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Fattening results and carcass value of Polish Large White pigs and commercial crossbreeds raised on a traditional farm in the Kuyavian-Pomeranian Voivodeship

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The aim of the study was to evaluate the fattening results and carcass value of Polish Large White pigs and commercial crossbreeds reared on a traditional farm in the Kuyavian-Pomeranian Voivodeship. The study was conducted on three groups of pigs: group I – Polish Large White pigs, group II – F_1 (PLW x PL) x PIC crossbreeds, and group III – Polish Landrace x F_1 (Duroc x Pietrain) crossbreeds. There were 20 animals in each group. The fattening traits evaluated included length of fattening period, average daily weight gain, and food consumption during the fattening period. The carcass traits analysed were hot carcass weight, dressing percentage, carcass meat content, backfat thickness and loin muscle depth. A simplified economic analysis of fattening profitability was carried out, taking into account the cost of purchase of piglets, cost of feeding over the entire fattening period, and other costs. It was shown that the crossbred pigs from group II had a higher growth rate and attained slaughter body weight earlier than the pigs of groups I and III ($p \leq 0.01$). The carcass value of the pigs of all groups was very good, as most were assigned to the highest classes, S, E, and U. In the profitability analysis, similar sales value was attained in groups I and II, but the lowest production costs were noted for group III, because the piglets for fattening were bred on the farm itself.

KEY WORDS: pigs / fattening / carcass value / fattening profitability

The low profitability of pork production in the last few years is probably the main reason for the decline in interest in this area of production and the dramatic reduction in the size of the pig population in Poland [5, 14]. Many market analysts see an opportunity for improvement of the current situation in intensification, concentration, and continual expansion of production [18]. One obstacle in achieving this goal is the substantial fragmentation of Polish farms [14, 18], which have difficulty competing with large farms due to their small production scale. However, the positive aspects of their operation should be

noted as well; for example, by taking advantage of the achievements of many generations and specialized knowledge, they produce fattening pigs while taking into consideration the welfare of the animals and farming traditions, without posing a threat to the natural environment. At the same time they achieve satisfactory production outcomes and constitute an integral element of the landscape of rural Poland. Thus there is a need for research on optimization of production of fattening pigs on small farms, taking into account the profitability of fattening.

The aim of the study was to assess the efficiency of production of fattening pigs on a small farm in the region of Pomerania and Kujawy, raising animals in a traditional manner, and to estimate the profitability of fattening different genetic variants of pigs.

Material and methods

The study was carried out on a traditional farm typical of the Kuyavian-Pomeranian Voivodeship. The study was conducted on three groups of pigs. Group I consisted of Polish Large White pigs (PLW), group II of F_1 (PLW x PL) x PIC crosses, and group III of Polish Landrace x F_1 (Duroc x Pietrain) crosses. There were 20 animals in each group (an equal number of males and females). The group III animals were reared on the farm, while the group I and II pigs were purchased.

The animals for the study were permanently marked and housed in compliance with animal welfare principles, in groups of 10 in a 14.40 m^2 pen, on shallow litter. The growth rate of each pig was individually monitored during the experiment by weighing at the start and completion of the fattening period.

Fattening was begun from a body weight of about 30 kg. The pigs were fed in a three--stage system on total mixed rations prepared on the farm according to nutritional standards for pigs [11]. The mixtures were based on on-farm cereal meal, premixes and soybean and rapeseed meal, supplemented with probiotics. The nutritional value of 1 kg of the total mixed ration was as follows: T1 – 173.8 g crude protein and 12.87 MJ ME, T2 – 158.3 g crude protein and 12.51 MJ ME, T3 – 140.8 g crude protein and 12.51 MJ ME. Fattening was completed at a body weight of about 110 kg. The animals were fed dry feed from automatic feeders, with permanent access to water. For the entire fattening period the animals' feed intake and individual growth rate was monitored. After the fattening period the animals were transported to the abattoir, where they were slaughtered according to currently binding standards and regulations. The carcasses were evaluated according to the EUROP classification. Lean meat content was determined with an IM-03 apparatus approved for use in small abattoirs.

The following fattening characteristics were analysed: total body weight gain during the fattening period, length of the fattening period, daily weight gain, and feed intake during fattening. The carcass characteristics analysed were hot carcass weight, dressing percentage, lean meat content, backfat thickness, and the depth of the loin muscle. In addition, a simplified economic analysis of the production of fatteners was performed, which took into

account the sales value of the pigs according to the EUROP carcass evaluation, the cost of feeding the pigs, the cost of purchase (groups I and II) or rearing (group III) of a piglet, and averaged other costs. The profitability index of pig production on the farm was calculated [10]. The results were analysed statistically by one-way analysis of variance (ANOVA) using Statistica software [17]. Values were defined using arithmetic means and standard deviation. Significance of differences between groups, i.e. I – PLW, II – F_1 [(PLW x PL) x PIC], and III – F_1 [PL x (Duroc x Pietrain)], was verified by Fisher's F test, and pairs of means were checked by LSD. Levels of significance were as follows: significant at $p \leq 0.05$ and highly significant at $p \leq 0.01$. The following linear model was used:

$$y_{ij} = \mu + \alpha_i + \varepsilon_{ij}$$

where:

y_{ij} – value of the dependent variable
μ – grand mean
α_i – fixed effect – *i*-th genotype ($i = 1, 2, 3$)
ε_{ij} – random error

