Scientific Papers. Series D. Animal Science. Vol. LXIV, No. 2, 2021
ISSN 2285-5750; ISSN CD-ROM 2285-5769; ISSN Online 2393-2260; ISSN-L 2285-5750

THE BIOCHEMICAL INDICATORS OF BLOOD SERUM AND THEIR RELATIONSHIP WITH FATTENING AND MEAT QUALITIES OF YOUNG SWINE OF DIFFERENT INBREED DIFFERENTIATION ACCORDING TO THE SAZER-FREDIN INDEX

Viktor KHALAK[1], Bogdan GUTYJ[2], Olexander BORDUN[3], Olha STADNYTSKA[4], Maria ILCHENKO[5]

[1]State institution - Institute of Grain Crops, National Academy of Sciences of Ukraine, 14 Vernadsky St., Dnipro, 49009, Ukraine
[2]Stepan Gzhytskyi National University of Veterinary Medicine and Biotechnologies Lviv, 50 Pekarska St., Lviv, 79010, Ukraine
[3]Institute of Agriculture of Northern East of National Academy of Agrarian Sciences of Ukraine, 1 Zelena St., Sumy, 42343, Ukraine
[4]Institute of Agriculture of the Carpathian Region of NAAS of Ukraine, Obroshino, 5 Hrushevskoho St., Lviv region, 81100, Ukraine
[5]Institute of Pig Breeding and agroindustrial production of NAAS of Ukraine, 1 Shvedska Mohyla St., Poltava, 36006, Ukraine

Corresponding author email: v16kh91@gmail.com, bvh@ukr.net

Abstract

The article presents the results of studies of protein metabolism and their relationship with fattening and meat qualities of young pigs of large white breeds of different interbreed differentiation according to the index of A. Sazer - H. Fredin. It was found that the biochemical parameters of the serum of young pigs of the experimental group correspond to the physiological norm of clinically healthy animals. Taking into account the interbreed differentiation of young pigs of the large white breed according to the index of A. Sazer - H. Fredin, it was found that the animals of group II outperformed peers of I on average daily live weight gain during control fattening, age of 100 kg live weight, fat thickness at 6-7 thoracic vertebrae, the length of the chilled carcass, the length of the bacon half of the chilled half-carcass on average by 4.03%. The pairwise correlation coefficient between the biochemical parameters of blood serum, fattening, and meat qualities of young pigs of large white breeds range from -0.533 to +0.528.

Key words: *correlation, economic efficiency, variability, young pigs.*

INTRODUCTION

Studies of domestic and foreign scientists show that an essential factor in intensifying the selection process in pig breeding is developing and implementing innovative methods for assessing animals' breeding value and the search for biological markers of early prediction of quantitative traits (Getya, 2009; Esfandyari et al., 2015; Khalak et al., 2020).

To assess the breeding value of pigs, the information on the productivity of parents, siblings, and semi-siblings, the animal's productivity, and their offspring's productivity are used (Tserenyuk, 2009; Khalak, 2015). The effectiveness of these methods is different, and therefore in world practice, use a comprehensive assessment of pigs using signs of productivity and biochemical parameters of serum. Thus, according to (Bazhov & Komlatsky, 1989), it was found that the selection for groups with different indicators of growth energy according to the long-headedness index at 2 months of age, the difference in live weight at the age of 7 months is 8.6-2.1 kg; according to the body mass index 4.6-13.9 kg; taking into account these indices 16.2-20.4 kg. The correlation coefficient between the index's value and the actual growth rate in the control cultivation is equal to 0.727-0.862, in the control fattening - 0.712-0.856. The authors note that the indices of exchange at 4 months of age are closely related to economic benefits. The correlation coefficients of protein metabolism indices with productive traits exceed 0.70, lipid - 0.50-0.88, protein-lipid -

0.64-0.95. The opposite pattern is established in the work of (Khalak & Gutyj, 2020). The authors' studies showed that the pairwise correlation coefficients between the concentration of total lipoproteins, serum aspartate aminotransferase (AsT), and alanine aminotransferase (AlT) activity, fattening and meat qualities of young white pigs are characterized as multidirectional and weakly (-0.157 ± 0.2059), average daily increase in live weight during the period of control fattening, kg × alkaline phosphatase activity, units/l.) - + 0.161 ± 0.2058 (age of reaching live weight 100 kg, days × concentration of total lipoproteins, mg %) selection and evaluation indices. The authors argue that the use of biochemical parameters of blood serum for early prediction of fattening and meat qualities of young pigs is ineffective.

