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INTERIOR PROFILE OF YOUNG PIGS OF DIFFERENT GENOTYPES AND THE USE OF ITS COMPONENTS FOR EARLY PREDICTION OF QUANTITATIVE CHARACTERS

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Abstract

The paper presents the research results of blood serum biochemical parameters, as well as fattening and meat qualities of Large White young pigs of different genotypes by melanocortin receptor gene 4 MC4R; the level of phenotypic consolidation of quantitative characters is calculated and their correlations are determined.

It was found that the serum biochemical parameters of young pigs from the experimental groups correspond to the physiological norm of clinically healthy animals. Studies have shown that animals of the MC4R^{AG} genotype exceed significantly their peers of the MC4R^{AA} genotype in the age of achievement of live weight of 100 kg, in fatback thickness at the level of 6-7 thoracic vertebrae and in the length of the chilled carcass by 4.47% on average.

The coefficients of phenotypic consolidation of fattening and meat qualities of young pigs from the experimental groups ranged from -0.101 to +0.370.

The number of significant correlations between serum biochemical parameters, fattening and meat qualities of Large White young pigs of the MC4R^{AA} genotype is 26.67%, of MC4R^{AG} genotype is 33.34%. This indicates the possibility of using interior indicators for early prediction of fattening and meat qualities of Large White young pigs. The maximum increase in additional products was obtained from Large White young pigs of the MC4R^{AG} genotype by the melanocortin receptor gene in amount of +2.02%.

Key words: pigs, genotype, gene, fattening and meat qualities, variability, correlation.

INTRODUCTION

Evaluation of young pigs by fattening and meat qualities was carried out taking into account the following indicators: the average daily gain in live weight for the period of control feeding, kg; the age of achievement of live weight of 100 kg, days; the thickness of fatback at the level of 6-7 thoracic vertebrae, mm; the length of chilled carcass, cm; the length of bacon side of chilled half carcass, cm (Berezovskii & Khatko, 2005).

DNA typing of animals was performed in the Laboratory of Genetics of the Institute of Pig Breeding and the Agro-industrial Institution NAAS (Kim et al., 2006).

In the blood serum, the total protein content (g/l), the urea content (mmol/l) and the concentration of total lipoproteins (mg %) were determined (Vlizlo

et al., 2012). Phenotypic consolidation coefficients (K1, K2) and biometric indicators were calculated according to the methods of Polupan (1996) and Lakin (1990).

It is established that the main criteria for increasing the gross production of pork is to improve both the reproductive qualities of sows and breeding boars and to increase the fattening and meat qualities of their offspring (Tsereniuk, 2014; Bankovska, 2016; Khalak et al., 2007; Furata & Hashimoto, 1995; Khalak, 2014; Khalak et al., 2020).

In order to accelerate the selection and breeding work in these areas in the conditions of breeding factories, farms and industrial complexes, and with using animals of foreign selection, active searching work for biological markers of early prediction of economically important characters is conducted.

The works of native and foreign scientists prove the relevance of the chosen field of research (Khalak et al., 2020; Tsareniuk, 2010; Pelykh & Ushakova, 2015; Shulga et al., 2012; Susol, 2013; Luhovoi & Kramarenko, 2010; Hugo et al., 1999).

The aim of the paper is to study the biochemical parameters of blood serum, as well as fattening and meat qualities of Large White young pigs of different genotypes by the melanocortin receptor gene MC4R and to calculate the level of phenotypic consolidation of quantitative characters and their correlations.

MATERIALS AND METHODS

The research was conducted in STOV «Druzhba-Kaznacheyivka» Dnipropetrovsk

region, meat-packing factory «Dzhaz», the Research Centre for Biosafety and Environmental Control of Resources of the Agro-industrial Complex of Dnipro State Agrarian and Economic University, the Laboratory of Genetics of Institute of Pig Breeding and the Agro-industrial Institution NAAS of Ukraine, and the Animal Husbandry Laboratory of State Institution - Institute of Grain Crops NAAS of Ukraine. Large White young pigs were the object of the study.

DNA typing of animals was performed in the Laboratory of Genetics of the Institute of Pig Breeding and the Agro-industrial Institution NAAS (Kim et al., 2006).

Figure 1 shows a typical electrophoregram of the corresponding restriction fragment.