Pearson's correlation coefficients describing the linear relationship for the population (n=60) between growth rate and the remaining fattening and carcass characteristics were calculated. Correlation coefficients were estimated on the basis of pairs of observations of variables x and y using Statistica software [17].

Results and discussion

The fattening performance results for the pigs are presented in Table 1. Their body weight at the start of the fattening period was similar, but the pigs in group II were somewhat heavier than the pigs in groups I and III. The differences were confirmed as statistically highly significant. At the end of the fattening period the highest body weight was noted in group I and the lowest in group III ($p \leq 0.05$). Total weight gain was higher in group I than in group III ($p \leq 0.05$).

The most beneficial production outcomes were noted in the crossbreeds from PIC boars (group II), which had the shortest fattening period, reaching slaughter weight earliest, and also had a higher growth rate than the PLW pigs (group I) and the crosses from F_1 (Duroc x Pietrain) boars (group III). In most cases the statistical analysis confirmed these differences as highly significant.

Daily weight gains characterize the growth rate of pigs. The highest mean daily weight gain, exceeding 900 g, was noted in the group II crossbreeds, as compared to the purebred PLW pigs (group I) and the group III crosses ($p \leq 0.01$). An increase in daily weight gain in fattening pigs does not always mean an increase in the deposition of muscle tissue. This largely depends on the feeding system—rationed or ad libitum [1, 2, 6], on genetically determined capacity for protein deposition [3, 4, 7], and on the level of genetic gain [16]. Orzechowska et al. [13] showed a clear relationship between growth

Table 1
Fattening results

Trait	Group		
	I	II	III
Number (head)	20	20	20
Body weight (kg)			
at the beginning of fattening	$28.62^{B} \pm 1.29$	$29.95^{A} \pm 2.04$	$28.37^{B} \pm 0.79$
at the end of fattening	$111.75^{a} \pm 6.51$	110.15 ± 5.27	$107.95^{b} \pm 6.51$
Total weight gain (kg)	$83.13^{a} \pm 6.74$	80.20 ± 4.52	$79.58^{b} \pm 3.85$
Fattening period (days)	$99.10^{A} \pm 3.29$	$87.65^{B} \pm 6.99$	$96.15^{A} \pm 6.63$
Average daily weight gain (g)	$839^{B} \pm 83$	$915^{A} \pm 89$	$828^{B} \pm 72$
Feed consumption per animal throughout the fattening period (kg)	251.25	195.00	213.50
Feed consumption per 1 kg of weight gain (kg/kg)	3.02	2.43	2.68

Group I – Polish Large White, group II – F_1 [(Polish Large White x Polish Landrace) x PIC] crossbreeds, group III – F_1 [(Polish Large White x (Duroc x Pietrain)] crossbreeds
A, B and a, b – values in rows with different letters differ significantly at $p \leq 0.01$ and $p \leq 0.05$

rate, feed consumption and the length of the fattening period. They also found that animals with lower daily feed intake more efficiently utilized protein from their feed to build muscle tissue.

In the present study, the crossbred pigs from PIC boars (group II) had lower feed consumption throughout the fattening period, as well as the lowest feed consumption per kg of body weight gain as compared to the crosses from F_1 (Duroc x Pietrain) boars (group III) and the PLW pigs (group I). The fattening characteristics of the group II crosses indicate a high level of suitability for production and potentially high profitability of production.

Table 2 presents the results for the carcass characteristics of the pigs. The hot carcass weight was similar in all groups. The highest dressing percentage was noted for the carcasses of the crosses from PIC boars (group II), as compared to group III ($p \leq 0.05$). The thinnest backfat, measured with an IM-03 apparatus, was noted for the carcasses of the crosses from F_1 (Duroc x Pietrain) boars (group III), and the thickest for the PLW pigs (group I) ($p \leq 0.01$). Statistically significant differences were also found for this characteristic between groups I and II ($p \leq 0.05$).

