DOI 10.32900/3083-7987-2026-138-44-57
UDC636.4.082

SOME INTERIOR TRAITS, FATTENING PERFORMANCE, AND MEAT QUALITY CHARACTERISTICS OF GROWING PIGS DIFFERENTIATED BY THE GROWTH DECLINE INTENSITY COEFFICIENT DURING EARLY ONTOGENESIS

Viktor KHALAK, Candidate of Agricultural Sciences, Senior Researcher
https://orcid.org/0000-0002-4384-6394
State Institution "Institute of Grain Crops of the National Academy of Agrarian Sciences of Ukraine", Dnipro, Ukraine
Bogdan GUTYJ, Doctor of Veterinary Sciences, Professor
https://orcid.org/0000-0002-5971-8776
Stepan Gzhytskyi National University of Veterinary Medicine and Biotechnologies of Lviv, Lviv, Ukraine
Oksana FESENKO, Candidate of Agricultural Sciences, Senior Researcher
https://orcid.org/0009-0006-5047-7781
Poltava State Agrarian University, Poltava, Ukraine
Bogdan SHAFERIVSKYI, Candidate of Agricultural Sciences, Associate Professor
https://orcid.org/0000-0001-5742-5016
Poltava State Agrarian University, Poltava, Ukraine
Ihor CHERNYSHOV, Candidate of Agricultural Sciences, Associate Professor
https://orcid.org/0000-0002-8988-6404
Kherson State Agrarian University, Kherson, Ukraine

Received: October 12, 2026
Revised: October 22, 2026
Published: October 30, 2026

This is an Open Access article under the **CC BY-NC-ND 4.0 license**

This study presents the results of an investigation into serum biochemical parameters, fattening performance, meat quality characteristics, and growth decline intensity in growing pigs of the Hungarian-origin Large White breed. Correlation coefficients between the quantitative traits were calculated based on the data obtained. The study was conducted within Research Programme No. 31 of the National Academy of Agrarian Sciences of Ukraine, "Genetic Improvement of Farm Animals, Their Reproduction, and Conservation of Biodiversity" (Genetics, Conservation, and Reproduction of Animal Genetic Resources). The results showed that the serum biochemical parameters, including blood urea nitrogen concentration (mg%) and alkaline phosphatase activity (U/L), were within the physiological reference ranges for clinically healthy pigs. Growing pigs of the Hungarian-origin Large White breed exhibited high fattening performance and meat production traits. Specifically, their performance exceeded the minimum requirements for the elite class in terms of age at reaching 100 kg live weight, backfat thickness measured at the level of the 6th–7th thoracic vertebrae, and chilled carcass length by 6.21%, 30.67%, and 3.82%, respectively. Pigs in experimental group II had a greater chilled carcass length than those in groups I and III by 2.2 cm (td = 3.14) and 1.0 cm (td = 0.11), respectively. The maximum (anterior) width of the chilled carcass was greater by 2.5 cm (td = 2.33) and

1.6 cm (td = 1.41), respectively, while the minimum (posterior) width was greater by 2.3 cm (td = 3.10) and 0.6 cm (td = 0.81), respectively. Pairwise correlation coefficients calculated among the growth decline intensity coefficient (Δk), serum biochemical parameters, fattening performance, and meat production traits ranged from −0.403 to +0.529 in growing pigs of the Hungarian-origin Large White breed.

Keywords: growing pigs; breed; serum biochemical parameters; growth decline intensity coefficient; fattening performance; meat production traits; variability; correlation.

ДЕЯКІ ОЗНАКИ ІНТЕР'ЄРУ, ВІДГОДІВЕЛЬНІ ТА М'ЯСНІ ЯКОСТІ У МОЛОДНЯКА СВИНЕЙ РІЗНОЇ ДИФЕРЕНЦІАЦІЇ ЗА КОЕФІЦІЄНТОМ ІНТЕНСИВНОСТІ СПАДУ РОСТУ У РАННЬОМУ ОНТОГЕНЕЗІ

Віктор ХАЛАК, к. с.-г. н., с. н. с., https://orcid.org/0000-0002-4384-6394
Державна установа Інститут зернових культур Національної академії аграрних наук України, Дніпро, Україна
Богдан ГУТИЙ, д. в. н., професор, https://orcid.org/0000-0002-5971-8776
Львівський національний університет ветеринарної медицини та біотехнологій імені С. З. Ґжицького, Львів, Україна
Оксана ФЕСЕНКО, к. с.-г. н., с. н. с., https://orcid.org/0009-0006-5047-7781
Полтавський державний аграрний університет, Полтава, Україна
Богдан ШАФЕРІВСЬКИЙ, к. с.-г. н., доцент,
https://orcid.org/0000-0001-5742-5016
Полтавський державний аграрний університет, Полтава, Україна
Ігор ЧЕРНИШОВ, к.с.-г.н, доцент, https://orcid.org/0000-0002-8988-6404
Херсонський державний аграрний університет, Херсон, Україна

Дата надходження до редакції: 12.10.2026 р.
Дата прийняття до друку після рецензування: 22.10.2026 р.
Дата публікації: 30.10.2026 р.
Це стаття відкритого доступу за ліцензією **CC BY-NC-ND 4.0**

В роботі наведено результати досліджень біохімічних показників сироватки крові, відгодівельних і м'ясних якостей, а також інтенсивність спаду росту у молодняка свиней великої білої породи угорського походження; на основі одержаних даних розраховано рівень кореляційних зв'язків між кількісними ознаками. Роботу виконано згідно програми наукових досліджень Національної академії аграрних наук України №31 «Генетичне поліпшення сільськогосподарських тварин, їх відтворення та збереження біорозмаїття». (Генетика, збереження та відтворення біоресурсів у тваринництві). Установлено, що біохімічні показники сироватки крові (вміст азоту азоту сечовини, мг%; активність лужної фосфатази, од/л) у молодняку свиней великої білої породи угорського походження відповідають фізіологічній нормі клінічно здорових тварин. Молодняк свиней великої білої породи угорського походження характеризується високими показниками відгодівельних і м'ясних якостей, а за віком досягнення живої маси 100 кг, товщиною шпику на рівні 6-7 грудних хребців і довжиною охолодженої туші переважають мінімальні вимоги класу еліта на

