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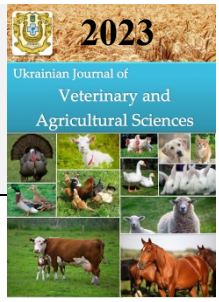

Activity of blood serum enzymes and their relationship with feeding and meat qualities in young pigs of different intrageneric differentiation according to the "formation intensity" index

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Contents

Abstract

The article presents the study results of the activity of blood serum enzymes, fattening, and meat qualities of young pigs of the universal direction of productivity, considering their intrabreed differentiation according to the "formation intensity" index. It was established that the activity of aspartate aminotransferase (AST), alanine aminotransferase (ALT), and alkaline phosphatase (ALP) in the blood serum of young pigs of the large white breed corresponds to the physiological norm of clinically healthy animals; by the age of reaching a live weight of 100 kg, the thickness of lard at the level of 6–7 thoracic vertebrae and the length of the chilled carcass – I class and elite class. Taking into account the intrabreed differentiation of young pigs of the large white breed according to the "formation intensity" index, the animals of the experimental group I (Δ = 0.715–1.009) exceeded those of the same age as II (Δ = 1.011–1.356) in terms of average daily increase in live weight by 5.71%, age reaching a live weight of 100 kg – 1.28 %, fat thickness at the level of 6–7 thoracic vertebrae – 1.44 %. The pairwise correlation coefficient between biochemical indicators of blood serum and fattening and meat qualities of young pigs of the large white breed shows that this biometric indicator varies from -0.344 ± 0.1485 to +0.402 ± 0.1448. The maximum increase in additional production was obtained from young pigs of the first experimental group, in which the "formation intensity" index ranges from 0.715 to 1.009 points (+3.40 %). The criterion for selecting highly productive animals of the leading herd based on the absolute parameters of their offspring's fattening and meat qualities is their correspondence to the elite class, according to the "intensity of formation" index – 0.715–1.009 points.

Keywords: young pigs; breed; fattening; meat qualities; "formation intensity" index; variability; correlation and cost of additional products.

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1. Introduction

Intensification of the breeding process, as well as the introduction of modern technologies for keeping and feeding pigs of different sex and age groups, determine the work program of agricultural formations, the goal of which is to create highly profitable pork production (Voloshchuk & Vasyliv, 2013; Bankovska, 2016; Barkar & Dekhtiar, 2017; Voloshchuk & Hryshyna, 2017; Martyshuk et al., 2021). At the same time, the essential issues are the objective assessment of the level of animal productivity and the search for effective methods of early prediction of the reproductive qualities of sows and breeding boars, as well as the fattening and meat qualities of their offspring (Kim et al., 2000; Chen et al., 2004; Fontanesi et al., 2010; Khalak et al., 2020; 2021; Khalak & Gutyj, 2022; Zorc et al., 2022).

The relevance of the chosen research direction is confirmed by the works of other domestic and foreign scientists (Garmatyk et al., 2020; Susol et al., 2021; Krupa et al., 2021; Li et al., 2021; Xu et al., 2021; Ros-Freixedes et al., 2022).

Aim of the work – to investigate the activity of blood serum enzymes, fattening, and meat qualities of young pigs of the universal direction of productivity, taking into account their intrabreed differentiation according to the "intensity of formation" index.

2. Materials and methods

The research was conducted at the "Druzhba-Kaznacheivka" meat processing plant, "Jazz" meat processing plant of the Dnipropetrovsk region, the Scientific Research Center for Biosafety and Environmental Control of

Agricultural Resources of the Dnipro State Agrarian and Economic University, as well as the Animal Husbandry Laboratory of the State Institution "Institute of Grain Crops of the National Academy of Agrarian Sciences of Ukraine".

The work was carried out following the program of scientific research of the National Academy of Agrarian Sciences of Ukraine No. 30, "Innovative technologies of breeding, industrial and organic production of pig products", the task "Develop a local system of breeding and hybridization of pigs using modern genetic methods (DNA markers)".

The assessment of young pigs for fattening and meat qualities was carried out taking into account the following quantitative characteristics: average daily increase in live weight during the period of control fattening, g; the age of reaching 100 kg live weight, days; fat thickness at the level of 6–7 thoracic vertebrae, mm; length of the cooled carcass cm; length of the bacon half of the chilled half carcass, cm, the most significant (front) width of the bacon half of the carcass; the most minor (back) width of the bacon half of the corpse.

