ASSESSMENT OF LIVE PIG PERFORMANCE WITH FOCUS ON THE BREED AND GENDER

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Abstract

The aim of this study was to evaluate the effects of gender and purebred breed on growth performance and body composition traits of pigs under commercial production conditions. A total of 154 pigs, including 96 gilts and 58 boars from five purebred breeds (Large White, Landrace, Hampshire, Pietrain and Duroc), were analysed. Growth and body composition traits were standardized to 100 kg live weight. Boars reached the testing weight at a significantly younger age than gilts (165.94 vs. 176.54 days) and achieved higher ADG_{100} (649.47 vs. 607.49 g/day), higher lean meat content (63.89 vs. 62.79%) and lower back fat thickness (0.77 vs. 0.91 cm) ($P< 0.05$). Significant breed differences were observed, with Pietrain pigs showing the highest ADG_{100} (656.80 g/day), the lowest BFT_{100} (0.57 cm) and the highest LMC_{100} (66.04%), while Hampshire pigs exhibited the least favourable carcass composition. Significant gender × breed interactions were detected for most traits. The results confirm that both gender and breed significantly affect growth efficiency and body composition and should be considered in breeding and management decisions.

Key Words: pig; gender; breed; growth performance; body composition

Live pig performance represents a complex set of production traits that are strongly influenced by genetic, biological, and environmental factors. Among the most important determinants of variability in growth and production traits are breed and gender, which significantly affect growth intensity, carcass characteristics, and overall economic efficiency of pig production (Elbert et al., 2020; Van den Broeke et al., 2019; Li et al., 2020). A detailed understanding of the effects of these factors is essential for the optimization of breeding programs and the effective management of modern pig production systems.

The influence of gender on pig performance has been extensively documented in the scientific literature. Males generally achieve higher average daily gains; however, they often exhibit poorer feed efficiency compared with females (Elbert et al., 2020; Van den Broeke et al., 2019). Castrated males have been reported to produce carcasses with a lower proportion of lean meat, which negatively affects carcass value (Van den Broeke et al., 2019). In contrast, gilts are characterized by a higher proportion of muscle tissue, more favourable carc traits, and higher market value of carcasses (Elbert et al., 2020; Gilleland et al., 2017; Razmaitė et al., 2021).

Breed represents another key factor determining the production potential of pigs. Considerable differences among breeds and sire lines have been observed in growth performance, feed efficiency, and carcass quality (De Cuyper et al., 2019; Manu et al., 2021; Xie et al., 2023). Crossbreeding is often associated with positive heterosis effects, which are most pronounced in reproductive and maternal traits, but may also influence growth and production characteristics (Iversen et al., 2019). In addition, several local pig breeds have been shown to achieve competitive performance levels

while maintaining superior meat quality (Babicz et al., 2019; Razmaitė et al., 2021). The effect of breed may be further modified by environmental conditions and interactions with gender, thereby increasing variability in production traits among animal groups (Li et al., 2020; Elbert et al., 2020).

From a genetic perspective, variation in production traits is determined not only by additive genetic effects but also by dominance effects, which contribute substantially to growth performance, feed efficiency, and backfat thickness (Tusell et al., 2019). Despite the large number of studies focusing on individual factors, their combined evaluation under uniform production conditions remains of practical importance, as it enables an objective assessment of their actual impact on live pig performance.

The aim of this study was to compare the effects of breed and gender on live pig performance based on selected growth and production traits and to contribute to an objective evaluation of the importance of these factors under commercial production conditions.

Material and Methods

Biological material

A total of 154 pigs were included in the experiment, comprising 96 gilts and 58 boars from the purebred pig breeds Large White (Lw), Landrace (La), Hampshire (Ha), Pietrain (Pie), and Duroc (Du). For each breed, approximately 20 gilts and 10 boars were selected. All animals were evaluated within a live weight range of 80 to 120 kg. The production performance of the pigs was assessed under practical commercial production conditions on selected pig farms in Slovakia.

Housing and Feeding

Data were collected from commercial pig farms located in different regions of Slovakia. As the animals originated from multiple production units, it was not possible to standardize housing and feeding conditions across all farms. Nevertheless, all farms operated under conventional intensive production systems commonly used in the Slovak pig industry. Pigs were housed in groups and managed according to standard farm management practices. Drinking water was provided ad libitum. Feeding was based on complete compound diets formulated for growing pigs, with diet composition and feeding strategies determined independently by each farm. Although minor differences in housing systems and feeding regimes may have occurred among farms, all animals were reared under comparable practical production conditions.