6,21, 30,67 і 3,82 % відповідно. За довжиною охолодженої туші молодняк свиней II піддослідної групи переважав ровесників I і III на 2,2 (t_d=3,14) і 1,0 см (t_d=0,11), найбільшою (передньою) шириною охолодженої туші – 2,5 (t_d=2,33) і 1,6 см (t_d=1,41), найменшою (задньою) шириною охолодженої туші – 2,3 (t_d=3,10) і 0,6 см (t_d=0,81). Коефіцієнти парної кореляції між коефіцієнтом інтенсивності спаду росту (Δk), біохімічними показниками сироватки крові, відгодівельними і м'ясними якостями у молодняка свиней великої білої породи угорського походження свідчать, що даний біометричний показник коливається у межах від –0,403 до +0,529.

Ключові слова: молодняк свиней, порода, біохімічні показники сироватки крові, коефіцієнт інтенсивності спаду росту, відгодівельні і м'ясні якості, мінливість, кореляція

Introduction. Improving pig productivity and enhancing fattening performance and meat quality traits are important objectives of modern pig production. The effectiveness of breeding programmes largely depends on the accurate assessment of the breeding value of animals, particularly based on the performance of their offspring (Khalak et al., 2025; Moisei et al., 2025). In this context, identifying additional indicators that can be used to assess the growth and development of young pigs during the early stages of ontogenesis remains an important research priority.

To evaluate the fattening performance and meat quality traits of offspring from breeding sows and boars, the methodology developed by Berezovskyi and Khatko (2005) is commonly used. This approach involves performance testing of growing pigs under controlled fattening conditions, followed by slaughter and the assessment of major carcass characteristics. The principal traits evaluated include average daily gain during the fattening period from 30 to 100 kg live weight, age at reaching 100 kg live weight, feed consumption per kilogram of weight gain, chilled carcass length, backfat thickness, loin eye area, and the weight of the posterior third of the chilled half-carcass. Although this methodology provides a comprehensive assessment of animal productivity, it requires considerable financial resources and a relatively long evaluation period.

Consequently, researchers have increasingly focused on identifying additional indicators associated with fattening performance and meat quality traits in pigs. One such approach involves molecular genetic methods, which make it possible to investigate associations between genetic variation and productive traits. These aspects have been addressed by Hyria et al. (2018), Balatskyi et al. (2018), Kozyr et al. (2019), Van den Broeke et al. (2015), Oliinychenko et al. (2021), and Piórkowska et al. (2012). The findings of these studies indicate the potential value of genetic characteristics in pig breeding, although their associations with productive traits may vary depending on breed and genotype.

In addition to genetic characteristics, considerable attention has been given to biochemical and haematological blood parameters, which reflect the physiological status and metabolic processes of animals. Various aspects of their relationships with growth and productivity in young pigs have been investigated by Matsenko (2020), Khalak et al. (2024), and Prudyus (2024). However, these parameters are influenced by age, genotype, feeding conditions, and physiological status, which should be considered when assessing their potential usefulness as additional indicators of productivity.

Mathematical models and selection indices are also used in breeding programmes to evaluate animals based on several economically important traits. Their development and practical application have been discussed by Hetia (2009), Kodak and Nagy (2019), Pelikh et al. (2019), Khalak et al. (2022), and Alfonso (2019). These approaches make it

possible to consider not only individual performance traits but also the relationships among them, which is important for selecting animals with desirable combinations of fattening performance and meat quality characteristics.

At the same time, pig productivity is influenced by a combination of factors, including genetic background, rearing conditions, nutrition, and live weight at slaughter. The effects of these factors on fattening performance and meat quality have been investigated by Nechmilov (2018), Mykhalko et al. (2020), Koroban and Lykhach (2024), and Burhu et al. (2024). Their findings highlight the importance of considering both the biological characteristics of animals and their production conditions when evaluating performance.

In this context, particular attention should be paid to growth intensity during early ontogenesis and its relationship with subsequent fattening performance and meat production traits. One indicator reflecting individual growth patterns is the growth decline intensity coefficient (Δk), calculated from body weight at birth and at 45 and 90 days of age. However, its relationships with productive traits and serum biochemical parameters remain insufficiently understood. Further investigation of these associations in growing pigs of the Hungarian-origin Large White breed is therefore warranted to assess the potential usefulness of early growth indicators for characterising subsequent animal productivity.

The aim of this study was to investigate serum biochemical parameters, fattening performance, and meat production traits in growing pigs of the Hungarian-origin Large White breed differing in growth decline intensity, and to determine the strength and direction of correlations among the quantitative traits examined.

Materials and methods. The study was conducted at the Druzhba-Kaznacheivka agricultural production complex in Dnipropetrovsk Oblast, Ukraine, the Jazz meat processing plant, the Research Center for Biosafety and Environmental Control of Agricultural Resources ("Biosafety-Center") at Dnipro State Agrarian and Economic University, and the Animal Husbandry Laboratory of the State Institution "Institute of Grain Crops of the National Academy of Agrarian Sciences of Ukraine".

The research was carried out within Research Programme No. 31 of the National Academy of Agrarian Sciences of Ukraine, entitled "Genetic Improvement of Farm Animals, Their Reproduction, and Conservation of Biodiversity" (Genetics, Conservation, and Reproduction of Animal Genetic Resources).