The length of the cooled carcass (cm) was measured with a measuring tape from the edge of the fusion of the pubic bones to the front surface of the first cervical vertebra; the length of the bacon half of the chilled half carcass (cm) – from the front edge of the pubic bone to the middle of the front edge of the first rib; the most significant (front) width of the bacon half - at the level of the seventh thoracic vertebra, perpendicular to the half of the carcass; the most minor (back) width of the bacon half – at the level of the penultimate lumbar vertebra, perpendicular to the half of the carcass (Berezovskyi & Khatko, 2005).

The age of reaching a live weight of 100 kg (1, 2) and the "formation intensity" index (Δt) (3) were calculated according to the following mathematical models:

If the live weight of the animal was 85–99 kg:

$$D_{100} = \left[(100\ kg - M_0) \div \frac{M_0 - M_{no}}{D_0 - D_{no}} \right] + D_0, \quad (1)$$

if the live weight of the animal was 101–115 kg:

$$D_{100} = D_0 - \left[(M_0 - 100\ kg) \div \frac{M_0 - M_{no}}{D_0 - D_{no}} \right] + D_0, \quad (2)$$

where: D_{100} – age of reaching a live weight of 100 kg, days; D_0 – an age at last weighing, days; $D_{по}$ – age of previous weighing, days; M_0 – live weight at the last weighing, kg; $M_{по}$ – live weight at preliminary weighing, kg;

$$\Delta t = \frac{Wв - Wa}{0{,}5 \times (Wв + Wa)} - \frac{Wc - Wв}{0{,}5 \times (Wc + Wв)}, \quad (3)$$

where: Δt – "formation intensity" index, score; W*a* – live weight at the time of birth, kg, W*в* – live weight at the age of 3 months, kg, W*c* – live weight at the age of 6 months, kg.

The activity of aspartate aminotransferase (AST), alanine aminotransferase (ALT), and alkaline phosphatase (ALP) in the blood serum of 5-month-old young pigs was studied according to generally accepted methods using reagent kits from the company "Filisit-Diagnostyka" (Ukraine, Dnipro) (Hryban et al., 2001; Vlizlo et al., 2012).

The conditions of feeding and maintenance of young pigs of the experimental groups were identical and corresponded to zootechnical standards.

The cost of additional products was calculated according to the following data: the purchase price of a product unit, following the current prices in Ukraine; average productivity of animals; the average premium of the primary production, which is expressed as a percentage per 1 head when applying a new and improved breeding achievement compared to the productivity of animals of primary use; the number of livestock of agricultural animals of a new or improved breeding achievement. The constant coefficient of reduction of the result, associated with additional costs for profitable additional products, is equal to 0.75.

Biometric processing of the obtained material was carried out according to the methods of V. P. Kovalenko and others (Kovalenko et al., 2010) and S. S. Kramarenko and others (Kramarenko et al., 2019) using the programmable module "Data Analysis" in Microsoft Excel.

The strength of correlations between traits was determined using the Chaddock scale (Table 1).

Table 1

Chaddock's scale for grading the strength of the correlation between quantitative traits

The value of the correlation coefficient	The power of correlation strength
0.1–0.3	Weak
0.3–0.5	Moderate
0.5–0.7	Moderate
0.7–0,9	High
0.9–0.99	Very high

3. Results and discussion

The results of laboratory studies show that the activity of aspartate aminotransferase (AST), alanine aminotransferase (ALT), and alkaline phosphatase (ALP) in the blood serum of 5-month-old young pigs corresponds to the physiological norm of clinically healthy animals (Table 2).

Table 2

Biochemical indicators of blood serum of young pigs of the experimental group, n = 13

Indicator (sign), units of measurement	Biometric indicators		
	$X \pm Sx$	$\sigma \pm X_\sigma$	$Cv \pm Sc_v$, %
Aspartate aminotransferase (AST) activity,	59.38 ± 3.761	13.56 ± 2.664	22.83 ± 4.485
Alanine aminotransferase activity (ALT),	44.38 ± 2.474	8.92 ± 1.752	20.09 ± 3.946
The activity of alkaline phosphatase (ALP), unit/l	122.12 ± 8.653	31.20 ± 6.129	25.54 ± 5.017

The coefficient of variation of biochemical parameters of blood serum of young pigs ranges from 20.09 to 25.54 %.

The results of the study of the absolute and integrated growth indicators of the young pigs of the experimental groups show that the live weight of the young pigs of the experimental groups at the time of birth is 1.48–1.51 kg at the age of 3 months – 31.6–33.5 kg (Table 3).