Vashchenko's (2019) studies show that the evaluation of factory-type pigs "Bagachansky" on linear models using DNA marker data (g. 143 CTSL C>T) and without it, showed a high correlation ($r = 0.96 \pm 0.001$, $p \leq 0.001$), which can be explained by the low frequency of the allele g. 143 $CTSL^T$ in the population. The results of DNA typing of Myrhorod pig breed according to the MC4R gene should be used as a fixed factor in determining the breeding value by the BLUP method based on "age of 100 kg" and "fat thickness". The correlation between the estimates obtained from the models with and without the use of data on the genotype of pigs by the MC4R gene, based on age at 100 kg is 0.76 ± 0.109 ($p \leq 0.001$); based on "fat thickness" - 0.71 ± 0.119 ($p \leq 0.001$)

The work aims to investigate some indicators of protein metabolism and their connection with fattening and meat qualities of young pigs of the large white breed of different interbreed differentiation according to the index of A. Sazer - H. Fredin, as well as to calculate the level of correlations between traits and economic effectiveness of research results.

MATERIALS AND METHODS

The research was conducted in agricultural formations and processing enterprises of the Dnipro region, the research center of biosafety and ecological control of agro-industrial resources of Dnipro State Agrarian and Economic University and livestock laboratory of the Institute of Grain Crops of NAAS. The work was performed according to the research program of NAAS of Ukraine №30, "Innovative technologies of breeding, industrial and organic production of pig products" ("swine breeding").

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

Evaluation of animals of the specified production group and genotype on indicators of fattening and meat qualities was carried out taking into account the following indicators: average daily gain of live weight for the period of control fattening, g; the age of live weight 100 kg, days; fat thickness at the level of 6-7 thoracic vertebrae, mm; length of the chilled carcass, cm; length of bacon half of chilled half-carcass., cm (Berezovsky & Khatko, 2005).

The formula calculated the A. Sazer - H. Fredin index and the complex index of fattening and meat qualities (Tyler B. index):

$$I = \frac{1}{\sigma_g} \times \Delta G_1 - \frac{1}{\sigma_f} \times \Delta F_1, \quad (1)$$

where: I - index of A. Sazer - H. Fredin; ΔG1 - the growth rate in deviations from the average; ΔF_1 - fat thickness in deviations from the average; σ_g - the phenotypic standard deviation of growth rate; σf is the phenotypic standard deviation of the fat thickness (Kozlovsky et al., 1982);

$$I_в = 100 + (242 \times K) - (4{,}13 \times L) \quad (2)$$

where: $I_в$ - the complex index of fattening and meat qualities (Tyler B. index), points; K - average daily weight gain, kg; L - the fat thickness at the level of 6-7 thoracic vertebrae, mm; 242; 4,13 - the constant coefficients (Vashchenko, 2019).

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

Economic efficiency of research results and biometric processing of the obtained data

(Lakin, 1990) was carried out according to generally accepted methods.

The Chaddock scale determined the strength of the correlations between the traits (Sidorova et al., 2003) (Table 1).

Table 1. Chaddock scale for gradation of correlation strength

The value of the correlation coefficient	The 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 DISCUSSIONS

It was found that the biochemical parameters of the serum of young pigs of the experimental group correspond to the physiological norm of clinically healthy animals. Thus, the total protein content is 82.0 ± 2.10 g/l (Cv = 7.71%), urea content is 4.77 ± 0.30 mmol/l (Cv = 18.01%) and creatinine concentration is 90, 86 ± 4.193 μmol/l (Sv = 17.88%).