The fattening performance and meat production traits of growing pigs of the Hungarian-origin Large White breed were evaluated using the following quantitative parameters: average daily gain during the performance testing period (g); age at reaching 100 kg live weight (days); backfat thickness measured at the level of the 6th–7th thoracic vertebrae (mm); chilled carcass length (cm); maximum (anterior) width of the bacon half of the chilled carcass (cm); and minimum (posterior) width of the bacon half of the chilled carcass (cm) (Berezovskyi & Khatko, 2005; Voloshchuk et al., 2017).

The age at reaching a live weight of 100 kg (Equations 1 and 2) and the growth decline intensity coefficient (Δk; Equation 3) were calculated using the following formulas:

For pigs with a live weight of 89–99 kg:

$$D_{100} = \left[(100\ kg - M_0) \div \frac{M_0 - M_{prev}}{D_0 - D_{prev}} \right] + D_0 \qquad (1)$$

For pigs with a live weight of 101–115 kg:

$$D_{100} = D_0 - \left[(M_0 - 100\ kg) \div \frac{M_0 - M_{prev}}{D_0 - Д_{prev}} \right] \quad (2)$$

where D_{100} is the age at reaching 100 kg live weight (days); D_0 is the age at the most recent weighing (days); D_{prev} is the age at the preceding weighing (days); M_0 is the live weight at the most recent weighing (kg); and M_{prev} is the live weight at the preceding weighing (kg) (Instructions for Pig Grading; Instructions for Maintaining Breeding Records in Pig Production, 2003).

$$\Delta K = \left[\left(\frac{W_{45} - W_0}{\frac{W_{45} + W_0}{2}} \right) - \left(\frac{W_{90} - W_{45}}{W_{90} + W_{45}} \right) \right] \times 100, \quad (3)$$

where ΔK is the growth decline intensity coefficient (points); W_0 is the live weight at birth (kg); W_{45} is the live weight at 45 days of age (kg); and W_{90} is the live weight at 90 days of age (kg).

Serum samples collected from five-month-old growing pigs were analysed to determine blood urea nitrogen concentration (mg%) and alkaline phosphatase activity (U/L), according to the methods described by Vlizlo et al. (2012). Statistical analysis of the experimental data was performed using standard biometric methods described by Kovalenko et al. (2011).

Results. Laboratory analysis of serum biochemical parameters in growing pigs of the Hungarian-origin Large White breed showed that, at five months of age, the mean blood urea nitrogen concentration was 10.14 ± 0.422 mg%, while alkaline phosphatase activity was 215.77 ± 5.181 U/L (Table 1).

Both serum biochemical parameters were within the physiological reference ranges reported for clinically healthy pigs (Vlizlo et al., 2012).

Table 1

Serum Biochemical Parameters in Growing Pigs of the Hungarian-Origin Large White Breed (n = 13)

Parameters	$X \pm Sx$	$\sigma \pm X_\sigma$	$C_v \pm Sc_v$, %
Blood urea nitrogen concentration (mg%)	10.14 ± 0.422	1.52 ± 0.298	15.00 ± 2.946
Alkaline phosphatase activity (U/L)	215.77 ± 5.181	18.68 ± 3.669	8.66 ± 1.701

The growth decline intensity coefficient (Δk), calculated for the period from birth to three months of age, was 78.86 ± 1.379 points. The average daily gain was 775.0 ± 5.92 g, while the age at reaching 100 kg live weight was 178.2 ± 0.84 days. Backfat thickness measured at the level of the 6th–7th thoracic vertebrae was 20.8 ± 0.37 mm, and chilled carcass length was 96.7 ± 0.39 cm. The maximum (anterior) and minimum (posterior) widths of the bacon half of the carcass were 34.1 ± 0.49 cm and 24.7 ± 0.37 cm, respectively (Table 2).

ISSN 3083-7987 print

Table 2

Fattening Performance and Meat Production Traits of Growing Pigs of the Hungarian-Origin Large White Breed (n = 37)

Parameters	$X \pm Sx$	$\sigma \pm X_\sigma$	$C_v \pm Sc_v$, %
Growth decline intensity coefficient (Δk), points	78.86 ± 1.379	8.39 ± 0.975	10.64 ± 1.237
Average daily gain (g)	775.0 ± 5.92	36.07 ± 4.194	4.65 ± 0.540
Age at reaching 100 kg live weight (days)	178.2 ± 0.84	5.12 ± 0.595	2.88 ± 0.334
Backfat thickness at the level of the 6th–7th thoracic vertebrae (mm)	20.8 ± 0.37	2.26 ± 0.262	10.84 ± 1.260
Chilled carcass length (cm)	96.7 ± 0.39	1.79 ± 0.208	1.86 ± 0.216
Maximum (anterior) width of the bacon half of the chilled carcass (cm)	34.1 ± 0.49	2.40 ± 0.279	7.04 ± 0.818
Minimum (posterior) width of the bacon half of the chilled carcass (cm)	24.7 ± 0.37	1.85 ± 0.215	7.50 ± 0.872

The coefficient of variation (C_V, %) for serum biochemical parameters, fattening performance, and meat production traits in growing pigs ranged from 1.86% for chilled carcass length to 15.00% for blood urea nitrogen concentration.

Analysis of the within-breed differentiation of growing pigs according to the growth decline intensity coefficient (Δk) showed that animals in experimental group II had higher blood urea nitrogen concentrations than those in groups I and III by 0.46 mg% (td = 0.46; P > 0.05) and 0.27 mg% (td = 0.25; P > 0.05), respectively. The highest serum alkaline phosphatase activity was recorded in experimental group III, reaching 138.60 U/L. This value was 30.67 U/L (td = 1.60; P > 0.05) and 8.80 U/L (td = 0.46; P > 0.05) higher than those observed in groups II and I, respectively (Table 3).

