

ORIGINAL ARTICLE

## Some biochemical indicators of serum, fattening and meat quality of young pigs of different classes of distribution according to the Sazer-Fredin index

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The paper presented research on biochemical indicators from blood serum of young pigs of Large White breed, their fattening and meat qualities, and the cost-effectiveness of the research results. Research was carried out in agricultural formations of the Dnipropetrovsk region, meat-packing plant "Jazz", the Research Center for Biosafety and Environmental Control of Agricultural Resources of the Dnieper State Agrarian and Economic University, and the Laboratory of Animal Husbandry of the Institute of Grain Crops of NAAS. The work was carried out according to the research program of NAAS of Ukraine No.30 research program, "Innovative technologies of breeding, industrial and organic production of pig breeding" ("Pig breeding"). The object of the research was young pigs of a large white breed of Hungarian selection. Conditions for feeding and keeping animals in the experimental groups were identical and complied with zootechnical standards. Evaluation of young pigs for fattening and meat quality was carried out taking into account the following indicators: average daily gain of live weight during the control fattening, g; the age of reaching live weight 100 kg, days; thick bacon at the level of 6-7 thoracic vertebrae, mm; the length of the chilled carcass, cm; length of bacon half of chilled half-carcass, cm. According to generally accepted methods, the economic efficiency of the research results and biometric processing of the data were carried out. The Cheddock scale determined the strength of the correlations between signs. The biochemical indicators of the serum of young pigs of the experimental group were found to correspond to the physiological norm of clinically healthy animals. The difference between the groups in terms of total protein content (g/l), urea content (mmol/l) and creatinine concentration ( $\mu\text{mol/l}$ ) on average is 7.18%. Young pigs of the controlled herd at the age of reaching a live weight of 100 kg, the thickness of the bacon at the level of 6-7 thoracic vertebrae, and the length of the chilled carcass, according to the requirements of the current instruction on pig grading, the minimum requirements for the elite class prevail by an average of 14.38%. Taking into account the intra-breed differentiation of young pigs of large white breeds according to the Sazer-Fredin index, it was found that animals in group II ( $I=+0.003$ - $+3.211$ ) were dominated by peer I ( $I=-1.791$ - $-0.329$ ) by the average daily increase in live weight during the control fattening period of control fattening by 3.62% ( $td=1.43$ ,  $P>0.05$ ), the age of reaching a live weight of 100 kg by 2.86% ( $td=2.21$ ,  $P<0.05$ ), the thickness of bacon at the level of 6-7 thoracic vertebrae - by 10.10% ( $td=3.70$ ,  $P<0.01$ ), the length of the cooled carcass by 1.34% ( $td=1.52$ ,  $P>0.05$ ), the length of bacon half of the cooled half-carcass by 2.25% ( $td=0.87$ ,  $P>0.05$ ). The pair correlation coefficient between the biochemical indicators of blood serum, fattening, and meat qualities of young pigs of the large white breed range from -0.533 to +0.528. The use from young pigs of group II (Sazer-Fredin index ranges from +0.003 to +3.211 points) provides additional products at the level of +1.38%, and its cost is 360.32 UAH/head.

**Keywords:** Young pigs, serum biochemical indicators, fattening and meat quality, index; variability, correlation.

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## Introduction

The use of new technologies in pig breeding, taking into account the productive potential of each animal, makes it possible to use its genetic potential to some extent. Considering the individual characteristics of the pig organism of pigs in breeding work allows improving its breed qualities with the inheritance of valuable and economic and valuable traits (Khalak et al., 2020). The intensification of the selection process in reproductive quality pig breeding involves improving reproductive, fattening, and meat qualities, consolidation of individual populations according to these signs, and the selection of animals with a high level of adaptation to environmental conditions (Khalak et al., 2021).