Evaluated parameters

During performance testing, individual production traits were recorded for each pig, including live weight (kg), age (days), average daily gain (g/day), back fat thickness (cm), and lean meat content (%).

Back fat thickness and lean meat content were assessed by ultrasound using a Piglog 105 device (SFK Technology A/S, Denmark). Measurements were conducted with pigs standing calmly in a horizontal measuring crate on a solid floor. The anatomical positions of the measurement points for back fat thickness and lean meat content were determined according to the methodology described by Reháček et al. (2021).

Average daily gain (ADG), back fat thickness (BFT), and lean meat content (LMC) were standardized to a reference live weight of 100 kg according to the conversion procedure described by Řeháček et al. (2001). This standardization was applied to minimize the effect of individual differences in body weight and age at the time of measurement and to allow objective comparison among animals. Because pigs were evaluated at slightly different live weights, the use of unadjusted values could bias the interpretation of growth and body composition traits.

Standardized average daily gain (ADG_{100}):

$$ADG_{100} = ADG - CC \times (LW - 100)$$

where: ADG represents the average daily gain recorded on the day of measurement, LW is the live weight of the pigs at measurement (kg), and CC is the correction coefficient for gilts (2.58) and boars (2.26).

Standardized back fat thickness (BFT_{100}): $BFT_{100} = BFT - CC \times (LW - 100)$ where: BFT is the mean back fat thickness measured on the test day, LW is the live weight (kg), and CC denotes the correction coefficient for gilts (0.017) and boars (0.012).

Standardized lean meat content (LMC_{100}): $LMC_{100} = LMC + CC \times (LW - 100)$ where: LMC is the lean meat content (%) determined on the day of measurement, LW is the live weight of the pigs (kg), and CC is the corresponding correction coefficient for gilts (0.0859) and boars (0.0894).

Statistical analysis

The data were analysed using IBM SPSS Statistics software (version 20.0). Differences among groups were evaluated by two-way analysis of variance (ANOVA), with gender and breed included as fixed effects. Multiple comparisons were performed using Scheffé's post hoc test. Statistical significance was declared at $P< 0.05$.

The statistical model used for the analysis was as follows:

$$Y_{ijk} = \mu + GE_i + PB_j + (GE \times PB)_{ij} + \varepsilon_{ijk}$$

where Y_{ijk} is the observed value of the analysed trait (e.g. ADG_{100}), μ is the overall mean, GE_i represents the fixed effect of gender (gilts and boars), PB_j is the fixed effect of purebred breed (Lw, La, Ha, Pie, and Du), $(GE \times PB)_{ij}$ denotes the interaction between gender and breed, and ε_{ijk} is the random residual error.

Results

The effects of gender, breed and their interaction on growth performance and body composition traits are summarized in Table 1. Gender and breed significantly affected most of the evaluated parameters, with the exception of live weight, which was not influenced by either factor ($P> 0.05$). Significant breed effects were detected for age, ADG_{100}, BFT_{100} and LMC_{100} ($P < 0.001$), while differences in live weight were not statistically significant. Significant gender × breed interactions were observed for age, converted average daily gain (ADG_{100}), back fat thickness (BFT_{100}) and lean meat content (LMC_{100}), indicating that the magnitude of gender differences varied among individual breeds.

Results of pig live performance for gilts and boars are presented in Table 2. Boars reached the testing weight at a significantly younger age than gilts (165.94± 1.88 vs. 176.54± 1.46 days; $P< 0.001$), reflecting their higher growth intensity. This was confirmed by significantly higher ADG_{100} values in boars compared with gilts (649.47± 5.64 vs. 607.49± 4.38 g/day; $P< 0.001$). Live weight at evaluation did not differ significantly between genders, indicating that the observed differences in age and growth rate were not confounded by body weight.

Gender also had a significant effect on body composition. Gilts exhibited higher standardized back fat thickness (0.91± 0.03 vs. 0.77± 0.04 cm; $P< 0.01$), whereas boars showed significantly higher lean meat content (63.89± 0.18 vs. 62.79± 0.14%; $P< 0.001$). These results demonstrate a clear gender dimorphism in growth and carcass-related traits under practical production conditions.