Analysis of the results of the study shows that the average daily increase in live weight of young pigs during the control period of fattening is 777.1 ± 11.11 g (Sv=7.29%), the age of 100 kg live weight - 172.1 ± 1.18 days (Cv = 3.52%), fat thickness at the level of 6-7 thoracic vertebrae - 20.9 ± 0.36 mm (Cv = 9.22%), length of the cooled carcass – 96.3 ± 0.43 cm 2.38%), the length of the bacon half of the chilled half-carcass - 83.3 ± 1.06 cm (Sv = 6.73%), the complex index of fattening and meat qualities (Tyler B. index) - 152.64 ± 2.115 points (Sv = 7.33%). The index of A. Sazer - H. Fredin ranges from -1.791 to +3.211 points.

The results of studies of biochemical parameters of blood serum of young pigs of the large white breed of different classes of distribution according to the index of A. Sazer - H. Fredin are shown in Table 2.

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

The indicator, units of measurement	The biometric Indicators	Index of A. Sazer - H. Fredin	
		The index gradation	
		-1.791 - -0.329	+0.003 - +3.211
		Group	
		I	II
The content of total protein, g/l	$\overline{X} \pm S_{\overline{X}}$	83.0±1.61	80.0±6.11
	σ±Sσ	3.94±1.246	10.58±3.348
	$Cv \pm S_{Cv}$, %	4.74±1.500	13.22±4.183
The urea content, mmol/l	$\overline{X} \pm S_{\overline{X}}$	4.72±0.303	4.63±0.307
	σ±Sσ	0.80±0.253	0.81±0.256
	$Cv \pm S_{Cv}$, %	16.94±5.440	17.53±5.547
Creatinine concentration, μmol/l	$\overline{X} \pm S_{\overline{X}}$	80.6±5.88	96.0±4.95
	σ±Sσ	13.16±4.164	15.67±4.958
	$Cv \pm S_{Cv}$, %	16.32±5.164	16.32±5.164

It was found that the difference between the groups in total protein content is 3.0 g/l (td=0.47, P>0.05), the urea content - 0.09 mmol/l (td = 2.25, P<0.05), the creatinine concentration - 15.4 μmol/l (td = 2.20, P<0.05).

The results of the study of fattening and meat qualities of young pigs of different interbreed differentiation according to the index of A. Sazer - H. Fredin are given in table 3.

It was found that the young pigs of group II outperformed 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 of reaching a live weight of 100 kg - by 5.1 days (td = 2.21, P<0.05), the thickness of the fat at the level of 6-7 thoracic vertebrae - 2.3 mm (td = 3.70, P<0.01), the 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).

Table 3. Fattening and meat qualities of young pigs of the large white breed of different classes of distribution according to the index of A. Sazer - H. Fredin

The indicator, units of measurement	The biometric Indicators	Index of A. Sazer - H. Fredin	
		The index gradation	
		-1.791 - -0.329	+0.003 - +3.211
		Group	
		I	II
The average daily gain of live weight during the period of control fattening, g	n	12	16
	$\overline{X} \pm S_{\overline{X}}$	759.8±14.96	788.0±12.82
	σ±Sσ	55,14±11.276	51,31±9,081
	$Cv \pm S_{Cv}$, %	7.25±1.482	6.51±1.152
The age of reaching live weight 100 kg, days	$\overline{X} \pm S_{\overline{X}}$	178.1±1.67	173.0±1.62
	σ±Sσ	5.20±1.063	6.50±1.150
	$Cv \pm S_{Cv}$, %	2.91±0.595	3.75±0.663
The thickness of the fat at the level of 6-7 thoracic vertebrae, mm	$\overline{X} \pm S_{\overline{X}}$	22.1±0.48	19.8±0.40
	σ±Sσ	1.69±0.345	1.61±0.284
	$Cv \pm S_{Cv}$, %	7.64±1,564	8.13±1.421
The length of the cooled carcass, cm	$\overline{X} \pm S_{\overline{X}}$	95.4±0.58	96.7±0.63
	σ±Sσ	2.02±0.413	2.54±0.449
	$Cv \pm S_{Cv}$, %	2.11±0.429	2.62±0.469
The length of the bacon half of the cooled carcass, cm	$\overline{X} \pm S_{\overline{X}}$	82.2±1.69	84.1±1.36
	σ±Sσ	5.86±1.198	5.45±0.964
	$Cv \pm S_{Cv}$, %	7.12±1.458	6.48±1.146
A comprehensive index of fattening and meat qualities (Tyler B. index) points	$\overline{X} \pm S_{\overline{X}}$	149.56±3.293	154.95±2.701
	σ±Sσ	11.41±2.333	10.80±1.911
	$Cv \pm S_{Cv}$, %	7.62±1.558	6.96±1.231