The difference between the groups in terms of live

weight in the 6-month month and the "formation intensity" index is equal to 3.5 kg (td = 3.36; P > 0.01), 0.289 points (td = 10.70; P > 0.001).

The data on control fattening show that high indicators of fattening and meat qualities characterize young pigs of the controlled population (N = 42). Thus, the average daily increase in live weight of young pigs during the period of control fattening is 780.4 ± 5.91 g (Cv = 4.91%), the age of reaching 100 kg live weight is 177.5 ± 0.80 days (Cv = 2.95 %), the thickness of lard at the level of 6–7 thoracic vertebrae – 20.7 ± 0.34 mm (Cv = 10.68 %), the length of the chilled carcass – 96.6 ± 0.35 cm (Cv = 1.77 %), the length of the bacon half of the chilled half carcass is 85.2 ± 0.50 cm (Cv = 2.88 %). The indicators of the most significant (front) and most minor (back) width of the bacon half are equal to 34.1 ± 0.44 cm (Cv = 6.74 %) and 24.7 ± 0.35 cm (Cv = 7.52 %), respectively. The "intensity of formation" index in young pigs of the controlled population is equal to 1.06 ± 0025 points (Cv = 15.58 %).

The results of the study of the activity of aspartate aminotransferase (AST), alanine aminotransferase (ALT), and alkaline phosphatase (ALP) in blood serum, fattening and meat qualities of young pigs of different intrabreed differentiation according to the "formation intensity" index are shown in Table 4.

It was established that the difference between the animals of the experimental groups in the activity of aspartate aminotransferase (AST) is equal to 4.9 units/l (td = 0.55; P > 0.05), alanine aminotransferase (ALT) – 6.85 units/l (td = 1.48; P > 0.05), alkaline phosphatase is 19.76 units/l (td = 1.23; P > 0.05), the average daily gain of live weight is 46.2 g (td = 4.47; P < 0.001), age of reaching 100 kg live weight – 2.3 days (td = 150; P > 0.05), fat thickness at the level of 6–7 thoracic vertebrae – 0.3 mm (td = 0.44; P > 0.05).

Table 3

Absolute and integrated indicators of growth of young pigs of experimental groups

Indicator	Biometric indicators	Index "intensity of formation" (Δt), point	
		0.715–1.009	1.011–1.356
		group	
		I	II
Live weight at the time of birth, kg	n	17	25
	$X \pm Sx$	1.48 ± 0.040	1.51 ± 0.040
	$\sigma \pm X_\sigma$	0.14 ± 0.024	0.13 ± 0.018
	$Cv \pm Sc_v$, %	9.45 ± 1.620	8.60 ± 1.216
Live weight at the age of 3 months, kg	$X \pm Sx$	31.6 ± 0.352	33.5 ± 0.276
	$\sigma \pm X_\sigma$	1.45 ± 0.248	1.38 ± 0.195
	$Cv \pm Sc_v$, %	4.58 ± 0.785	4.11 ± 0.581
Live weight at the age of 6 months, kg	$X \pm Sx$	102.4 ± 0.704	98.9 ± 0.779
	$\sigma \pm X_\sigma$	2.90 ± 0.497	3.86 ± 0.545
	$Cv \pm Sc_v$, %	2.83 ± 0.485	3.90 ± 0.551
Index "intensity of formation" (Δt), point	$X \pm Sx$	0.896 ± 0.0221	1.185 ± 0.0161
	$\sigma \pm X_\sigma$	0.091 ± 0.015	0.08 ± 0.011
	$Cv \pm Sc_v$, %	10.15 ± 1.740	6.75 ± 0.954

Table 4

The fattening and meat qualities of young pigs of different intrabreed differentiation according to the "intensity of formation" index