Selective and breeding work in quality pig breeding is aimed at creating populations of pigs with high reproductive qualities of the original parental forms and fattening and meat indicators of their offspring (Khalak et al., 2020). It is essential to improve the quality of the final product, meat and lard (Khalak et al., 2019; Khalak & Gutyj, 2020). For this purpose, use several measures, namely: to investigate the influence of feed factors on the quality of slaughter products, live weight and sex of animals, the use of breeding boars of different breeds, intrabreed types and lines, susceptibility, the genotype of some genetic markers, transportation and method of slaughter, housing conditions and other factors (Martysjuk et al., 2019; 2020; Leskiv et al., 2021; Roman et al., 2021).

The theoretical basis for the research is the scientific development of domestic and foreign scientists (Bazhov & Komlatskiy, 1989; Tsereniuk, 2009; Getya, 2009; Khalak, 2015; Voloshchuk & Khalak, 2015; Khalak et al., 2020). The authors note that under modern conditions of industrial technology of pork production, essential features of pigs, along with the reproductive qualities of sows and breeding boars, are the improvement of fattening and meat quality of their offspring. For this purpose in zootechnical practice, industrial crossing and hybridization are used, proper conditions of keeping and feeding are created, conducting selection of highly productive animals of the main herd based on their evaluation of fattening and meat quality of their offspring, as well as DNA markers (Pierzchaa, 2004; Balatsky et al., 2016; Bankovskaja et al., 2016; Balatsky, 2016).

An important issue in working with the population of pigs of a particular breed is an objective evaluation of their productive potential and its implementation under biological markers of early prediction of important quantitative characteristics. This determines the practical significance of this work and the vector for further research.

The work aims to investigate the biochemical indicators of the blood serum of the young pigs of Large White breed, their fattening and to meat quality, and calculate the cost-effectiveness of the research results.

## Materials and Methods

Research was carried out in agricultural formations of the Dnipropetrovsk region, meat-packing plant "Jazz", the Research Center for Biosafety and Environmental Control of Agricultural Resources of the Dnieper State Agrarian and Economic University, and the Laboratory of Animal Husbandry of the Institute of Grain Crops of NAAS. The work was carried out according to the research program of NAAS of Ukraine No.30 research program, "Innovative technologies of breeding, industrial and organic production of pig breeding" ("Pig breeding").

The object of the research was young pigs of a large white breed of Hungarian selection. Conditions for feeding and keeping animals in the experimental groups were identical and complied with zootechnical standards.

The evaluation in animals of the specified production group and genotype on indicators of fattening and meat quality was carried out taking into account the following indicators: average daily gain of live weight during the period of control fattening, g; the age of live weight 100 kg, days; bacon fat of bacon at the level of 6-7 thoracic vertebrae, mm; the length of the chilled carcass, cm; the length of bacon half of chilled half-carcass, cm.

The Sazer-Fredin index (1) and the economic efficiency of the research results (2) were calculated using the formula:

$$I = \left( \frac{1}{\sigma_g} \times \Delta G_1 \right) - \left( \frac{1}{\sigma_f} \times \Delta F_1 \right) \dots\dots(1)$$

Where: I-index of A. Sazer-H. Fredin,  $\Delta G_1$ -growth rate in deviation from the mean;  $\Delta F_1$ -thickness of lard in deviation from the average;  $\sigma_g$ -phenotypic standard deviation of growth rate;  $\sigma_f$ -phenotypic standard deviation of the thickness of the lard (Kozlovskij, 1982).

$$E = C \times \frac{S \times P}{100} \times L \times K \dots\dots(2)$$

Where: E-the cost of additional products, UAH; C-the purchase price per unit of output, following existing prices in force in Ukraine; S-average productivity of animals; P-the average margin of primary products (%), which is expressed as a percentage per 1 head when using a new and improved selection achievement compared to the productivity of animals of basic use; L-constant coefficient of reduction of the result, which is associated with additional costs for profitable products (0.75); K-the number of farm animals of new or improved breeding achievement, heads.

In the serum of 5-month-old animals, the content of total protein (h/l), urea content (mmol/l), and creatinine concentration (mg%) was determined (Vlizlo et al., 2012).