Differences among pigs in experimental groups I, II, and III in average daily gain were 24.6 g (td = 10.86; P > 0.05) and 45.0 g (td = 2.77; P < 0.05), respectively. The corresponding differences in age at reaching 100 kg live weight were 3.0 days (td = 1.63; P > 0.05) and 6.5 days (td = 3.00; P < 0.01), while differences in backfat thickness at the level of the 6th–7th thoracic vertebrae were 0.1 mm (td = 0.14; P > 0.05) and 0.5 mm (td = 0.40; P > 0.05), respectively.

Pigs in experimental group II had a greater chilled carcass length than those in groups I and III by 2.2 cm (td = 3.14; P < 0.01) and 1.0 cm (td = 0.11; P > 0.05), respectively. The maximum (anterior) width of the chilled carcass was greater by 2.5 cm (td = 2.33; P < 0.05) and 1.6 cm (td = 1.41; P > 0.05), respectively, while the minimum (posterior) width was greater by 2.3 cm (td = 3.10; P < 0.01) and 0.6 cm (td = 0.81; P > 0.05), respectively.

Table 3

Serum Biochemical Parameters, Fattening Performance, and Meat Production Traits of Growing Pigs Differentiated Within the Breed According to the Growth Decline Intensity Coefficient (Δk)

Parameters	Biometric statistics	Growth decline intensity coefficient (Δk), points		
		0.734-0.904	0.589-0.733	0.463-0.567
		Group		
		I	II	III
1	***n***	***5***	***5***	***3***
	$X \pm Sx$	9.84±0.750	10.30±0.649	10.03±0.833
	$\sigma \pm X_\sigma$	1.67±0.528	1.59±0.503	1.44±0.590
	$C_v \pm Sc_v$, %	17.04±5.392	15.44±4.886	14.39±0.409
2	$X \pm Sx$	129.80±12.550	107.93±12.983	138.60±13.970
	$\sigma \pm X_\sigma$	28.06±8.879	31.80±10.063	24.19±9.913
	$C_v \pm Sc_v$, %	21.62±6.841	29.46±9,322	17.46±7.155
3	*n*	*11*	*17*	*9*
	$X \pm Sx$	797.2±11.31	772.6±6.84	752.2±11.67
	$\sigma \pm X_\sigma$	37.51±7.997	28.21±4.838	35.01±8.257
	$C_v \pm Sc_v$, %	4.71±1.004	3.65±0.626	4.65±1.096
4	$X \pm Sx$	175.7±1.34	178.7±1.25	182.2±1.70
	$\sigma \pm X_\sigma$	4.47±0.953	5.16±0.885	5.11±1.205
	$C_v \pm Sc_v$, %	2.55±0.543	2.89±0.495	2.80±0.660
5	$X \pm Sx$	21.0±0.53	20.9±0.46	20.5±1.13
	$\sigma \pm X_\sigma$	1.75±0.373	1.91±0.327	3.39±0.799
	$C_v \pm Sc_v$, %	8.34±1.778	9.17±1.572	16.61±3.917
6	*n*	*6*	*12*	*5*
	$X \pm Sx$	95.2±0.48	97.4±0.52	96.4±0.74
	$\sigma \pm X_\sigma$	1.09±0.315	1.75±0.357	1.67±0.528
	$C_v \pm Sc_v$, %	1.15±0.332	1.80±0.368	1.74±0.550
7	$X \pm Sx$	32.6±0.84	35.1±0.67	33.5±0.92
	$\sigma \pm X_\sigma$	2.06±0.595	2.28±0.466	2.25±0.712
	$C_v \pm Sc_v$, %	6.32±1.826	6.51±1.331	6.74±2.132
8	$X \pm Sx$	23.1±0.47	25.4±0.58	24.8±0.47
	$\sigma \pm X_\sigma$	1.16±0.335	2.02±0.413	1.16±0.367
	$C_v \pm Sc_v$, %	5.05±1.459	7.95±1.625	4.71±1.490

Note: 1 – blood urea nitrogen concentration (mg%); 2 – alkaline phosphatase activity (U/L); 3 – average daily gain (g); 4 – age at reaching 100 kg live weight (days); 5 – backfat thickness at the level of the 6th–7th thoracic vertebrae (mm); 6 – chilled carcass length (cm); 7 – maximum (anterior) width of the bacon half of the chilled carcass (cm); 8 – minimum (posterior) width of the bacon half of the chilled carcass (cm).

Pairwise correlation analysis of the growth decline intensity coefficient (Δk), serum biochemical parameters, fattening performance, and meat production traits in growing pigs of the Hungarian-origin Large White breed yielded correlation coefficients ranging from −0.403 to +0.529 (Table 4).

ISSN 3083-7987 print

Table 4

Correlations Between the Growth Decline Intensity Coefficient (Δk), Serum Biochemical Parameters, Fattening Performance, and Meat Production Traits in Growing Pigs of the Hungarian-Origin Large White Breed (n = 37)