The difference between groups of animals in the complex index of fattening and meat qualities (Tyler B. index) is equal to 5.39 points (td = 1.26, P> 0.05).

The coefficient of variation of biochemical parameters of blood serum, fattening, and meat qualities of young pigs of the experimental groups range from 2.11 to 17.53%.

The calculation of the pairwise correlation coefficients between the biochemical parameters of blood serum, fattening, and meat qualities of young pigs of the large white breeds are shown in Table 4.

The pairwise correlation coefficient between the biochemical parameters of blood serum, fattening, and meat qualities of young pigs of the large white breeds range from -0.533 to +0.528.

A significant relationship was found between the following pairs of features: total protein content × length of bacon half of chilled half-carcass (0.533 ± 0.1727**), total protein content, g/l × index of A. Sazer - H. Fredin (-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 × index of A. Sazer - H. Fredin (0.497 ± 0.1771).

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

Table 4. The pairwise correlation coefficient between biochemical parameters of blood serum, fattening, and meat qualities of young pigs of large white breed

The signs		The biometric Indicators		The correlation strength
x	*y*	r±Sr	tr	
The content of total protein, g/l	1	-0.252±0.1975	1.28	Weak
	2	0.162±0.2014	0.80	Weak
	3	0.375±0,1892	1.98	Moderate
	4	-0.321±0.1933	1.66	Moderate
	5	-0.533±0.1727**	3.09	Moderate
	6	-0.309±0.1941	1.59	Moderate
	7	-0.395±0.1875*	2.11	Moderate
The urea content, mmol/l	1	0.101±0.2031	0.50	Weak
	2	0.331±0.1926	1.72	Moderate
	3	0.007±0.2041	0.03	Weak
	4	-0.445±0.1828*	2.43	Помірна
	5	0.019±0.2041	0.09	Weak
	6	-0.013±0.2041	0.06	Weak
	7	0.016±0.2041	0.08	Weak
The creatinine concentration, μmol/l	1	0.142±0.2021	0.70	Weak
	2	-0.015±0.2041	0.07	Weak
	3	-0.338±0.1921	1.76	Moderate
	4	0.528±0.1734**	3.05	Noticeable
	5	0.519±0.1745**	2.97	Noticeable
	6	0.140±0.2021	0.69	Weak
	7	0.497±0.1771**	2.81	Moderate

Note: 1 - Average daily gain of live weight during the period of control fattening; 2 - Age of reaching a live weight of 100 kg, days; 3 - The thickness of the fat 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 - Comprehensive index of fattening and meat qualities (Tyler B. index), points; 7 - Index of A. Sazer - H. Fredin, points, * - P<0.05; ** - P<0.01; *** - P<0.001

Table 5. The economic efficiency of research results

The group	Index gradations A. Sazer - H. Fredin	The average daily increase in live weight during the period of control fattening from 30 to 100 kg, g	The supplement of additional products,%	The cost of additional products, UAH/US dollars/animal.
General sample	-1.791 – +3.211	777.1±11.11	–	–
I	-1.791 – -0.329	759.8±19.96	-2.22	-579.65 / -20.96
II	+0.003 – +3.211	788.0±12.82	+1.38	+360.32 / +13.03

Note: * - the selling price of young pigs at the time of the research was UAH 44.8. or 1.62 US dollars for 1 kg of live weight.

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

CONCLUSIONS

It was found that the biochemical parameters of the serum of 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 (g/l), urea content (mmol/l), and creatinine concentration (μmol/l) averages 7.18%.