Indicator (sign), units of measurement	Biometric indicators	Index "intensity of formation", point	
		0.715–1.009	1.011–1.356
		group	
		I	II
The activity of aspartate aminotransferase (AST), units/l	n	5	8
	$X \pm Sx$	62.40 ± 7.877	57.50 ± 3.991
	$\sigma \pm X_\sigma$	17.61 ± 5.572	11.28 ± 2.820
	$Cv \pm Sc_v$, %	28.22 ± 8.930	19.61 ± 4.902
The activity of alanine aminotransferase (ALT), units/l	$X \pm Sx$	48.60 ± 3.249	41.75 ± 3.271
	$\sigma \pm X_\sigma$	7.26 ± 2.297	9.25 ± 2.312
	$Cv \pm Sc_v$, %	14.93 ± 4.724	22.15 ± 5.537
Alkaline phosphatase activity, unit/l	$X \pm Sx$	134.28 ± 10.327	114.52 ± 12.210
	$\sigma \pm X_\sigma$	23.09 ± 7.306	34.53 ± 8.632
	$Cv \pm Sc_v$, %	17.19 ± 5.439	30.15 ± 7.537
Average daily gain of live weight during the period of control fattening, g	n	17	25
	$X \pm Sx$	807.9 ± 8.80	761.7 ± 5.41
	$\sigma \pm X_\sigma$	36.29 ± 6.224	27.09 ± 4.794
	$Cv \pm Sc_v$, %	4.49 ± 0.770	3.55 ± 0.502
Age of reaching 100 kg live weight, days	$X \pm Sx$	176.9 ± 1.20	179.2 ± 0.95
	$\sigma \pm X_\sigma$	4.96 ± 0.850	4.77 ± 0.674
	$Cv \pm Sc_v$, %	2.80 ± 0.480	2.66 ± 0.376
The thickness of the lard at the level of 6–7 thoracic vertebrae, mm	$X \pm Sx$	20.5 ± 0.47	20.8 ± 0.48
	$\sigma \pm X_\sigma$	1.97 ± 0.337	2.40 ± 0.339
	$Cv \pm Sc_v$, %	9.60 ± 1.646	11.53 ± 1.630

The length of the cooled carcass, cm	n	8	16
	$X \pm Sx$	96.2 ± 0.52	96.8 ± 0.45
	$\sigma \pm X_\sigma$	1.48 ± 0.370	1.83 ± 0.323
	$Cv \pm Sc_v$, %	1.53 ± 0.382	1.89 ± 0.334
The length of a bacon half of a chilled half carcass, cm	$X \pm Sx$	84.2 ± 0.45	85.9 ± 0.52
	$\sigma \pm X_\sigma$	2.12 ± 0.530	2.50 ± 0.442
	$Cv \pm Sc_v$, %	2.51 ± 0.444	2.91 ± 0.515
The largest (front) width of the bacon half of the chilled carcass, cm	$X \pm Sx$	34.5 ± 0.82	34.2 ± 0.53
	$\sigma \pm X_\sigma$	2.32 ± 0.410	2.28 ± 0.403
	$Cv \pm Sc_v$, %	6.72 ± 1.189	6.67 ± 1.180
The smallest (back) width of the bacon half of the chilled carcass, cm	$X \pm Sx$	24.1 ± 0.54	25.0 ± 0.47
	$\sigma \pm X_\sigma$	1.55 ± 0.274	2.00 ± 0.353
	$Cv \pm Sc_v$, %	6.43 ± 1.138	8.00 ± 1.415

It was established that the maximum length of the chilled carcass (96.8 ± 0.45 cm) and the length of the bacon half of the chilled half-carcass (85.8 ± 0.62 cm) are characteristic of young pigs of the II experimental group. Compared with peers of the first experimental group, the difference according to these indicators is 0.6 (td = 0.88; P > 0.05) and 1.7 cm (td = 2.50; P < 0.05), respectively.

According to the indicator "the largest (front) width of the bacon half of the chilled carcass, cm", the difference between the groups is 0.3 cm (td = 0.30; P > 0.05), "the smallest (back) width of the bacon half of the chilled carcass, cm" – 0.9 cm (td = 1.26; P > 0.05).

The coefficient of variability (Cv, %) of the absolute indicators of fattening and meat qualities in young pigs of different intrabreed differentiation according to the "intensity of formation" index ranges from 1.53 (the length of the chilled carcass in animals of the I group) to 11.53 % (thickness fat at the level of 6–7 thoracic vertebrae in animals of the II experimental group).

The results of calculating the pairwise correlation coefficient between the biochemical indicators of blood serum and the fattening and meat qualities of young pigs of the large white breed are shown in Table 5.

The calculation of the pairwise correlation coefficient between the biochemical indicators of blood serum and the fattening and meat qualities of young pigs of the large white breed shows that this biometric indicator varies from -0.344 ± 0.1485 to +0.402 ± 0.1448.