Table 3 presents the performance traits of pigs according to breed. The youngest animals at the time of testing were Pietrain pigs (161.85± 2.76 days), followed by Landrace (167.06± 2.69 days), whereas Large White pigs were the oldest (179.71± 2.68 days) ($P< 0.05$). The highest growth intensity expressed as ADG_{100} was recorded in Pietrain pigs (656.80± 9.29 g/day), followed by Landrace (643.74± 7.89 g/day), while the lowest ADG_{100} was observed in Large White pigs (602.02± 8.03 g/day) ($P< 0.05$).

Marked differences among breeds were found in body composition traits. Pietrain pigs showed the lowest BFT_{100} (0.57± 0.06 cm) and the highest LMC_{100} (66.04± 0.26%), confirming their well-known leanness. In contrast, Hampshire pigs

exhibited the highest BFT_{100} (1.16± 0.05 cm) and the lowest LMC_{100} (61.80± 0.25%). Duroc pigs showed intermediate values for both fatness and lean meat content.

The correlation matrix presented in Table 4 indicates strong relationships among several growth and body composition traits. Age was positively correlated with ADG_{100} (r = 0.642; P< 0.01) and negatively correlated with body weight (r = −0.894; P < 0.01). A strong negative correlation was found between back fat thickness and lean meat content (r = −0.677; P< 0.01), confirming the biological antagonism between fat deposition and muscle accretion. ADG_{100} was moderately positively correlated with LMC_{100} (r = 0.311; P< 0.01), suggesting that faster-growing pigs tended to be leaner.

Table 1. Statistical significance of gender, breed and their interaction on evaluated traits in pigs

Indicator (unit)	Gender *P*-Value	Breed *P*-Value	Gender x Breed *P*-Value
Age (days)	<0.001	<0.001	<0.05
Weight (kg)	n.s	n.s	n.s
ADG_{100} (g/day)	<0.001	<0.001	<0.001
BFT_{100} (cm)	<0.01	<0.001	<0.01
LMC_{100} (%)	<0.001	<0.001	<0.001

ADG_{100}: Average daily gain on 100 kg live weight; BFT_{100}: Back fat thickness on 100 kg live weight; LMC_{100}: Lean meat content on 100 kg live weight; n.s: non-significant.

Table 2. Growth performance and body composition traits standardized to 100 kg live weight according to gender

Indicator (unit)	Gilts X±SE (n=96)	Boars X±SE (n=58)
Age (days)	176.54± 1.46	165.94± 1.88
Weight (kg)	112.38± 0.83	111.79± 1.07
ADG_{100} (g/day)	607.49± 4.38	649.47± 5.64
BFT_{100} (cm)	0.91± 0.03	0.77± 0.04
LMC_{100} (%)	62.79± 0.14	63.89± 0.18

ADG_{100}: Average daily gain on 100 kg live weight; BFT_{100}: Back fat thickness on 100 kg live weight; LMC_{100}: Lean meat content on 100 kg live weight; X: Mean; SE: Standard Error.

Table 3. Growth performance and body composition traits of purebred pigs standardized to 100 kg live weight

Indicator (unit)	Lw X±SE (n=31)	La X±SE (n=31)	Ha X±SE (n=30)	Pie X±SE (n=30)	Du X±SE (n=32)
Age (days)	179.71± 2.68^{b}	167.06± 2.69^{ab}	175.17± 2.63^{b}	161.85± 2.76^{a}	172.42± 2.60^{ab}
Weight (kg)	114.13± 1.53	110.51± 1.50	114.57± 1.50	110.03± 1.57	111.19± 1.48
ADG_{100} (g/day)	602.02± 8.03^{a}	643.74± 7.89^{ab}	622.48± 7.88^{ab}	656.80± 9.29^{b}	617.39± 7.81^{a}
BFT_{100} (cm)	0.87± 0.06^{b}	0.88± 0.05^{b}	1.16± 0.05^{c}	0.57± 0.06^{a}	0.73± 0.05^{ab}
LMC_{100} (%)	62.49± 0.25^{a}	62.71± 0.25^{a}	61.80± 0.25^{a}	66.04± 0.26^{c}	63.66± 0.24^{b}

ADG_{100}: Average daily gain on 100 kg live weight; BFT_{100}: Back fat thickness on 100 kg live weight; LMC_{100}: Lean meat content on 100 kg live weight; X: Mean; SE: Standard Error.; ^{a,b}: different letters in the same row indicate significant differences among the mean values (P<0.05).