Trait X	Trait Y	$r \pm S_r$	t_r	P
Growth decline intensity coefficient (Δk), points	Average daily gain during the performance testing period (g)	+0.529 ± 0.1184	4.47	<0.001
	Age at reaching 100 kg live weight (days)	−0.331 ± 0.1465	2.26	<0.05
	Backfat thickness at the 6th–7th thoracic vertebrae (mm)	+0.044 ± 0.1642	0.27	>0.05
	Chilled carcass length (cm)	−0.157 ± 0.1604	0.98	>0.05
	Maximum (anterior) width of the bacon half of the chilled carcass (cm)	−0.120 ± 0.1621	0.74	>0.05
	Minimum (posterior) width of the bacon half of the chilled carcass (cm)	−0.306 ± 0.1491	2.05	<0.05
Blood urea nitrogen concentration (mg%)	Average daily gain during the performance testing period (g)	+0.249 ± 0.1543	1.61	>0.05
	Age at reaching 100 kg live weight (days)	−0.403 ± 0.1378	2.92	<0.01
	Backfat thickness at the 6th–7th thoracic vertebrae (mm)	−0.392 ± 0.1392	2.82	<0.01
	Chilled carcass length (cm)	−0.056 ± 0.1640	0.34	>0.05
	Maximum (anterior) width of the bacon half of the chilled carcass (cm)	+0.478 ± 0.1269	3.77	<0.001
	Minimum (posterior) width of the bacon half of the chilled carcass (cm)	+0.204 ± 0.1576	1.30	>0.05
Alkaline phosphatase activity (U/L)	Average daily gain during the performance testing period (g)	+0.105 ± 0.1627	0.64	>0.05
	Age at reaching 100 kg live weight (days)	+0.008 ± 0.1645	0.05	>0.05
	Backfat thickness at the 6th–7th thoracic vertebrae (mm)	−0.101 ± 0.1628	0.62	>0.05
	Chilled carcass length (cm)	−0.111 ± 0.1624	0.68	>0.05
	Maximum (anterior) width of the bacon half of the chilled carcass (cm)	−0.265 ± 0.1529	1.73	>0.05
	Minimum (posterior) width of the bacon half of the chilled carcass (cm)	−0.147 ± 0.1609	0.91	>0.05

Statistically significant correlations were reported between the following pairs of traits: growth decline intensity coefficient (Δk) and average daily gain during the performance testing period ($r = +0.529$; $t = 4.47$); Δk and age at reaching 100 kg live weight ($r = −0.331$; $t = 2.26$); and Δk and minimum (posterior) width of the bacon half of the chilled carcass ($r = −0.306$; $t = 2.05$). Correlations were also reported between blood

urea nitrogen concentration and age at reaching 100 kg live weight (r = −0.403; t = 2.92), backfat thickness at the level of the 6th–7th thoracic vertebrae (r = −0.392; t = 2.82), and maximum (anterior) width of the bacon half of the chilled carcass (r = +0.478; t = 3.77).

Discussion. The results of the present study indicate associations between growth patterns during early ontogenesis and subsequent fattening performance and meat production traits in growing pigs. These findings are of interest because early-life growth characteristics may provide additional information for the preliminary assessment of productive potential. However, the strength and direction of the observed correlations varied across economically important traits, suggesting that early growth intensity is not equally associated with all aspects of subsequent performance.

In the present study, the growth decline intensity coefficient (Δk) was positively correlated with average daily gain during the performance testing period (r = +0.529; P < 0.001). A negative correlation was also observed between Δk and age at reaching 100 kg live weight (r = −0.331; P < 0.05). Thus, pigs with higher Δk values generally exhibited faster growth during the fattening period and reached the target live weight at an earlier age. These findings suggest that the growth decline intensity coefficient may serve as an additional indicator for the early assessment of fattening performance in growing pigs.

Similar associations were reported by Zeng et al. (2019), who investigated the relationships between early-life growth indicators, survival, subsequent growth performance, and carcass characteristics in pigs. Based on data from 7,654 animals, the authors demonstrated that birth weight and growth performance during the suckling and nursery periods were associated with subsequent productivity. In particular, pigs with higher weight gains during the nursery period generally exhibited better subsequent growth performance and greater carcass weight at the end of the fattening period. These observations are consistent with the overall trends identified in the present study and highlight the importance of considering early developmental characteristics when evaluating pig productivity.

The importance of growth-related traits in breeding programmes was also addressed by Khalak et al. (2022), who investigated the effectiveness of multicomponent mathematical models of selection indices. Their findings showed that evaluating growing pigs using a combination of performance indicators can help identify animals with more favourable fattening performance and meat production traits. Statistically significant correlations were identified between selection indices and economically important characteristics. These results support the inclusion of quantitative growth indicators in pig evaluation systems while also emphasising the need to consider them alongside other productive traits.

Nevertheless, the present findings indicate that the growth decline intensity coefficient was not consistently associated with meat production characteristics. The correlation between Δk and backfat thickness at the level of the 6th–7th thoracic vertebrae was very weak (r = +0.044; P > 0.05), while its association with chilled carcass length was weak and statistically non-significant (r = −0.157; P > 0.05). These observations suggest that early growth characteristics may be more closely associated with subsequent growth performance than with individual carcass morphometric traits.

Comparable variability in the relationships among productive traits was reported by Miar et al. (2014). In a study involving 6,408 pigs, the authors found that genetic and phenotypic correlations among growth performance, carcass characteristics, and meat quality traits differed considerably in both magnitude and direction. Selection for faster growth may therefore be associated with changes in certain carcass traits without necessarily improving all aspects of meat quality. These findings highlight the complex relationships among productive characteristics and the importance of considering their

associations in breeding programmes. However, the phenotypic correlations obtained in the present study should not be directly equated with genetic correlations.

These observations are also partly consistent with the findings of Mykhalko et al. (2020), who investigated fattening performance and slaughter characteristics in pigs of Irish origin with different growth intensities during the fattening period. Their study examined differences in productive performance associated with growth rate, supporting the practical relevance of differentiated approaches to the evaluation of growing pigs. Nevertheless, comparisons among studies involving different breeds and genotypes should account for differences in rearing conditions, animal live weight, and evaluation methods.

Serum biochemical parameters provide valuable information for assessing the physiological status of growing pigs. In pigs of the Hungarian-origin Large White breed, the mean blood urea nitrogen concentration was 10.14 ± 0.422 mg%, while alkaline phosphatase activity was 215.77 ± 5.181 U/L. Both values were within the physiological reference ranges reported in the literature. The coefficient of variation was 15.00% for blood urea nitrogen concentration and 8.66% for alkaline phosphatase activity, indicating differences in the degree of individual variability between these biochemical parameters.

