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WEIGHT IMPACT OF THE PEN-AR-LAN LINE FATTENERS ON THE SLAUGHTER VALUE AND MEAT QUALITY

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Key words: carcass weight, meatiness, slaughter value, meat quality

The goal of this research project was to compare selected traits of the slaughter value and meat quality of carcasses of the PEN-AR-LAN line fatteners of different pre-slaughter weights. The investigations were conducted on heavy fatteners of the mean net weight of 133.4 kg (95 fatteners), fatteners with the net weight of 113.6 kg (221 animals) and light fatteners of mean net weight of 103.5 kg (84 pigs). The weight increase of fatteners to about 133.0 kg failed to reduce significantly the meatiness of carcasses, although it exerted a significant impact on the size of cuts, increased marbling and improved physico-chemical and sensory traits of the meat and raw smoked loin.

INTRODUCTION

The main concern of swine producers is to bring to the slaughter house fatteners characterized by high carcass dressing percentage and meat content. On the other hand, meat industry is interested most in fatteners which are characterized by the appropriate body weight and optimal proportion of good meat quality in the carcass [Koćwin-Podsiadła *et al*., 2004; Przybylski *et al*., 2005]. Pisula & Florowski [2005] maintain that the key slogan so popular at the moment "from the consumer to the farm" is a good example of a new trend whose basic objective is to improve the quality of both live animals and meat. From the moment of the introduction of the EUROP system in Poland, a significant progress has been achieved in the area of the improvement of carcass meatiness of mass populations. Unfortunately, very often, this was possible only at the expense of the relatively low carcass weight of the purchased fatteners [Lisiak & Borzuta, 2003; Strzelecki *et al*., 2006]. Moreover, this had also negative economical consequences because, despite the increased meatiness of fatteners, the quantitative yield of the most expensive cuts and meat in the most valuable commercial class was relatively low. So the ultimate financial production effect of meat fatteners depends not only on their meatiness but also on the carcass weight, yield of valuable cuts and meat quality [Strzelecki, 2002; Borzuta *et al*., 2005]. Therefore, it is often stressed that, at considerable meatiness and good meat quality, it is also important for carcasses to have desirable weight. It is widely known that the peak of meatiness is achieved, in the case of, for example, White Polish Landrace, at the body weight interval ranging from 100 to 110 kg [Kozłowski, 1998; Przybylski *et al*., 2005]. Further fattening allowing pigs to reach higher slaughter weight may lead to increased fat deposition and, consequently, to the reduction of meatiness and consequently to a drop in price [Wajda & Daszkiewicz, 1998; Łyczyński *et al*., 2000]. Simultaneously, investigations are being conducted aiming to increase the slaughter weight of fatteners to the level which would allow maintaining high meatiness of heavy carcasses which would simultaneously be characterised by a higher content of the most expensive cuts and higher quantities of valuable meat for processing and sale and which, in turn, improves the profitability of pig rearing [Przybylski *et al*., 2005; Zybert, 2005]. The growth of muscle tissue depends on the deposition rate of protein and fat in the animal body which, in turn, is determined by the genotype and various environmental factors [Wajda, 1997; Schinckel *et al*., 2001]. Apart from the well known domestic maternal breeds of wbp and pbz and paternal breeds of mainly foreign origin (Pietrain, Duroc, Hempshire), thanks to recent development in genetics, pig growers are offered more and more frequently hybrid lines. In commercial swine production, PEN-AR-LAN line fatteners derived from the mating of Naima sows with P-76 boars are becoming quite common [Grześkowiak *et al*., 2000]. Carcasses of these fatteners are characterised by high meatiness and good meat quality [Rybarczyk *et al*., 2004].

The aim of the undertaken investigations was to compare selected traits of the carcass slaughter value and meat quality of the PEN-AR-LAN line fatteners of different pre-slaughter weights.

MATERIAL AND METHODS

The experiments were carried out on 400 PEN-AR-LAN hybrid fatteners which derived from one pig farm where they