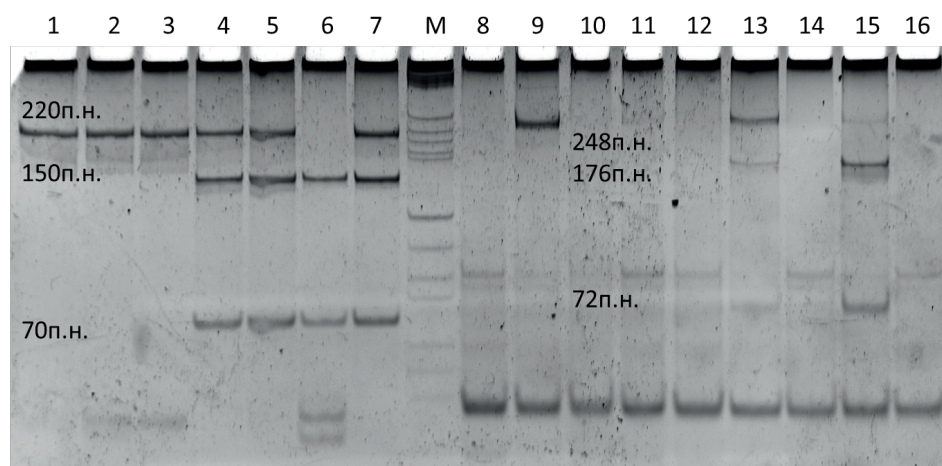


Figure 1. Electrophoresis in 8% polyacrylamide gel restriction of MC4R and Leptin (LEP) genes (Saienko & Khalak, 2020)

In the blood serum of 5th-month-old animals the total protein content (g/l), the urea content (mmol/l) and the concentration of total lipoproteins (mg %) were determined (Vlizlo et al., 2012).

Evaluation of young pigs by fattening and meat qualities was carried out taking into account the following indicators: the average daily gain in live weight for the period of control feeding, kg; the age of achievement of live weight of 100 kg, days; the thickness of fatback at the level of 6-7 thoracic vertebrae, mm; the length of chilled carcass, cm; length of bacon side of chilled half carcass, cm (Berezovskii & Khatko, 2005).

Complex assessment of young pigs of different genotypes in fattening and meat qualities (SI) and phenotypic consolidation coefficients of

quantitative characters (K1, K2) were calculated by the following formulas:

$$SI = 0.18 \times X_1 - 4.46 \times X_2, \quad (1)$$

where: SI - selection index, points; X_1 - the average daily live weight gain during the period of control fattening, g; X_2 - thickness of fatback at the level of 6-7 thoracic vertebrae, mm (Bazhov & Komlatsii, 1989);

$$K_1 = 1 - \frac{\sigma_2}{\sigma_3} \quad (2)$$

$$K_2 = 1 - \frac{Cv_2}{Cv_3} \quad (3)$$

where: σ_2 and c_{v_2} - standard deviation and coefficient of variability of the evaluated group

of animals by a specific trait; σ_3 and c_{v3} - the same indicators of the general total (Polupan, 1996). The cost of additional products was calculated according to currently accepted methods (Methodology for determining economic..., 1983). The results of the research were processed by the method of variation statistics according to Lakin (1990).

RESULTS AND DISCUSSIONS

It was found that the serum biochemical parameters of young pigs of different genotypes by the melanocortin receptor gene MC4R correspond to the physiological norm of clinically healthy animals (Table 1).

Table 1. Biochemical parameters of blood serum of young pigs from experimental groups, n = 8

Indicators, units of measurement	Biometric indicators	Genotype	
		<i>MC4R^{AA}</i>	<i>MC4R^{AG}</i>
		group	
		I	II
Total protein, g/l	$\bar{X} \pm S_{\bar{X}}$	81.25±0.977	85.87±0.895**
	$Cv \pm Sc_{cv}, \%$	3.40±0.850	2.95±0.737
Urea, mmol/l	$\bar{X} \pm S_{\bar{X}}$	4.77±0.576	5.10±0.275
	$Cv \pm Sc_{cv}, \%$	34.13±8.532	15.26±3.815
Total lipoproteins, mg%	$\bar{X} \pm S_{\bar{X}}$	559.28±41.775	547.80±32.436
	$Cv \pm Sc_{cv}, \%$	19.76±4.940	13.24±3.310

Note: ** - $P \leq 0.01$

The difference between the groups in terms of total protein content is 4.62 g/l (td = 3.50; $P < 0.01$), of urea - 0.33 mmol/l (td = 0.52; $P > 0.05$), of total lipoproteins - 11.48 mg % (td = 0.21; $P > 0.05$). The coefficient of variability of blood serum biochemical parameters of young pigs of different genotypes ranges from 2.95 to 34.13%.

Analysis of the results of Large White young pigs control fattening shows (n = 50) that the average daily gain in live weight of animals during the control period is 779.9 ± 5.38 g ($Sv = 4.84\%$), the age of achievement of live weight of 100 kg is 177.2 ± 0.68 days ($Cv = 2.82\%$), fatback thickness at the level of 6-7 thoracic vertebrae is 20.4 ± 0.35 mm ($Cv = 12.48\%$), the length of chilled carcass is $96, 4 \pm 0.33$ cm ($Cv = 1.78\%$), the length of the bacon side of the chilled half-carcass is 85.4 ± 0.59 cm ($Cv = 3.59\%$). The selection index SI ranges from 23.29 to 84.77 points.