Khalak et al. (2024) reported that serum biochemical parameters in growing pigs with different MC4R genotypes were within physiological reference ranges. The authors found no statistically significant differences in the biochemical parameters among the genotypes examined. However, correlations were observed between certain serum biochemical characteristics and fattening performance and meat production traits. The present findings complement these observations by examining the relationships between additional biochemical parameters and productive traits in growing pigs of the Hungarian-origin Large White breed.

Correlation analysis revealed negative associations between blood urea nitrogen concentration and both age at reaching 100 kg live weight ($r = -0.403$) and backfat thickness at the level of the 6th–7th thoracic vertebrae ($r = -0.392$). In contrast, a positive correlation was observed between blood urea nitrogen concentration and the maximum (anterior) width of the bacon half of the chilled carcass ($r = +0.478$). As urea is an end product of nitrogen metabolism, these findings may reflect certain relationships between protein metabolism and the development of productive traits. Nevertheless, blood urea nitrogen concentration is influenced by dietary protein supply, its utilisation by the animal, and physiological status. Therefore, the observed associations require further confirmation.

The present findings are partly consistent with those of Doornenbal et al. (1986), who investigated relationships among serum biochemical constituents, growth performance, and carcass characteristics in pigs. Their study indicated that nitrogen-related serum constituents, including urea, total protein, albumin, and creatinine, may provide information relevant to fattening performance and carcass composition. However, individual biochemical parameters did not consistently correlate with all productive traits. These observations suggest that serum biochemical characteristics should be considered supplementary indicators of physiological and metabolic status rather than independent predictors of productivity.

Unlike blood urea nitrogen concentration, serum alkaline phosphatase activity showed no statistically significant correlations with fattening performance or meat production traits in the present study. The correlation coefficients ranged from −0.265 to +0.105 ($P > 0.05$). In contrast, Doornenbal et al. (1986) reported positive associations between alkaline phosphatase activity and both average daily gain and the proportion of bone tissue in the carcass. These differences may be related to breed characteristics,

animal age, feeding and housing conditions, and sample size. Accordingly, alkaline phosphatase activity should be interpreted with caution when considered as a potential indicator of productive performance.

Within-breed differentiation of growing pigs according to the growth decline intensity coefficient revealed differences in several fattening performance and meat production traits. Pigs in experimental group I exhibited higher average daily gains and reached 100 kg live weight at an earlier age than those in group III. However, the highest mean values for chilled carcass length and both anterior and posterior carcass widths were recorded in experimental group II. These findings suggest that superior growth performance is not necessarily accompanied by corresponding advantages in all carcass characteristics.

The importance of a comprehensive approach to evaluating growing pigs was also emphasised by Pelikh et al. (2019), who investigated the use of selection indices and the establishment of selection thresholds based on reproductive, fattening, and meat production traits. Their findings highlight the need to consider multiple characteristics, their variability, and their importance in breeding programmes. In this context, the growth decline intensity coefficient may be regarded as a potential component of comprehensive performance evaluation rather than a replacement for conventional productivity indicators.

Overall, the findings suggest that early individual growth characteristics may be useful as supplementary indicators for the preliminary assessment of fattening performance in growing pigs.

Conclusions:

1. The serum biochemical parameters, including blood urea nitrogen concentration (mg%) and alkaline phosphatase activity (U/L), in growing pigs of the Hungarian-origin Large White breed were within the physiological reference ranges reported for clinically healthy animals.

2. Growing pigs of the Hungarian-origin Large White breed exhibited favourable fattening performance and meat production traits. Their performance exceeded the minimum requirements for the elite class in terms of age at reaching 100 kg live weight, backfat thickness measured at the level of the 6th–7th thoracic vertebrae, and chilled carcass length by an average of 13.56%.

3. Pigs in experimental group II had a greater chilled carcass length than those in groups I and III by 2.2 cm (td = 3.14) and 1.0 cm (td = 0.11), respectively. The maximum (anterior) width of the chilled carcass was greater by 2.5 cm (td = 2.33) and 1.6 cm (td = 1.41), respectively, while the minimum (posterior) width was greater by 2.3 cm (td = 3.10) and 0.6 cm (td = 0.81), respectively.

4. Pairwise correlation coefficients calculated among the growth decline intensity coefficient (Δk), serum biochemical parameters, fattening performance, and meat production traits in growing pigs of the Hungarian-origin Large White breed ranged from −0.403 to +0.529.

Acknowledgments. The authors would like to express their sincere gratitude to N. O. Shepel, Chief Technologist of Druzhba-Kaznacheivka Agricultural Enterprise, Dnipropetrovsk Oblast, Ukraine; Professor D. M. Masiuk, Doctor of Veterinary Sciences and Director of the Research Center for Biosafety and Environmental Control of Agricultural Resources (“Biosafety-Center”) at Dnipro State Agrarian and Economic University; and Associate Professor V. H. Yefimov, PhD in Veterinary Sciences and Head of the Department of Physiology, Biochemistry, and Chemical-Toxicological Analysis, for their valuable assistance and support.

References

Alfonso, L. (2019). Impact of incorporating greenhouse gas intensities in selection indexes for sow productivity traits. *Livestock Science,* 219, 57–61. https://doi.org/10.1016/j.livsci.2018.11.016

Balatskyi, V. M., Vovk, V. O., Buslyk, T. V., Ilchenko, M. O., & Oliinychenko, Ye. K. (2018). Henetychnyi ta asotsiatyvnyi analiz odnonukleotydnoho polimorfizmu g.22G>C u heni katepsynu F svynei riznykh porid [Genetic and association analysis of the single-nucleotide polymorphism g.22G>C in the cathepsin F gene in pigs of various breeds]. *Visnyk Poltavskoi derzhavnoi ahrarnoi akademii,* (4), 137–141. https://doi.org/10.31210/visnyk2018.04.20 (in Ukrainian).