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were kept in identical environmental and feeding conditions until they reached different body weights. The pigs were divided into three experimental groups: heavy fatteners (group I) of mean net weight of 133 kg (95 pigs), intermediate fatteners (group II) of mean net weight of 113.6 kg (221 fatteners) and light pigs (group III) of mean net weight of 103.5 kg (84 fatteners). All animals were slaughtered in a slaughter house approximately 200 km away from the farm after a 2-h rest period. During the slaughter, the following parameters were established: carcass weight, its meatiness with the Ultra-Fom 300 apparatus, pH in the *longissimus dorsi* (LD) muscle about 45 min after slaughter using for that purpose a pH meter equipped in a combined electrode Radiometer PHM 80, electrical conductivity (EC) in the LD muscle about 5 h after slaughter by an MT-03 conductometer, back fat thickness at three points, *i.e.* KII, on the back and over the shoulder, as well as marbling on the basis of the assessment of the *gluteus medius* muscle in a 5-point scale. On the basis of the pH_{45} measurement, it was possible to establish meat quality defects in individual carcasses: extreme PSE – pH_{45} up to 5.80; PSE – pH_{45} ranging from 5.81 to 6.00; partially PSE meat – pH_{45} ranging from 6.1 to 6.30. In addition, the proportion of meat with the electrical conductivity EC_5>8.0 mS was also assessed. Twenty half-carcasses were selected randomly from the carcasses of fatteners from groups I and II which were then subjected to cutting into primary elements (in order to determine their yield). Samples collected from their LD muscles were used to carry out physico-chemical analyses which allowed the authors to evaluate: water content (by the dryer method at the temperature of 105°C to constant mass), fat (Soxhlet method), crude protein (by Kjeldahl method using a Tecator Company apparatus), free drip (samples weighing about 100 g in plastic bags at the temperature of 4°C for 48 h), water holding capacity (WHC) (by Grau and Hamm method as modified by Pohja and Niinivvaara), colour lightness "L" (Minolta Chroma Matters CR300 apparatus) and marbling by a score method (4-point scale). In addition, sensory evaluation of the cooked muscle as well as smoked, raw loin was also performed by estimating: loss during cooking (samples were heated to the temperature of 70°C in the centre of the muscle), flavour, juiciness, tenderness, palatability (scale 1-5 points) and tenderness by the Warner-Bratzler (WB) apparatus by determining the sheare force.

The obtained experimental results were elaborated statistically determining the significance of differences between the examined groups with the assistance of the Tukey's test [Stanisz, 1998].

RESULTS AND DISCUSSION

Table 1 presents the research results of the carcass slaughter value and meat quality of fatteners in the individual experimental groups differing with regard to their pre-slaughter weight. With the increase of the mean weight of pigs from 103.5 kg (group III) to 113.6 kg (group II) and 133.4 kg (group I), the following carcass weights were determined: 84.1 kg; 90.9 kg and 106.0 kg. Hence, it can be said that the mean body weight increase of fatteners by 10.1 kg (groups III and II) caused the increase of mean carcass weight by 6.8 kg, whereas in the case of light and heavy fatteners, their body weight increase of 29.9 kg increased their carcass weights by 21.9 kg. Simultaneously, together with the carcass weight increase, the authors observed a non-significant drop in the dressing percentage determined in relation to the net weight of fatteners as well as a decline in carcass meatiness assessed using the Ultra-Fom 300 apparatus. In the case of carcass meatiness, despite a similar trend, differences are considerably smaller and statistically non-significant. The observed mean carcass meatiness in group III of 55.59% was by 0. 64% higher than of carcasses of the intermediate weight and by 0.69% higher in comparison with the carcasses from group I. Differences between groups I and II are small and amount to 0.6% in the case of the dressing percentage and in the case of meatiness – to 0.5% – in favour of carcasses of fatteners from group II. Similar, albeit more varied, results were reported by Przybylski *et al*. [2005] who found that fatteners slaughtered at the body weight of about 100 kg were characterised by the highest meatiness, and the increase of the slaughter weight by 19.79 kg and 31.21 kg resulted by a decline in meatiness by 1.62% and 1.96%. Also Gardzińska *et al*. [2002], when evaluating the slaughter value of pzb x (Duroc x Pietrain) reported that the highest

TABLE 1. Investigations results of carcasses of fatteners with different body weight.

Traits	Group I	Group II	Group III
Number	95 animals	221 animals	84 animals
Body weight	133.4 kg	113.6 kg	103.5 kg
Carcass weight	106.0 kg	90.9 kg	84.1 kg
Carcass meatiness	54.9 0%	54.95%	55.59%
Proportion of S class	1 animal – 1.1%	11 animals – 5.0%	4 animals – 4.8%
Proportion of E class	45 animals – 47.4%	116 animals – 52.5%	50 animals – 59.5%
Proportion of U class	44 animals – 46.3%	79 animals – 35.7%	27 animals – 32.1%
Proportion of R class	3 animals – 3.2%	15 animals – 6.8%	3 animals – 3.6%
Proportion of O class	-	-	-
Proportion of P class	-	-	-
Proportion of C class	2 animals – 2.0%	-	-
pH_{45} acidity	6.47	6.46	6.45
- PSE ex. ($pH_{45} \leq 5.8$)	No animals	1 animal – 0.7%	No animals
- PSE (pH_{45} 5.81 – 6.00)	No animals	3 animals – 2.1%	1 animal – 1.19%
- partial PSE (pH_{45} 6.01 – 6.30)	22 animals – 23.2%	32 animals – 22.4%	12 animals – 14.29%
Electrical conductivity EC5 > 8.0mS	No animals	No animals	3 animals – 3.57%
Linear measurement of back fat (mm)			
- KII	16.6a	15.6	12.6b
- back	23.2a	22.6	19.6b
- shoulder	38.4a	35.3	34.5b
Marbling (points)	2.2a	1.9	1.6b

