu pomiarów, mm	24.03	22.50	1.79
Lard weight, kg – Masa sadła, kg	1.65 a	1.28 b	0.65
Loin “eye” area, cm <sup>2</sup> – Powierzchnia „oka” połówicy, cm <sup>2</sup>	46.84 b	50.88 a	0.86

a, b – significant of difference at  $P \leq 0.05$ ; a, b – różnice istotne na poziomie  $P \leq 0.05$ .  
FCR – feed conversion ratio – zużycie paszy.

The carcass value depends from fleshiness and fatness. Higher by 1.38% meatiness had LW x PLW crossbreeds, as well as their carcasses were less fatness. Proved, that: higher by 4.04 cm<sup>2</sup> loin eye area ( $P \leq 0.05$ ), thinner by 1,53 mm backfat from 5 measurements ( $P > 0.05$ ) and less by 0.37 kg lard weight ( $P \leq 0.05$ ) in comparison with animals I group. Whereas, Stasiak et al. [2003] showed less meatiness (48.1%), and less (20.0 mm) backfat thickness for Pulawska x PLW crossbreeds.

Meat quality is determined by contents of nutrients component. The analysis of basal nutrients showed, that the longest muscle of I group contained significantly more dry matter, crude protein and crude fat (Table 3). The results obtained are similar with reported by Florowski et al. [2006 a]. Authors noticed significantly more dry matter, protein and fat in Pulawska *longissimus* muscle in comparison with Polish Landrace. Intramuscular fat content is important coefficient of quality and culinary usefulness of meat. Wajda et al. [2004] and Łyczyński et al. [2007] proved that optimum level of this nutrient in *longissimus* muscle will be 2–3%. In our experiment intramuscular fat content in *longissimus* muscle was low (1.76% and 1.14% in I and II group respectively), but similar content (1.74%) of this nutrient reported Grześkowiak et al. [2006] for Pulawska x Polish Landrace crossbreeds.

Dietetic value of meat is limited by composition and share fatty acids profile of muscles. In *longissimus* and *adductor* muscles of animals from I group noticed less linoleic acid (C18:2), but in *adductor* muscle the difference was statistical significance ( $P \leq 0.01$ ). Both muscles of Pulawska x PLW crossbreeds had significantly ( $P \leq 0.05$ ) more  $\alpha$ -linolenic acid (C18:3), which is classified as lacking in statistical Polish diet. The  $\alpha$ -linolenic acid is precursor of eicosapentaenoic acid (EPA – C20:5) and docosahexaenoic acid (DHA – C22:6) which are essential to growth correct and preservation health of humans [Jelińska 2005]. This experiment did not proved statistical differences in saturated fatty acids (SFA), unsaturated fatty acids (UFA), monounsaturated (MUFA) and polyunsaturated (PUFA), what corresponded with results obtained by Lenartowicz and Kulisiewicz [2000]. Authors did not noticed statistical influence of crossbreed pig's type on fatty acids profile of loin and ham. However, Kondracki [2000] proved, that intramuscular fat content as well as share of fatty acids were depend from pig breeds. Also Migdał et al. [2006] claimed that pigs which slower growth have more favourable fatty acids profile of lipid fraction, whereas more concentration polyunsaturated fatty acids in intramuscular fat, as well as adiposity fat influence unfavourably on technological and sensory properties obtained products.

The measurement of hydrogen ion concentration is important as parameters of meat quality estimation (Table 4), because it influences on characteristic sensory and technological usefulness obtained raw meat. Acidity of *longissimus* muscles measured after 45 minutes after slaughter difference significantly ( $P \leq 0.05$ ) between groups. The muscle of PL x PLW pigs was more acidity, but after 24 hour  $\text{pH}_{24}$  was similar (5.62 and 5.61 in I and II group respectively). According to pH value classification by Pospiech [2000] all measurements were typical for "normal" meat. It is meat, which pH limiting values are  $>5.8$  and  $<6.00$  for measurements 45 minutes and 24 hour from slaughter respectively.

The researches [Florek et al. 2004, Kajak et al. 2007, Strzyżewski et al. 2008] proved coexistence of linear dependence between acidity and colour brightness ( $L^*$ ) as well as water holding capacity of meat. Decrease pH value of meat caused increase colour brightness and often decrease water holding capacity. In our experiment did not notice these dependences. Meat of Pulawska x PLW crossbreeds was darker than PL x PLW, and difference was significantly in *longissimus* muscle ( $P \leq 0.05$ ) despite similar value of  $\text{pH}_{24}$ . In *longissimus* muscle noticed significant differences in water holding capacity ( $P \leq 0.01$ ) and drip loss of meat ( $P \leq 0.05$ ), which is a result of crossbreeds. Also Florowski et al. [2006 a] showed the same pH were measured 48 hour from slaughter, less drip loss and better water holding capacity of meat Pulawska in comparison with PL.