The results of studies of fattening and meat qualities of Large White young pigs of different genotypes by the melanocortin receptor gene 4 (*MC4R^{AA}*, *MC4R^{AG}*) are shown in Table 2.

It was found that the young pigs from group II exceeded peers from group I in average daily live weight gain during the period of control fattening by 33.8 g (td = 3.49; $P < 0.01$), in the age of achievement of live weight of 100 kg by 3.9 days (td = 2.80; $P < 0.01$), in fatback thickness at the level of 6-7 thoracic vertebrae by 1.8 mm (td = 2.60; $P < 0.05$), in the length of chilled carcass by 2.2 cm (td = 4.07; $P < 0.001$), in the length of the bacon side of the chilled half-carcass by 2.9 cm (td = 3.53; $P < 0.001$).

According to the selection index SI, the difference between animals from groups II and I is 11.69 points (td = 2.90; $P < 0.01$).

Consolidation of a selection group of animals is a process of achieving a certain stability in genotypic and phenotypic similarity by selection characteristics among structural units of breed, herd, which is realized through relative narrowing of genotypic and phenotypic variability, fixing them at the desired level of demonstration with the appropriate interaction of "genotype-environment", which provides high heritable stability of their transmission by animals to their offspring (Polupan, 2001).

Table 2. Fattening and meat qualities of Large White young pigs of different genotypes by melanocortin receptor gene 4 ($MC4R^{AA}$, $MC4R^{AG}$)

Indicators, units of measurement	Biometric indicators	Genotype	
		$MC4R^{AA}$	$MC4R^{AG}$
		group	
		I	II
Average daily gain in live weight during the control fattening period, kg	n	24	26
	$\bar{X} \pm S_{\bar{X}}$	760.8±6.22	796.0±7.08**
	Cv±Scv, %	3.67±0.530	4.54±0.629
Age of achievement of live weight of 100 kg, days	$\bar{X} \pm S_{\bar{X}}$	178.5±1.08	174.4±1.09**
	Cv±Scv, %	2.72±0.393	3.19±0.442
Thickness of fatback at the level of 6-7 thoracic vertebrae, mm	$\bar{X} \pm S_{\bar{X}}$	21.4±0.55	19.5±0.51*
	Cv±Scv, %	11.59±1.674	13.43±1.862
Length of chilled carcass, cm	n	9	15
	$\bar{X} \pm S_{\bar{X}}$	95.1±0.35	97.3±0.42
	Cv±Scv, %	1.10±0.259	1.67±0.305
Length of the bacon side of chilled half carcass, cm	$\bar{X} \pm S_{\bar{X}}$	83.3±0.60	86.2±0.57***
	Cv±Scv, %	2.16±0.509	2.56±0.468

Note: * - $P \leq 0.05$, ** - $P \leq 0.01$, *** - $P \leq 0.001$

The results of the calculation the phenotypic consolidation coefficients of fattening and meat qualities of young pigs from the experimental groups are shown in Table 3.

Table 3. Phenotypic consolidation coefficients (K1, K2) of fattening and meat qualities of young pigs from experimental groups

Indexes	Coefficients of phenotypic consolidation	Group	
		I	II
Average daily gain in live weight during the control fattening period, g	K ₁	0.063	0.157
	K ₂	0.039	0.177
Age of achievement of live weight of 100 kg, days	K ₁	-0.059	0.129
	K ₂	-0.051	0.122
Thickness of fatback at the level of 6-7 thoracic vertebrae, mm	K ₁	-0.101	0.156
	K ₂	-0.056	0.176
Length of chilled carcass, cm	K ₁	0.370	0.037
	K ₂	0.363	0.045
Length of the bacon side of chilled half carcass, cm	K ₁	0.214	0.075
	K ₂	0.200	0.086

It was found that the phenotypic consolidation coefficients of fattening and meat qualities of young pigs from experimental groups ranged from -0.101 (phenotypic consolidation coefficient K₁, young pigs from group I, trait - fatback thickness at the level of 6-7 thoracic vertebrae, 70 mm) to +0,370 (phenotypic

consolidation coefficient K₁, young pigs from group I, trait - length of chilled carcass, cm). The results of the correlation analysis between the blood serum biochemical parameters, fattening and meat qualities of Large White young pigs of different genotypes by the

melanocortin receptor gene 4 (MC4R^{AA}, MC4R^{AG}) are shown in Table 4. It was established that the correlation coefficient between these groups of traits ranges from -0.919 (urea content × average

daily live weight gain during the control period, the group - young pigs of the MC4R^{AG} genotype) to +0.977 (total protein content × age of achievement of live weight of 100 kg, group - young pigs of the MC4R^{AG} genotype).