a, b – level of significance of differences for $p \leq 0.05$

slaughter value was recorded in fatteners slaughtered at 100 kg body weight, whereas the smallest slaughter value – when their body weight at slaughter was over 120 kg. Daszkiewicz & Wajda [2004] reported less varied results. They also showed that, with the increase of the carcass weight, meatiness decreased, while the thickness of the back fat on the back increased.

The carcasses of the assessed fatteners were allocated to the highest meatiness classes. Only 3.2% of carcasses from group I; 6.8% – from group II and 3.6% – from group III were allocated to class R with meatiness of less than 50%, whereas: respectively, 1.1%; 5.0% and 4.8% of carcasses were assessed as class S with meatiness above 60%. In the case of heavy fatteners, two carcasses exceeded the weight limit of 120 kg and were classified as class C.

The assessment of carcass quality on the basis of the pH_{45} measurement in the LD muscle confirms their very good quality. The mean pH_{45} values between the experimental groups differed only slightly and amounted to: 6.47 – in group I, 6.46 – in group II and 6.45 – in group III. In their investigations, Grześ *et al*. [2006] demonstrated that meat of heavy fatteners is characterised by considerably higher pH values than the meat of light pigs. There was only one carcass with extremely PSE meat ($pH_{45} \leq 5.8$) which was found in group II and which constituted 0.7% of the population of this group. Meat with PSE defect (pH_{45} 5.81-6.00) occurred in group II in 2.1% of carcasses and in group I – in 1.19%.

Good quality of the evaluated carcases, in particular – carcasses of heavy fatteners, was further confirmed by measurements of electrical conductivity (EC_5) carried out also in the LD muscle.

TABLE 2. Cutting results of carcasses of heavy (50.0 kg) and intermediate weight (43.8 kg) fatteners.

Primary cuts	Group I		Group II	
	Mean weight (g)	%	Mean weight (g)	%
Neck	322.7	6.43	2869.9	6.56
Loin	5095.2	10.16	4351.7	9.95
Ham with shank	13749.7	27.43	12238.9	27.97
Loin end	479.8	0.96	624.3	1.43
Shoulder	7330.5	14.62	6106.7	13.96
Front shank	103.1	2.07	9.27.9	2.12
Yowl	1727.1	3.45	1533.5	3.51
Groin	2118.1	4.23a	1260.6	2.88b
Front foot	531.1	1.06	456.8	1.04
Hind foot	865.4	1.73	753.1	1.72
Head	2200.6	4.39	1934.6	4.42
Back fat	4316.9	8.61a	2661.2	6.08b
Belly with bone	5236.6	10.44	5052.6	11.56
Ribs	991.1	1.98	890.4	2.04
Second class meat	721.2	1.44a	1896.5	4.00b
Fourth class meat	311.7	0.62	193.7	0.44
Total	49938.3	99.62	43752.2	99.68
Cutting loss		0.38		0.32

a, b – level of significance of differences for $p \leq 0.05$

Linear measurement results of the back fat thickness in the examined points are significantly different between the extreme groups and, in the case of heavy carcasses, back fat was found 4 mm thicker in comparison with the carcasses from group I. In addition, together with the increase of carcass weight, meat marbling evaluated by appropriate points on the basis of assessment of the *gluteus medius* muscle was also higher. The mean evaluation result for group I was 2.2 points, group II – 1.9 points and group III – 1.6 points. Differences between extreme groups are statistically significant.

Table 2 presents yields of basic elements obtained from the carcass cuttings of heavy and intermediate weight fatteners. It is quite clear from this Table that, despite slight percentage differences, the weight of the most valuable cuts from the carcasses from group III is significantly higher, which is very advantageous from the technological and commercial points of view. Also Zybert *et al*. [2005] reported that if the weight the hot carcass was increased by about 5 kg (from 80.0 kg to 85.0 kg), it had a significant influence on higher yields of valuable elements obtained from carcass cutting, i.e. ham, shoulder, loin and neck. On the other hand, Szyndler-Nędza & Różycki [2006] claim that together with the increase of the body weight of boars from 95.0 kg to 125.0 kg, the percentage proportion of the weight of the proper ham and shank decreased, while that of the belly – increased.