Table 3. Content of basal nutrients and composition and share of fatty acids in muscles  
Tabela 3. Zawartość składników podstawowych i udział kwasów tłuszczowych w mięśniach

Specification Wyszczególnienie	<i>longissimus</i>			<i>adductor</i>		
	I	II	SEM	I	II	SEM
Basal nutrients, % – Składniki podstawowe, %						
Dry matter Sucha masa	26.59 a	25.07 b	0.13	26.04	25.02	0.51
Crude ash Popiół surowy	1.12	1.13	0.01	1.12	1.14	0.01
Crude protein Białko ogólne	23.70 a	22.74 b	0.11	22.81	21.96	0.60
Crude fat Tuszczy surowy	1.76 A	1.14 B	0.04	2.11	1.92	0.32
Composition and share of fatty acids, % of sum Skład i udział kwasów tłuszczowych, % sumy						
C12:0	0.05	0.06	0.005	0.06	0.06	0.002
C14:0	0.99 a	0.89 b	0.01	0.93	0.90	0.01
C16:0	26.78	26.71	0.21	25.24	25.33	0.28
C16:1	3.86	3.52	0.07	3.90	3.77	0.08
C18:0	11.02	11.09	0.38	9.38 b	9.91 a	0.08
C18:1	54.00	54.58	0.35	56.74	56.08	0.17
C18:2	2.33	2.35	0.19	2.91 B	3.20 A	0.006
C18:3	0.10 a	0.05 b	0.006	0.13 a	0.06 b	0.006
C20:0	0.04	0.03	0.01	0.04	0.03	0.01
C20:1	0.39	0.32	0.05	0.32	0.31	0.003
C20:2	0.08 A	0.03 B	0.002	0.05	0.05	0.006
C20:3	0.04	0.04	0.008	0.02	0.01	0.002
C20:4	0.11	0.13	0.02	0.10	0.12	0.03
others – inne	0.20	0.20	0.002	0.18	0.17	0.005
SFA	38.89	38.78	0.34	35.65	36.23	0.21
UFA	60.91	61.02	0.32	64.17	63.60	0.35
MUFA	58.25	58.42	0.41	61.03	60.16	0.19
PUFA	2.66	2.60	0.17	3.14	3.44	0.31
DFA = UFA + C18:0	71.93	72.11	0.35	73.55	73.51	0.30
OFA = C14:0 + C16:0	27.77	27.60	0.20	26.17	26.23	0.24

A, B – significant of difference at  $P \leq 0.01$  – A, B – różnice istotne na poziomie  $P \leq 0,01$ .

a, b – significant of difference at  $P \leq 0.05$  – a, b – różnice istotne na poziomie  $P \leq 0,05$ .

DFA – neutral or hypocholesterolemic fatty acids – kwasy neutralne i hypocholesterolemiczne.

OFA – hypercholesterolemic fatty acids – kwasy hipercholesterolemiczne.

Table 4. Physicochemical characteristics of meat

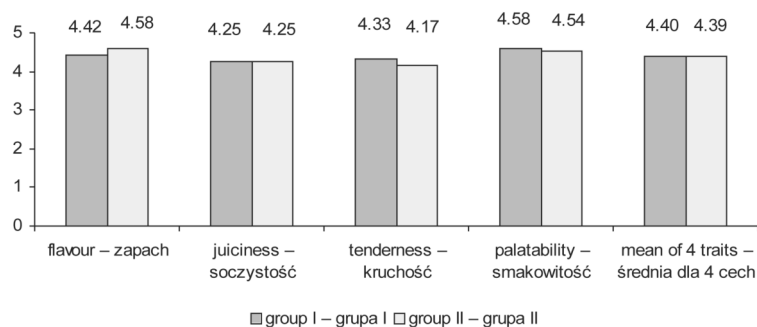
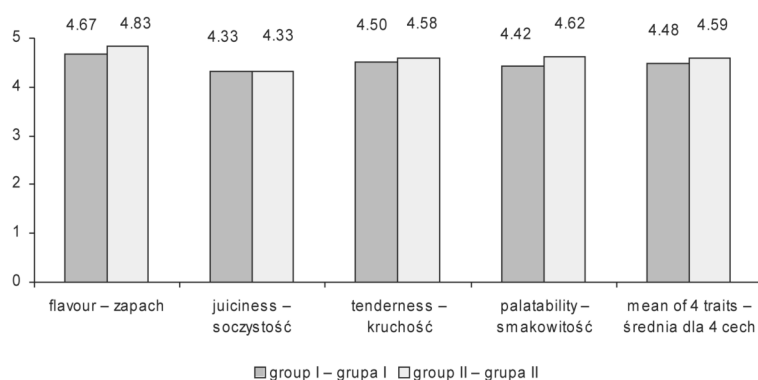
Tabela 4. Cechy fizykochemiczne mięsa