Berezovskyi, M. D., & Khatko, I. V. (2005). Metodyky otsinky knuriv i svynomatok za yakistiu potomstva v umovakh pleminnykh zavodiv i pleminnykh reproduktoriv [Methods for evaluating boars and sows based on progeny quality in pedigree breeding farms and multiplier farms]. *Suchasni metodyky doslidzhen u svynarstvi*, 32–37. (in Ukrainian).

Burhu, Yu. H., Kotova, Z. Ya., Hnitii, N. V., Oliferchuk, S. V., & Olefir, V. O. (2024). Vidhodivelni ta zabiini yakosti svynei pry chystoporodnomu rozvedenni ta skhreshchuvanni [Fattening and slaughter traits of pigs in purebred breeding and crossbreeding]. *Visnyk Sumskoho natsionalnoho ahrarnoho universytetu. Seriia: Tvarynnytstvo,* (2), 25–29. https://doi.org/10.32782/bsnau.lvst.2024.2.4 (in Ukrainian).

Doornenbal, H., Tong, A. K. W., & Sather, A. P. (1986). Relationships among serum characteristics and performance and carcass traits in growing pigs. *Journal of Animal Science*, 62(6), 1675–1681. https://doi.org/10.2527/jas1986.6261675x

Hetia, A. A. (2009). *Orhanizatsiia selektsiinoho protsesu v suchasnomu svynarstvi* [Organization of the Selection Process in Modern Pig Farming]. Monohrafiia. Poltava: Poltavskyi literator. (in Ukrainian).

Hunchak, R., & Sedilo, Kh. (2018). Dynamika morfolohichnykh ta biokhimichnykh pokaznykiv krovi pidsysnykh porosiat za riznoho rivnia akvatsytratu yodu v ratsionakh svynomatok [Dynamics of morphological and biochemical blood parameters in suckling piglets given different levels of iodine aquacitrate in the diets of sows]. *Naukovyi visnyk Lvivskoho natsionalnoho universytetu veterynarnoi medytsyny ta biotekhnolohii imeni S. Z. Gzhytskoho. Seriia: Silskohospodarski nauky*, 20(84), 27–32. https://doi.org/10.15421/nvlvet8405

Hyria, V. M., Metlytska, O. I., Usachova, V. Ye., & Bondarenko, O. M. (2018). Zviazok polimorfizmiv heniv PLIN i MC4R z vidhodivelnymy yakostiamy svynei [Association of PLIN and MC4R gene polymorphisms with fattening traits in pigs]. *Visnyk Poltavskoi derzhavnoi ahrarnoi akademii,* (1), 101–107. https://doi.org/10.31210/visnyk2018.01.18

Instruktsiia z bonituvannia svynei; Instruktsiia z vedennia pleminnoho obliku u svynarstvi [Instruction on Pig Evaluation; Instruction on Maintaining Breeding Records in Pig Farming] (2003). Kyiv : Kyivskyi universytet. (in Ukrainian).

Khalak, V. I., Hutyi, B. V., Ilchenko, M. O., Shostia, A. M., Usenko, S. O., & Petulko, P. V. (2022). Efektyvnist vykorystannia deiakykh polikomponentnykh matematychnykh modelei selektsiinykh indeksiv dlia otsinky molodniaku svynei za vidhodivelnymy i miasnymy yakostiamy [Efficiency of using certain multicomponent mathematical models of selection indices for evaluating young pigs based on fattening and meat traits]. *Visnyk Poltavskoi derzhavnoi ahrarnoi akademii,* (2), 197–204. https://doi.org/10.31210/visnyk2022.02.23 (in Ukrainian).

Khalak, V. I., Hutyi, B. V., Saienko, A. M., Bordun, O. M., & Yefimov, V. H. (2024). Deiaki osoblyvosti interieru, vidhodivelni ta miasni yakosti molodniaku svynei riznykh henotypiv [Certain interior characteristics, fattening performance, and meat traits of young pigs of different genotypes]. *Visnyk ahrarnoi nauky*, (8), 53–62. https://doi.org/10.31073/agrovisnyk202408-06 (in Ukrainian).

Khalak, V., Kostenko, O., Rodchenko, L., Gutyj, B., Martyshuk, T., & Vus, U. (2025). Physicochemical properties of muscle tissue of young pigs of the large white breed of foreign origin, their variability, and correlation with biochemical parameters of blood serum. *Scientific Messenger of LNU of Veterinary Medicine and Biotechnologies. Series: Veterinary Sciences*, 27(118), 133-140. https://doi.org/10.32718/nvlvet11818

Kodak, O., & Nagy, I. (2019). Historical overview of the selection indices applied in pig breeding. *Acta Agraria Kaposváriensis,* 23(1), 22–31. https://doi.org/10.31914/aak.2294

Koroban, M. P., & Lykhach, V. Ya. (2024). Zabiini ta miasni yakosti molodniaku svynei suchasnykh henotypiv za riznykh vahovykh kondytsii v umovakh promyslovoi tekhnolohii [Slaughter and meat traits of young pigs of modern genotypes at different weight conditions under industrial production technology]. *Tavriiskyi naukovyi visnyk. Seriia: Silskohospodarski nauky*, 135(1), 178–188. https://doi.org/10.32782/2226-0099.2024.135.1.24 (in Ukrainian).

Kovalenko, V. P., Khalak, V. I., Nezhlukchenko, T. I., & Papakina, N. S. (2010). Biometrychnyi analiz minlyvosti oznak silskohospodarskykh tvaryn i ptytsi [Biometric Analysis of Trait Variability in Farm Animals and Poultry: A Study Guide on the Genetics of Farm Animals]. Navchalnyi posibnyk z henetyky silskohospodarskykh tvaryn. Kherson: Oldi. (in Ukrainian).