The results of the evaluation of the basic composition and physico-chemical traits of the LD muscle in the examined carcasses of fatteners of different pre-slaughter weight are shown in Table 3. The obtained results show that the examined carcass muscle of heavy fatteners was characterised by a significantly smaller water content (by 1.79%), a significantly higher protein content (by 2.06%), worse water holding capacity (by 1.98%) and darker (desirable) colour in comparison with the assessment of the carcass LD muscle of fatteners from group II. Moreover, the results of sensory evaluation of the cooked meat and raw-smoked loin from the carcass LD muscle of heavy fatteners (Table 4) confirmed their higher quality in comparison with the meat quality of lighter carcasses. This refers, in particular, to a smaller (by 4.82%) loss during cooking ($p \leq 0.01$), better juiciness, tenderness and palatability as well as to better (by 13.44 N) tenderness assessed by the War-

TABLE 3. Basic composition and physico-chemical traits of LD muscles from carcasses of fatteners with different weight.

Trait	Group I		Group II	
	$\bar{x}$	s	$\bar{x}$	s
Water (%)	71.34A	0.72	73.13B	0.52
Fat (%)	2.18	0.61	2.50	0.60
Crude protein (%)	25.30A	0.92	23.24B	0.70
Free drip (%)	2.69	1.51	2.12	1.38
Water holding capacity (%)	28.51a	1.95	26.53b	2.76
Colour lightness („L”)	41.70	2.71	43.70	3.90
Colour (pts)	2.94A	0.45	2.37B	0.33
Marbling (pts)	2.35	0.57	2.25	0.50

A, B – level of significance of differences for $p \leq 0.01$; a, b – level of significance of differences for $p \leq 0.05$

TABLE 4. Results of sensory assessment of meat and Raw-smoked loin from carcasses of fatteners with different weight.

Trait	Group I		Group II	
	$\bar{x}$	s	$\bar{x}$	s
Cooked meat				
Cooking loss (%)	26.14A	4.06	30.96B	2.39
Juiciness (pts)	4.62A	0.25	4.21B	0.22
Tenderness (pts)	4.63A	0.24	4.24B	0.33
Palatability (pts)	4.67A	0.18	4.28B	0.19
Shear force accord. to WB (N)	52.74	9.17	59.33	12.90
Raw loin				
Juiciness (pts)	4.51	0.28	4.54	0.17
Tenderness (pts)	4.56	0.29	4.47	0.15
Palatability (pts)	4.84A	0.15	4.49B	0.10
Shear force accord. to WB (N)	26.00A	5.99	39.44B	7.94

A, B – level of significance of differences $p \leq 0.01$

ner-Bratzler apparatus ($p \leq 0.01$). Good meat quality obtained from carcasses of the PEN-AR-LAN line fatteners is also corroborated by the results of Rybarczyk *et al*. [2004a,b]. They reported that with the increase of the carcass weight, their meatiness decreased but the thickness of the LD muscle, back fat and marbling increased. The observed increased meatiness and decreased back fat thickness of the lighter carcasses was accompanied by a drop in the content of the intramuscular fat and dry matter as well as the increase in the meat of ash content. However, the authors failed to observe significant correlations between the thickness of the LD muscle and traits of its quality and basic chemical composition.

CONCLUSIONS

1. Hybrid PEN-AR-LAN line fatteners derived from the mating of Naima sows with P-76 boars provide good material for the production of heavy fatteners with approximately 130 kg body weight.

2. Increased weight of fatteners affects the value of carcasses by increased yields of meat weight as well as by heavier most valuable elements suitable for sale and processing.

3. The increased weight of fatteners within the examined range did not have significant negative impact on the meat content in carcasses of the PEN-AR-LAN line fatteners.

4. Meat obtained from the carcasses of heavy fatteners was characterised by higher content of protein and lower water content as well as better sensory quality assessed both on cooked samples and raw-smoked loin.

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WPŁYW MASY TUCZNIKÓW LINII PEN-AR-LAN NA WARTOŚĆ RZEŹNĄ I JAKOŚĆ MIĘSA

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Celem pracy było porównanie wybranych cech wartości rzeźnej i jakości mięsa tusz tuczników linii PEN-AR-LAN o zróżnicowanej masie przed ubojowej. Badania wykonano na tucznikach ciężkich o średniej masie netto 133,4kg (95szt.), tucznikach o masie netto 113,6kg (221szt.) i tucznikach lekkich o średniej masie netto 103,5kg (84szt.). Podwyższenie masy tuczników do około 133,0kg nie spowodowało istotnego obniżenia mięsności tusz, natomiast istotnie wpłynęło na wielkość elementów, wzrost marmurkowatości, poprawę cech fizykochemicznych i sensorycznych mięsa oraz polędwicy surowo-wędzonej.