Specification Wyszczególnienie	<i>longissimus</i>			<i>adductor</i>		
	I	II	SEM	I	II	SEM
pH <sub>1</sub>	6.47 A	6.16 B	0.05	–	–	–
pH <sub>24</sub>	5.62	5.61	0.08	–	–	–
Water holding capacity, % Wodochłonność, %	19.64 B	28.69 A	0.87	16.88	21.90	1.87
Drip loss, % Wyciek naturalny, %	2.57 b	6.26 a	0.79	1.94	2.71	0.35
Colour, brightness Jasność barwy L*	49.36 b	54.44 a	0.93	49.37	50.07	1.01

A, B – significant of difference at  $P \leq 0.01$  – A, B – różnice istotne na poziomie  $P \leq 0.01$ .

a, b – significant of difference at  $P \leq 0.05$  – a, b – różnice istotne na poziomie  $P \leq 0.05$ .

The completion of pork meat quality estimation is sensory characteristics such as: flavour juiciness, tenderness and palatability (Figs 1 and 2).

Fig. 1. Results of sensory evaluation of *longissimus* muscles, scoresRys. 1. Wyniki oceny sensorycznej mięśnia *longissimus*, pktFig. 2. Results of sensory evaluation of *adductor* muscles, scoresRys. 2. Wyniki oceny sensorycznej mięśnia *adductor*, pkt



Average notes obtained for characteristic of loin both group were similar. Slightly higher evaluated ham of PL x PLW crossbreeds, what will be connected with significantly higher share of stearic acid (C18:0) in lipid fraction. According Wood et al. [2004] it responded for tenderness and juiciness of meat, moreover authors showed existence positive correlation between flavour of meat and share of saturated fatty acids (SFA) and monounsaturated fatty acids (MUFA).

## CONCLUSIONS

The PL x PLW crossbreeds pigs obtained better daily weight gain and less feed conversion ratio per one kg body weight, higher meatiness and loin „eye” area, as well as were less fatness in comparison with Pulawska x PLW. However, slower growth crossbreeds had higher meat quality, their muscles contained more nutrients, including protein and intramuscular fat with higher a share of favourable  $\alpha$ -linolenic acid (C18:3). The muscles of longissimus and adductor of Pulawska x PLW crossbreeds had better water holding capacity and drip loss.

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#### PORÓWNANIE EFEKTÓW TUCZU, WARTOŚCI RZEŻNEJ I JAKOŚCI MIĘSA ŚWIŃ MIESZAŃCÓW RAS PUŁAWSKA X WBP I PBZ X WBP

**Streszczenie.** Doświadczeniem objęto dwie grupy tuczników mieszańców ras puł x wbp (grupa I – 20 zwierząt) i pbz x wbp (grupa II – 20 zwierząt). Tucz świń prowadzono od średniej masy ciała 30,5 kg do ok. 105 kg, przez 99 dni z podziałem na dwa okresy tuczu trwające kolejno 53 i 46 dni. Zwierzęta obu grup otrzymywały takie same mieszanki sporządzone na bazie pszenicy i jęczmienia (pierwszy okres tuczu – 12,99 MJ EM, 170 g b.og., 9,60 g lys.) i samego jęczmienia (drugi okres tuczu – 12,49 MJ EM, 150 g b.og., 8,37 g lys.) oraz koncentratu białkowego. Wykazano, że mieszańce ras pbz x wbp uzyskały lepsze przyrosty dobowe przy niższym zużyciu paszy na jednostkę przyrostu, większą mięsność i powierzchnię „oka” poledwicy ( $P \leq 0,05$ ) przy mniejszym otluszczeniu w porównaniu ze świniami puł x wbp. Jednakże wyższą jakością mięsa cechowały się mieszańce wolniej rosnące, mięśnie tych zwierząt zawierały więcej składników odżywczych, w tym białka i tłuszczu śródmięśniowego o istotnie ( $P \leq 0,05$ ) wyższej zawartości niezwykle cennego kwasu  $\alpha$ -linolenowego (C18:3). Ponadto mięśnie *longissimus* i *adductor* zwierząt grupy I miały lepszą wodochłonność i lepiej utrzymywały wodę własną, ale różnicę jako statystycznie istotną stwierdzono tylko w mięśniu *longissimus*.

**Słowa kluczowe:** jakość mięsa, rasa, tuczniaki, wyniki produkcyjne i poubojowe

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