Young pigs of the controlled herd at the age of reaching a live weight of 100 kg, fat thickness at the level of 6-7 thoracic vertebrae, and the chilled carcass's length, according to the current Instructions for grading pigs belong to class I and elite class.

Taking into account the interbreed differentiation of young pigs of the large white breed according to the index of A. Sazer - H. Fredin, it was found that the animals of group II outweighed peers I on average daily live weight gain during the control period of 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 the fat 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 half-carcass - by 2.25% (td = 0.87, P>0.05).

The coefficient of pair correlation between biochemical parameters of blood serum, fattening, and meat qualities of young pigs of large white breed vary from -0.533 to +0.528.

The use of young pigs of group II (index A. Sazer - H. Fredin ranges from +0.003 to +3.211 points) provides additional products at the level of +1.38%, and its cost is 360.32 UAH/animal.

ACKNOWLEDGEMENTS

This scientific work was financially supported by the Ministry of Education and Science of Ukraine (0120U101999)

REFERENCES

Bazhov, G.M., & Komlatsky, V.N. (1989). *Biotechnology of intensive pig breeding*. Moscow, RU: Rossagropromizdat Publishing House.

Berezovsky, M.D., & Khatko, I.V. (2005). Methods for assessing boars and sows on the quality of offspring in breeding plants and breeding breeders. Modern research methods in pig breeding. Poltava, 32–37.

Esfandyari, H., Sørensen, A.C., & Bijma, P. (2015). Maximizing crossbred performance through purebred genomic selection. *Genet Sel Evol*, 47, 16.

Getya, A.A. (2009). Organization of the selection process in modern pig breeding. Poltava: Poltava writer.

Khalak, V., Gutyj, B., Bordun, O., Ilchenko, M., & Horchanok, A. (2020). Effect of blood serum enzymes on meat qualities of piglet productivity. *Ukrainian Journal of Ecology,* 10(1), 158–161.

Khalak, V., Gutyj, B., Bordun, O., Horchanok, A., Ilchenko, M., Smyslov, S., Lytvyshchenko, L., & Kuzmenko, L. (2020). Large White breed sows. *Ukrainian Journal of Ecology*, 10(4), 122–126.

Khalak, V., Horchanok, A., Kuzmenko, O., Lytvyshchenko, L., Lieshchova, M., Kalinichenko, A., Liskovich, V., Zagoruy, L. (2020). Protein metabolism, physicochemical properties and chemical composition of muscle tissue in Large White weaners. *Ukrainian Journal of Ecology*, 10(4), 127–131.

Khalak, V.I. (2015). Some breeding traits of pigs and their assessment using innovative methods. *Scientific factor in the strategy of innovative development of pig breeding: a collection of articles. materials XXII Intern. scientific-practical conf. Grodno: GAU*, 140–145.

Khalak, V.I., & Gutyj B.V. (2020). Physicochemical properties and chemical composition of muscle tissue of young pigs of large white breed and their correlation with some serum enzymes. *Ukrainian Journal of Veterinary and Agricultural Sciences*, 3(3), 34–38.

Kozlovsky, V.G., Lebedev, Yu.V., Medvedev, V.A. et al. (1982). *The pedigree business in pig breeding. Moscow*: Kolos Publishing House.

Lakin, G.F. (1990). Biometrics. Study Manual for biol. special universities, 4th ed., Moscow: High school.

Sidorova, A.V. et al. (2003). Workshop on the theory of statistics: Textbook. Donetsk: Don. nat. un-t.

Tserenyuk, O.M. (2009). Quality of meat and fat products of animals with different stress resistance. *Scientific and technical bulletin. Institute of Animal Husbandry NAAS*. Kharkiv, 100, 491–496.

Vlizlo, V.V. et al. (2012). Laboratory research methods in biology, animal husbandry and veterinary medicine: handbook. Lviv: SPOLOM.

Voloshchuk, V.M., & Khalak, V.I. (2015). Productivity of pigs of different breeding value and distribution classes according to the indices of O. Wangen and A. Sazer, H. Fredin. Swine breeding. *Interdepartmental thematic sciences. zb. Institute of Pig Breeding and APV NAAS*. Poltava, 67, 81–86.