Table 4. Pair correlation coefficients between serum biochemical parameters, fattening and meat qualities of young pigs of different genotypes by melanocortin receptor gene 4 (MC4R^{AA}, MC4R^{AG})

Character		Group			
		I		II	
		biometric indicators			
x	y	r±Sr	tr	r±Sr	tr
Total protein, g/l	1	0.247±0.3956	0.62	-0.188±0.4010	0.47
	2	-0.726±0.2808*	2.59	0.977±0.0871***	11.22
	3	-0.284±0.3914	0.73	-0.817±0.2354*	3.47
	4	-0.824±0.2313*	3.56	-0.654±0.3088	2.12
	5	0.164±0.4027	0.41	0.114±0.4056	0.28
Urea, mmol/l	1	0.793±0.2487*	3.19	-0.919±0.1610***	5.71
	2	0.885±0.1901**	4.66	0.830±0.2277*	3.65
	3	-0.314±0.3876	0.81	-0.723±0.2820*	2.56
	4	0.131±0.4047	0.32	-0.624±0.3190	1.96
	5	-0.326±0.3859	0.84	0.501±0.3533	1.42
Total lipoproteins, mg %	1	0.288±0.3910	0.74	0.511±0.3509	1.46
	2	0.324±0.3862	0.84	-0.275±0.3925	0.70
	3	-0.041±0.4079	0.10	-0.125±0.4050	0.31
	4	-0.190±0.4008	0.47	-0.117±0.4054	0.29
	5	0.325±0.3861	0.84	-0.537±0.3444	1.56

Note: 1 - average daily gain in live weight during the control fattening period, g; 2 - age of achievement of live weight of 100 kg, days; 3 - length of chilled carcass, cm.; 4 - length of the bacon side of chilled half carcass, cm.; 5 - thickness of fatback at the level of 6-7 thoracic vertebrae, mm; * - P≤0.05, ** - P≤0.01, *** - P≤0.001

Significant correlations were also established between the following pairs of characters: total protein content × length of chilled carcass (r = -0.817, group - young pigs of the MC4R^{AG} genotype), urea content × age of achievement of live weight of 100 kg (tr = +0.885 - +0.830, group - young pigs of genotype MC4R^{AA}, MC4R^{AG}), urea content × length of chilled carcass (r = -0.723, group - young pigs of genotype MS4R^{AG}), total protein content × age of achievement of live weight of 100 kg (r = -0.726, group - young of pigs of the MC4R^{AA} genotype), total protein content × length of bacon side of chilled half-carcass (r = -0.824, group - young pigs of the MC4R^{AA} genotype), urea content × average daily live weight gain during the period of control fattening (tr =

+0.793, group - young pigs of genotype MC4R^{AA}).

The number of significant correlations between serum biochemical parameters, fattening and meat qualities of Large White young pigs of genotype MC4R^{AA} is 26.7%, of MC4R^{AG} is 33.4%. This indicates the possibility of using interior indicators for early prediction of fattening and meat qualities of Large White young pigs.

The calculation of the economic efficiency of the research results showed that the maximum increase in additional products was obtained from young pigs of group II (MC4R^{AG}) - +2.02%, and its cost from the sale of 1 animal is +92.4 UAH.

CONCLUSIONS

Biochemical parameters of blood serum of Large White young pigs from the controlled population correspond to the physiological norm of clinically healthy animals, and in terms of fattening and meat qualities they belong to the I class and the elite class.

It was established that animals of the MC4R^{AG} genotype exceeded their peers of the MC4R^{AA} genotype at the age of achievement of live weight of 100 kg, fatback thickness at the level of 6-7 thoracic vertebrae and the length of the chilled carcass by 4.47% on average. The coefficient of variation of the main quantitative characters of animals from the experimental groups varies from 1.10 to 13.43%.

Phenotypic consolidation coefficients of fattening and meat qualities of young pigs from experimental groups ranged from -0.101 (phenotypic consolidation coefficient K1, young pigs from group I, trait - fat thickness at the level of 6-7 thoracic vertebrae, mm) to +0.370 (phenotypic consolidation coefficient K1, young pigs from group I, trait - the length of the chilled carcass, cm).

The number of significant correlations between biochemical parameters of blood serum, fattening and meat qualities of Large White young pigs of genotype MS4R^{AA} is 26.7%, of MS4R^{AG} is 33.3%, which indicates the possibility of using interior indicators for early prediction fattening and meat qualities of Large White young pigs.

The maximum increase in additional products was obtained from Large White young pigs of MS4R^{AG} genotype by melanocortin receptor gene - +2.02%, and its cost from the sale of 1 animal is +92.4 UAH.

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