Biometric processing of the data (Lakin, 1990) was performed according to generally accepted methods.

The pairwise correlation coefficient (r), the error of this biometric indicator (S<sub>r</sub>), and the reliability criterion (t<sub>r</sub>) were calculated using the following formulas:

$$r = \frac{\sum xy - \frac{\sum x \cdot \sum y}{n}}{\sqrt{C_x \cdot C_y}} \quad (3) \quad S_r = \sqrt{\frac{1-r^2}{n-2}} \quad (4) \quad t_r = \frac{r}{S_r} \quad (5)$$

The strength of the correlations between traits was determined by the Chaddock scale (Sidorova et al., 2003).

**Table 1.** Chaddock scale for grading the strength of a correlation.

The value of the correlation coefficient	Correlation strength
0.1-0.3	Weak
0.3-0.5	Moderate
0.5-0.7	Noticeable
0.7-0.9	High
0.9-0.99	Very high

## Results and Discussion

The analysis of laboratory research shows that the biochemical indicators in the serum of young pigs of the experimental group correspond to the physiological norm of clinically healthy animals. Therefore, the total protein content is 82.0 ± 2.10 h/l (Cv=7.71%), the urea content is 4.77 ± 0.30 mmol/l (Cv = 18.01%) and creatinine concentration is 90.86 ± 4.193 μmol/l (Cv=17.88%).

According to the results of the control fattening, it was found that the average daily increase in live weight of young pigs is 777.1 ± 11.11 g (Cv=7.29%), an age of achievement of live weight of 100 kg-172.1 ± 1.18 days (Cv=3.52%), the thickness of the lard thickness at the level of 6-7 thoracic vertebrae -20.9 ± 0.36 mm (Cv=9.22%), the length of the cooled carcass is 96.3 ± 0.43 cm (Cv=2.38%), the length of the bacon half of the cooled half-carcass is 83.3 ± 1.06 cm (Cv=6.73%). The Sazer-Fredin index ranges from -1,791 to +3.211 points.

The results on the research of biochemical indicators of blood serum of young pigs of large white breeds of different distribution classes according to the Sazer-Fredin index are shown in Table 2.

**Table 2.** Biochemical parameters of the blood serum of young pigs of the large white breed of different classes according to the Sazer-Fredin index, n=5.

Indicators, units of measurement	Biometric Indexes	Sazer-Fredin index	
		index gradation	
		-1.791 – -0.329	+0.003–+3.211

		Group	
		I	II
The content of total protein, h/l	$\bar{X} \pm S_{\bar{X}}$	83.0 ± 1.61	80.0 ± 6.11
	$\sigma \pm S_{\sigma}$	3.94 ± 1.25	10.58 ± 3.35
	$Cv \pm S_{Cv}, \%$	4.74 ± 1.50	13.22 ± 4.18
Urea content, mmol/l	$\bar{X} \pm S_{\bar{X}}$	4.72 ± 0.30	4.63 ± 0.31
	$\sigma \pm S_{\sigma}$	0.80 ± 0.25	0.81 ± 0.26
	$Cv \pm S_{Cv}, \%$	16.94 ± 5.44	17.53 ± 5.55
Creatinine concentration, $\mu\text{mol/l}$	$\bar{X} \pm S_{\bar{X}}$	80.6 ± 5.88	96.0 ± 4.95
	$\sigma \pm S_{\sigma}$	13.16 ± 4.16	15.67 ± 4.96
	$Cv \pm S_{Cv}, \%$	16.32 ± 5.16	16.32 ± 5.16

The differences between the groups in the content of total protein were found to be 3.0 h/l (td=0.47, P >0.05), urea content-0.09 mmol/l (td=2.25, P <0.05), creatinine concentration-15.4  $\mu\text{mol/l}$  (td=2.20, P <0.05).

The results on the research of fattening and meat quality of young pigs of different intrabreed differentiation according to the Sazer-Fredin index are shown in Table 3.