Kozyr, V., Khalak, V., & Povod, M. (2019). DNA type results swine for MC4R-gene and its association with productivity. AgroLife Scientific Journal, 8(1), 128–133. URL: https://agrolifejournal.usamv.ro/index.php/agrolife/article/view/426

Matsenko, M. (2020). Hematolohichni pokaznyky ta shvydkist rostu zalezhno vid tryvalosti embrionalnoho rozvytku svynei, oderzhanykh za promyslovoho skhreshchuvannia [Hematological parameters and growth rate in relation to the duration of embryonic development in pigs obtained via industrial crossbreeding]. *Animal Science and Food Technology*, 11(3), 43–49. https://doi.org/10.31548/animal2020.03.047 (in Ukrainian).

Miar, Y., Plastow, G., Bruce, H., Moore, S., Manafiazar, G., Kemp, R., Charagu, P., Huisman, A., van Haandel, B., Zhang, C., McKay, R., & Wang, Z. (2014). Genetic and phenotypic correlations between performance traits with meat quality and carcass characteristics in commercial crossbred pigs. *PLOS ONE*, 9(10), e110105. https://doi.org/10.1371/journal.pone.0110105

Moisei, I. S., Gutyj, B. V., Boiko, A. O., Verbelchuk, T. V., Lenkov, L. H., Peliak, O. R., Shostia, H. M., Makhovii, O. H., Morozov, V. R., & Yermak, O. (2025). Efficiency of different feeding strategies during the rearing of piglets from hyperprolific sows under very early weaning. *Ukrainian Journal of Veterinary and Agricultural Sciences*, 8(3), 60–73. https://doi.org/10.32718/ujvas8-3.08

Mykhalko, O., Povod, M., Plechko, O., & Kokhana, O. (2020). Vidhodivelni ta zabiini yakosti svynei irlandskoho pokhodzhennia za riznoi intensyvnosti rostu na vidhodivli [Fattening and slaughter traits of pigs of Irish origin under different growth intensities during the fattening period]. *Visnyk Sumskoho natsionalnoho ahrarnoho universytetu. Seriia: Tvarynnytstvo*, 4(43), 50–57. https://doi.org/10.32845/bsnau.lvst.2020.4.8 (in Ukrainian).

Nechmilov, V. (2018). Vplyv sposobu hodivli hibrydnykh svynei na doroshchuvanni na yakist miasa [Influence of the feeding method for hybrid pigs during the rearing stage on meat quality]. *Naukovyi visnyk Lvivskoho natsionalnoho universytetu veterynarnoi medytsyny ta biotekhnolohii imeni S. Z. Gzhytskoho. Seriia: Silskohospodarski nauky,* 20(89), 56–60. https://doi.org/10.32718/nvlvet8910 (in Ukrainian).

Oliinychenko, Y. K., Rossokha, V. I., Boyko, O. A., Tur, G. N., Zaderikhina, O. A., & Brovko, O. V. (2021). Genetic analysis of Ukrainian Large White pig breed by polymorphisms in RYR1, ESR1 and PRLR genes. *Naukovo-tekhnichnyi biuleten Instytutu tvarynnytstva NAAN*, (125), 30–36. https://doi.org/10.32900/2312-8402-2021-125-30-36

Pelikh, V., Ushakova, S., & Pelikh, N. (2019). Index evaluation of pigs and determination of selection limits. *Agricultural Science and Practice,* 6(1), 67–74. https://doi.org/10.15407/agrisp6.01.067

Piórkowska, K., Ropka-Molik, K., Eckert, R., Tyra, M., & Żukowski, K. (2012). The association between polymorphisms of three cathepsins and economically important traits in pigs raised in Poland. *Livestock Science,* 150(1–3), 316–323. https://doi.org/10.1016/j.livsci.2012.09.022

Prudyus, T. (2024). Biokhimichni ta hematolohichni osoblyvosti pokaznykiv krovi, produktyvnist porosiat za vplyvu dodatkovoho kormu «Aktyvo» [Biochemical and hematological blood parameters and performance of piglets fed the supplementary feed "Aktivo".]. *Naukovyi visnyk Lvivskoho natsionalnoho universytetu veterynarnoi medytsyny ta biotekhnolohii imeni S. Z. Gzhytskoho. Seriia: Silskohospodarski nauky,* 26(100), 173–178. https://doi.org/10.32718/nvlvet-a10027 (in Ukrainian).

Van den Broeke, A., Aluwé, J., Wauters, J., Vanhaecke, L., Buys, N., Millet, S., & Tuyttens, F. (2015). The effect of the MC4R gene on boar taint compounds, sexual maturity, and behavior in growing-finishing boars and gilts. *Animal*, 9(10), 1688–1697. https://doi.org/10.1017/S1751731115001135

Vlizlo, V. V. (2012). *Laboratorni metody doslidzhen u biolohii, tvarynnytstvi ta veterynarnii medytsyni: Dovidnyk* [Laboratory Research Methods in Biology, Animal Husbandry, and Veterinary Medicine: A Handbook]. Lviv: SPOLOM. (in Ukrainian).

Voloshchuk, V. M., Hetia, A. A., & Tsereniuk, O. M. (2017). *Vyvchennia miasnoi produktyvnosti svynei* [Study of Meat Productivity in Pigs]. I. I. Ibatulin & O. M. Zhukorskyi (Red.), Metodolohiia ta orhanizatsiia naukovykh doslidzhen u tvarynnytstvi (s. 124–129). Ahrarna nauka. (in Ukrainian).

Zeng, Z. K., Urriola, P. E., Dunkelberger, J. R., Eggert, J. M., Vogelzang, R., Shurson, G. C., & Johnston, L. J. (2019). Implications of early-life indicators for survival rate, subsequent growth performance, and carcass characteristics of commercial pigs. *Journal of Animal Science*, 97(8), 3313–3325. https://doi.org/10.1093/jas/skz223