Table 4. Phenotypic correlations among growth performance and body composition traits in pigs

	Age	Weight	ADG_{100}	BFT_{100}	LMC_{100}
Age		0.642**	-0.894**	0.073	-0.210**
Weight			-0.244**	-0.093	0.113
ADG_{100}				-0.134	0.311**
BFT_{100}					-0.677**
LMC_{100}					

ADG_{100}: Average daily gain on 100 kg live weight; BFT_{100}: Back fat thickness on 100 kg live weight; LMC_{100}: Lean meat content on 100 kg live weight; ** Correlation is significant at the 0.01 level (2-tailed).

Discussion

The present study confirms that both gender and breed are major sources of variation in growth performance and body composition traits of pigs under commercial production conditions. The observed differences are consistent with previous studies showing that genetic background and gender significantly influence growth intensity, fat deposition and lean meat content (Elbert et al., 2020; Li et al., 2020; Kim et al., 2020).

Boars reached the target live weight at a younger age and achieved higher standardized average daily gain (ADG_{100}) than gilts, indicating superior growth efficiency. Similar results were reported by Elbert et al. (2020) and Kim et al. (2020), who attributed faster growth of males to physiological and hormonal differences affecting protein accretion. In contrast, gilts exhibited higher standardized BFT_{100}, whereas boars showed higher LMC_{100}, confirming sexual dimorphism in carcass traits, as also described by Adebambo (2021) and Razmaitė et al. (2021).

Significant breed effects were detected for all standardized growth and carcass traits, demonstrating substantial genetic variability among purebred populations. Pietrain pigs showed the most favourable carcass characteristics, with the lowest BFT_{100} and highest LMC_{100}, together with high growth intensity, which corresponds with earlier findings describing Pietrain as a terminal sire breed with exceptional carcass leanness (De Cuyper et al., 2019; Xie et al., 2023). Large White pigs exhibited lower growth intensity and were evaluated at an older age, likely reflecting their more balanced production profile and maternal breeding orientation. Hampshire pigs showed higher fat deposition and lower lean meat content, supporting previously reported breed-specific differences in fat accumulation (Li et al., 2020; Chen et al., 2020). Duroc pigs expressed intermediate growth performance combined with favourable carcass traits, in agreement with studies highlighting their use for improving meat quality rather than maximal leanness (Babicz et al., 2019; Chen et al., 2018).

The significant gender × breed interactions observed for several traits indicate that the effect of gender is not uniform across breeds, emphasizing the importance of considering both factors simultaneously in performance evaluation and breeding decisions (Christensen et al., 2019; Esfandyari et al., 2020).

Correlation analysis confirmed expected biological relationships among traits, particularly the strong negative association between standardized back fat thickness and lean meat content, reflecting the antagonism between fat deposition and muscle accretion (Christensen et al., 2019; Babicz et al., 2019). The positive relationship between ADG_{100} and LMC_{100} suggests that faster-growing pigs tended to be leaner, indicating that selection for growth performance does not necessarily compromise carcass quality when appropriate genetic lines are used. Overall, the results support previous findings obtained under commercial conditions

and underline the importance of breed- and gender-specific strategies in optimizing growth efficiency and carcass quality in pig production systems.

Conclusion

The study demonstrated that gender and purebred breed significantly influence growth performance and body composition traits of pigs under commercial production conditions. Boars showed higher growth intensity and reached 100 kg live weight earlier than gilts, achieving higher ADG_{100} (649.47± 4.38 vs. 607.49± 4.38 g/day), higher LMC_{100} (63.89± 0.18 vs. 62.79± 0.14%) and lower BFT_{100} (0.77± 0.04 vs. 0.91± 0.03 cm). Pronounced breed differences were identified, with Pietrain pigs exhibiting the most favourable carcass composition, characterized by the highest LMC_{100} (66.04± 0.26%) and the lowest BFT_{100} (0.57± 0.06 cm), together with the highest growth rate. In contrast, Hampshire pigs showed higher fat deposition and lower carcass leanness. Significant gender × breed interactions further indicated that growth and carcass traits are expressed differently depending on genetic background. Overall, the findings highlight the importance of breed- and gender-specific evaluation and selection strategies to optimize growth efficiency and carcass quality in practical pig production systems.

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