The young pigs of group II were found to outperform the peers of I on average daily live weight gain for the period of control fattening by 28.2 g (td=1.43, P >0.05), the age to reach a live weight of 100 kg by 5.1 days (td=2.21, P <0.05), the thickness of the lard at the level of 6-7 thoracic vertebrae-2.3 mm (td=3.70, P <0.01), the carcass length of the cooled carcass-1.3 cm (td=1.52, P >0.05), the length of the bacon half of the cooled half-carcass-1.9 cm (td=0.87, P >0.05).

The coefficient of variation of biochemical indicators of blood serum, fattening, and meat quality of young pigs of the experimental groups ranges from 2.11 to 17.53%.

The results of the calculation of the pair correlation coefficients between the biochemical indicators of blood serum, fattening, and meat quality of young pigs of the large white breed are shown in Table 4.

**Table 3.** Fattening and meat quality of young pigs of large white breeds of different classes of distribution according to the Sazer-Fredin index.

		Sazer-Fredin index	
		index gradation	
Indicators, units of measurement	Biometric Indexes	-1.791 – -0.329	+0.003 – +3.211
		The group	
		I	II
Average daily gain of live weight during the period of control fattening, h	n	12	16
	$\bar{X} \pm S_{\bar{X}}$	759.8 ± 14.96	788.0 ± 12.82

	$\sigma \pm S_{\sigma}$	55.14 ± 11.28	51.31 ± 9.08
	$Cv \pm S_{Cv}, \%$	7.25 ± 1.48	6.51 ± 1.15
	$\bar{X} \pm S_{\bar{X}}$	178.1 ± 1.67	173.0 ± 1.62
Age of reaching live weight 100 kg, days	$\sigma \pm S_{\sigma}$	5.20 ± 1.06	6.50 ± 1.15
	$Cv \pm S_{Cv}, \%$	2.91 ± 0.59	3.75 ± 0.66
	$\bar{X} \pm S_{\bar{X}}$	22.1 ± 0.48	19.8 ± 0.40
The thickness of the fat at the level of 6-7 thoracic vertebrae, mm	$\sigma \pm S_{\sigma}$	1.69 ± 0.35	1.61 ± 0.28
	$Cv \pm S_{Cv}, \%$	7.64 ± 1.56	8.13 ± 1.42
	$\bar{X} \pm S_{\bar{X}}$	95.4 ± 0.58	96.7 ± 0.63
The length of the cooled carcass, cm	$\sigma \pm S_{\sigma}$	2.02 ± 0.41	2.54 ± 0.45
	$Cv \pm S_{Cv}, \%$	2.11 ± 0.43	2.62 ± 0.47
	$\bar{X} \pm S_{\bar{X}}$	82.2 ± 1.69	84.1 ± 1.36
Length of bacon half of the cooled half-carcass, cm	$\sigma \pm S_{\sigma}$	5.86 ± 1.19	5.45 ± 0.96
	$Cv \pm S_{Cv}, \%$	7.12 ± 1.46	6.48 ± 1.15

The pair correlation coefficients between the biochemical indicators of blood serum, fattening, and meat quality of the young pigs of Large White breed range from -0.533 to +0.528.

A significant relationship was found between the following pairs of characteristics: total protein content × length of the bacon half of the chilled carcass (0.533 ± 0.1727), total protein content, h/l × Sazer-Fredin index h/l (-0.395 ± 0.1875), urea content × length of the chilled carcass (-0.445 ± 0.1828), creatinine concentration × length of the chilled carcass (0.528 ± 0.1734), creatinine concentration × length of bacon half of chilled half-carcass (0.519 ± 0.1745), creatinine concentration × Sazer-Fredin index (0.497 ± 0.1771).

According to the results of the calculation of the economic efficiency of the use of young pigs of different classes of distribution according to the Sazer-Fredin index, it was found that the maximum increase in additional products was obtained from animals of group II, namely +1.38% (Table 5).

**Table 4.** The pair correlation coefficient between the biochemical parameters of blood serum, fattening, and meat quality of young pigs of the large white breed.