Table 5

The level of correlations between the activity of blood serum enzymes, fattening, and meat qualities of young pigs of the controlled population

Feature		Biometric indicators		Strength of correlation
x	*y*	r ± Sr	tr	
Alkaline phosphatase activity, unit/l	1	0.128 ± 0.1568	0.82	Weak
	2	-0.001 ± 0.1581	0.01	-
	3	-0.101 ± 0.1573	0.64	Weak
	4	-0.111 ± 0.1571	0.71	Weak
	5	0.193 ± 0.1551	1.24	Weak
	6	-0.285 ± 0.1516	1.88	Weak
	7	-0.146 ± 0.1564	0.93	Weak
Aspartate aminotransferase (AST) activity,	1	-0.049 ± 0.1579	0.31	-
	2	0.212 ± 0.1545	1.37	Weak
	3	-0.316 ± 0.1500*	2.11	Moderate
	4	0.072 ± 0.1577	0.46	-
	5	0.197 ± 0.1550	1.27	Weak
	6	-0.058 ± 0.1578	0.37	-
	7	0.178 ± 0.1556	1.14	Weak
Alanine aminotransferase activity (ALT),	1	0.281 ± 0.1517	1.85	Weak
	2	-0.344 ± 0.1485*	2.32	Moderate
	3	0.091 ± 0.1575	0.58	-
	4	0.293 ± 0.1512	1.94	Weak
	5	0.402 ± 0.1448**	2.78	Moderate
	6	0.168 ± 0.1559	1.08	Weak
	7	0.097 ± 0.1574	0.62	-

Note: *1 – average daily increase in live weight during the period of control fattening, g; 2 – age of reaching 100 kg live weight, days; 3 – fat thickness at the level of 6–7 thoracic vertebrae, mm; 4 – length of the cooled carcass, cm; 5 – length of the bacon half of the chilled half carcass, cm; 6 – the largest (front) width of the bacon half of the carcass, cm; 7 – the smallest (back) width of the bacon half of the carcass, cm; * – P < 0.05; ** – P < 0.01*

Reliable pairwise correlation coefficients were established between the following pairs of traits: aspartate aminotransferase (AST) activity × fat thickness at the level of 6–7 thoracic vertebrae (r = -0.316 ± 0.1500, tr = 2.11), alanine aminotransferase (ALT) activity × age of achievement live weight of 100 kg (r = -0.344 ± 0.1485, tr = 2.32), alanine aminotransferase activity (ALT) × length of the bacon half of the chilled half carcass (r = 0.402 ± 0.1448, tr = 2.78).

The calculation of the economic efficiency of the research results shows that the maximum increase in additional production was obtained from the young pigs of experimental group I, in which the "formation intensity" index ranges from 0.715 to 1.009 points (+3.40 %) (Table 6).

Table 6
Economic efficiency of research results

Group	Average daily gain of live weight during the period of control fattening, g	± to the mean population value	The cost of additional products, UAH/head
General selection	780.4 ± 5.91	-	-
II	761.7 ± 5.41	-2.39	-170.37
I	807.9 ± 8.80	+3.40	+239.26

***Note:** * – the selling price of young pigs at the time of the study was 68.0 UAH per 1 kg of live weight*

The value of additional products obtained from one head of young pigs of the specified groups equals +239.26 UAH.

4. Conclusions

1. It was established that the activity of aspartate aminotransferase (AST), alanine aminotransferase (ALT), and alkaline phosphatase (ALP) in the blood serum of 5-month-old young pigs corresponds to the physiological norm of clinically healthy animals.

2. Taking into account the intrabreed differentiation of young pigs of the large white breed according to the "intensity of formation" index, the animals of the experimental group I (Δ = 0.715–1.009) prevailed over those of the same age as II (Δ = 1.011–1.356) in terms of the average daily increase in live weight by 5.71 %, the age of reaching a live weight of 100 kg – 1.28 %, the thickness of fat at the level of 6–7 thoracic vertebrae – 1.44 %.

3. The pairwise correlation coefficient between biochemical indicators of blood serum and fattening and meat qualities of the large white breed young pigs shows that this biometric indicator varies from -0.344 ± 0.1485 to +0.402 ± 0.1448.

4. The maximum increase in additional production was obtained from young pigs of the first experimental group, in which the "formation intensity" index ranges from 0.715 to 1.009 points (+3.40 %).

5. The criterion for selecting highly productive animals of the leading herd based on the absolute indicators of fattening and meat qualities of their offspring is their correspondence to the elite class, according to the "intensity of formation" index – 0.715–1.009 points.

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Conflict of interest

The author declare that there is no conflict of interest.

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