Table 2
Results of carcass value and EUROP classification

Trait	Group		
	I	II	III
Hot carcass weight (kg)	85.32 ±6.03	85.14 ±4.91	82.19 ±5.37
Dressing percentage (%)	76.32 ±2.02	77.29^{a} ±2.25	75.75^{b} ±2.47
Backfat thickness (mm)	20.12^{Aa} ±5.67	16.94^{b} ±4.82	15.68^{B} ±3.18
Loin muscle depth (mm)	58.76 ±7.22	59.57 ±5.76	61.12 ±5.25
Carcass meat content (%)	54.60^{Aa} ±4.00	56.68^{b} ±3.21	57.66^{B} ±2.33
EUROP carcass classification system			
class S (n/%)	1 (5%)	2 (10%)	2 (10%)
class E (n/%)	10 (50%)	11 (55%)	16 (80%)
class U (n/%)	6 (30%)	6 (30%)	2 (10%)
class R (n/%)	3 (15%)	1 (5%)	–

Group I – Polish Large White, group II – F_1 [(Polish Large White x Polish Landrace) x PIC] crossbreds , group III – F_1 [(Polish Large White x (Duroc x Pietrain)] crossbreds
A, B and a, b – values in rows with different letters differ significantly at $p \leq 0.01$ and $p \leq 0.05$

The depth of the *longissimus dorsi* muscle indicates that it was well formed in all analysed groups. This value was highest in the group III pigs. The carcasses of crosses from F_1 (Duroc x Pietrain) boars (group III) had the highest lean meat content. The differences were highly significant as compared to group I and significant between groups I and II.

Of the 60 carcasses analysed, 56 were assigned to the most valuable classes, S, E and U. This included 85% carcasses from group I, 95% from group II and 100% from group III. The carcasses of the crossbred animals had markedly thinner backfat and a higher value for the depth of the loin muscle, which clearly indicates greater meatiness.

As mentioned above, a high growth rate in pigs during fattening does not always ensure favourable carcass parameters. Therefore the correlations were calculated between daily weight gain and other fattening characteristics, as well as characteristics defining the meat content and fat cover of the carcass (Tab. 3).

The results obtained confirm that higher mean daily weight gains are highly significantly positively correlated with initial and final body weight, as well as with total weight

Table 3
Phenotypic correlation coefficients between growth rate and other characteristics

Trait	Average daily weight gain (g)
Body weight (kg)	
at the beginning of fattening	0.335**
at the end of fattening	0.699**
Total weight gain (kg)	0.618**
Fattening period (days)	–0.787**
Hot carcass weight (kg)	0.701**
Backfat thickness (mm)	0.216
Loin muscle depth (mm)	0.237
Carcass meat content (%)	–0.148

**Significant at $p \leq 0.01$

Table 4
Profitability of pig production

Trait	Group		
	I	II	III
Value of sale of 1 pig (PLN)	587.65	591.50	578.73
Cost of feeding 1 pig throughout the fattening period (PLN)	230.96	188.42	203.30
Cost of purchase/ rearing of 1 piglet (PLN)	215.00	210.00	120.00
Other costs (PLN)	100.00	100.00	100.00
Total costs per pig (PLN)	545.97	498.42	423.30
Profit on sale of 1 porker (PLN)	41.68	93.08	155.43
Profitability index (%)	107.63	118.67	136.72

Group I – Polish Large White, group II – F_1 [(Polish Large White x Polish Landrace) x PIC] crossbreds, group III – F_1 [(Polish Large White x (Duroc x Pietrain)] crossbreds
Price of 1 kg of livestock = 4.80 PLN + VAT

gain during the fattening period and carcass weight after slaughter. At the same time, the backfat thickness and lean meat content of the carcasses were not significantly correlated with daily weight gain. This may indicate that in the case of ad libitum feeding the high growth rate may have been beneficial in terms of reducing production costs, while at the same time having no negative impact on carcass value.

The profitability of production of fattening pigs largely depends on the price of pigs and the costs of production, which in turn depend on feed prices. The higher the prices of cereals and components for producing them, the higher the costs of feeding pigs. These account for about 75% of all costs [8, 9, 12, 14, 15, 18, 19, 20].

Table 4 compares costs and gives a simplified estimate of the profitability of production of fattening pigs in each group. The efficiency of pig fattening defines the level of profit from this activity. The sales value of the pigs according to the carcass evaluation was similar in the groups. In group III, however, lower production costs were noted, as the piglets were reared on the farm itself, which significantly increased the profit and profitability index of production of fattening pigs on the farm. In contrast, the profit from production of the pigs in groups I and II was negatively affected by the high purchase price of piglets.

According to many authors, the best production outcomes are obtained in fattening animals from the farm's own breeding [8, 12, 14, 20], using on-farm fodder [8, 12, 20]. Pepliński [14] showed that the costs of feed and of piglets dominate the costs of production of fattening pigs, and these depend on prices. This is confirmed by the results obtained in the present study.

It can be concluded from the study that in the conditions of a small traditional farm, the components of commercial crossbreeding offered by Polish pig breeders (group III) may produce good production outcomes, similar to those obtained from much more expensive imported animals (group II). The economic outcomes of fattening are significantly determined by relationships between the prices of feed and livestock and the costs of purchasing or rearing a piglet for fattening. The use of piglets reared on the producers' own farm may significantly improve the profitability of pig fattening.

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