	Signs		Biometric indicators		Correlation strength
	$x$	$y$	$r \pm Sr$	$tr$	
		1	-0.25 ± 0.19	1.28	Weak
The content of total protein, h/l		2	0.16 ± 0.20	0.80	Weak
		3	0.37 ± 0.19	1.98	Moderate

Urea content, mmol/l	4	-0.32 ± 0.19	1.66	Moderate
	5	-0.53 ± 0.17**	3.09	Noticeable
	6	-0.39 ± 0.19*	2.11	Moderate
	1	0.10 ± 0.20	0.50	Weak
	2	0.33 ± 0.19	1.72	Moderate
	3	0.007 ± 0.20	0.03	Weak
Creatinine concentration, µmol/l	4	-0.45 ± 0.18*	2.43	Moderate
	5	0.02 ± 0.20	0.09	Weak
	6	0.02 ± 0.20	0.08	Weak
	1	0.14 ± 0.20	0.70	Weak
	2	-0.02 ± 0.20	0.07	Weak
	3	-0.34 ± 0.19	1.76	Moderate
	4	0.53 ± 0.17**	3.05	Noticeable
	5	0.52 ± 0.18**	2.97	Noticeable
	6	0.50 ± 0.18**	2.81	Moderate

**Note:** 1) Average daily gain of live weight during the control fattening; 2) Age to reach a live weight of 100 kg, days; 3) The thickness of the lard at the level of 6-7 thoracic vertebrae, mm; 4) Length of the chilled carcass, cm; 5) Length of bacon half of chilled half-carcass, cm; 6) Sazer-Fredin index, points, \*-P<0.05; \*\*-P<0.01; \*\*\*-P<0.001.

**Table 5.** Economic efficiency of the research results.

Group	Index gradations Sazer-Fredina	The average daily increase in live weight during the control fattening from 30 to 100 kg, h	Supplement of additional products, %	The cost of additional products, UAH/head
General sample	-1.79 – +3.21	777.10 ± 11.11	–	–
I	-1.79 – -0.33	759.80 ± 19.96	-2.22	-579.65
II	+0.003 – +3.21	788.0 ± 12.82	+1.38	+360.32

**Note:** \*-the sale price of young pigs at the time of the research was UAH 44.8. per 1 kg of live weight.

The cost of additional products received from animals in these groups is +360.32 UAH/h.

## Conclusion

The biochemical indicators of blood serum in young pigs of the experimental group correspond to the physiological norm of clinically healthy animals. The difference between the groups in terms of total protein content (h/l), urea content (mmol/l) and creatinine concentration (µmol/l) averages 7.18%. Young pigs in the controlled herd at the age of reaching a live weight of 100 kg, the thickness of the lard at the level of 6-7 thoracic vertebrae, and the length of the chilled carcass, according to the requirements of

the current instruction on pig grading, the minimum requirements for the elite class prevail by an average of 14.38%. Taking into account the intra-breed differentiation of young pigs of large white breed according to the Sazer-Fredin index, it is found that the animals of group II ( $I=+0.003-+3.211$ ) dominated peer I ( $I=-1.791-0.329$ ) in the average daily increase in live weight during the period of control fattening by 3.62% ( $td=1.43$ ,  $P >0.05$ ), the age to reach a live weight of 100 kg by 2.86% ( $td=2.21$ ,  $P <0.05$ ), the thickness of the lard at the level of 6-7 thoracic vertebrae - by 10.10% ( $td=3.70$ ,  $P <0.01$ ), the length of the cooled carcass by 1.34% ( $td=1.52$ ,  $P >0.05$ ), the length of the bacon half of the cooled carcass by 2.25% ( $td=0.87$ ,  $P >0.05$ ). The pair correlation coefficient between the biochemical indicators of blood serum, fattening, and meat quality of young pigs of the large white breed ranges from -0.533 to +0.528. The use from young pigs of group II (Sazer-Fredin index ranges from +0.003 to +3.211 points) provides additional products at the level of +1.38%, and its cost is 360.32 UAH/head.

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