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INDICATORS OF PROTEIN METABOLISM AND THEIR RELATIONSHIP WITH FATTENING AND MEAT QUALITIES IN YOUNG PIGS OF DIFFERENT GENOTYPES

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The article presents the results of studies of some biochemical parameters of blood serum, as well as fattening and meat qualities of young pigs of large white breed of different genotypes by the gene of the melanocortin receptor MC4R. The research was conducted in «Druzhba-Kaznacheyivka» LLC of Dnipropetrovsk region, «Jazz» meat-packing plant, research center of biosafety and ecological control of agro-industrial resources of Dniprov'sk State Agrarian Economic University, genetics laboratory of the Institute of Pig Breeding and Agroindustrial Production of NAAS and of Animal Husbandry of the State Institution Institute of Grain Crops of NAAS. Evaluation of young pigs of large white breed for fattening and meat qualities was carried out taking into account the following indicators: the average daily increase in live weight during the period of control fattening, g; age of live weight 100 kg, days; fat thickness at the level of 6-7 thoracic vertebrae, mm, length of chilled carcass, cm; length of the bacon half of the cooled half-carcass,cm (Berezovsky, Khat'ko, 2005). DNA-typing of animals was performed in the genetics laboratory of the Institute of Pig Breeding and APV NAAS (Kim, Lee, Shin et al., 2006). The content of total protein (g/l) and the level of urea (mmol/l) in the serum of 5-month-old animals were studied according to conventional methods (Vlizlo et al., 2012). Biometric parameters were calculated according to the methods of Lakin (1990). It was found that the biochemical parameters of blood serum of young pigs of experimental groups correspond to the physiological norm of clinically healthy animals, and young pigs of genotype $MC4R^{AG}$ significantly outperform peers of genotype $MS4R^{AA}$ at the age of 100 kg, thickness of fathead minnow on average by 4.47 %. The number of significant correlations between biochemical parameters of blood serum, fattening and meat qualities of young pigs of large white breed of genotype $MC4R^{AA}$ is 40.00 %, $MC4R^{AG}$ - 50.00 %. This indicates the possibility of using interior indicators for early prediction of fattening and meat qualities in young pigs of large white breed. The maximum increase in additional products was obtained from young pigs of large white breed of the $MC4R^{AG}$ genotype by the melanocortin receptor gene. It is +2.02 %.

Key words: *pigs, breed, genotype, gene, fattening and meat qualities, index, variability, correlation, economic efficiency*
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Important factors contributing to the increase in gross pork production, along with improving the conditions of feeding and keeping animals of different sexes are increasing the quantitative indicators of reproductive qualities of sows and breeding boars, as well as fattening and meat qualities of their offspring [1-7].

For this purpose in the conditions of breeding plants and breeders, and also industrial complexes use animals of foreign selection, conduct active search of biological markers of early forecasting of economically important signs. These include interior indicators as well as DNA markers.

Confirmation of the relevance of the chosen direction of research are the works of domestic and foreign scientists [8-14].

The aim is to investigate the content of total protein and urea levels, their fattening and meat qualities in the blood serum of young white pigs of different genotypes by the gene of the melanocortin MC4R receptor, as well as to calculate correlations between traits and economic efficiency of research results.

Materials and research methods. The research was conducted in «Druzhba-Kaznacheyivka» LLC of Dnipropetrovsk region, «Jazz» meat-packing plant, research center of biosafety and ecological control of agro-industrial resources of Dniprovs'k State Agrarian and Economic University, genetics laboratory of the Institute of Pig Breeding and Agroindustrial Production of NAAS and of Animal Husbandry of the State Institution Institute of Grain Crops of NAAS.

The object of the study was young pigs of large white breed. Conditions of feeding and keeping of animals of experimental groups were identical and corresponded to zootechnical norms. Evaluation of animals for fattening and meat qualities was carried out taking into account the following indicators: the average daily gain of live weight during the period of control fattening, g; age of live weight 100 kg, days; length of chilled carcass, cm; length of bacon half of chilled half-carcass, cm; fat thickness at the level of 6-7 thoracic vertebrae, mm [15].

The content of total protein (g / l) and the level of urea (mmol / l) in the serum of 5-month-old animals were studied according to conventional methods [16].

DNA-typing of young pigs by the melanocortin receptor gene MC4R was performed in the genetics laboratory of the Institute of Pig Breeding and AIP NAAS [17, 18]. Figure 1 shows a typical electrophoregram of the corresponding restriction fragment.

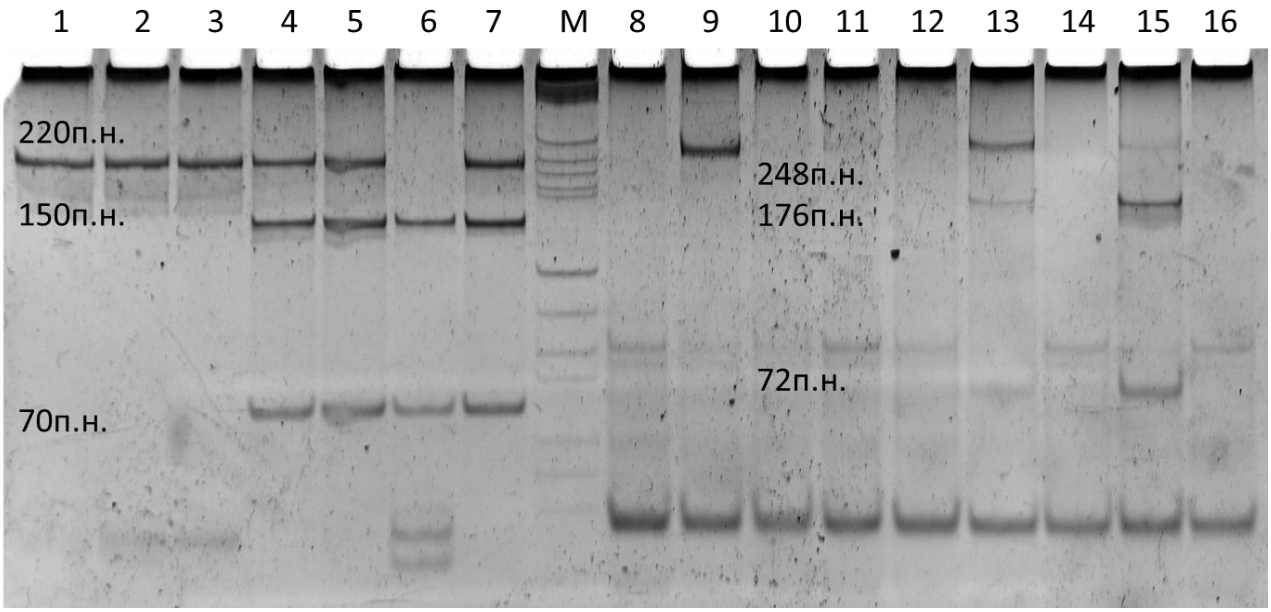

Fig. 1. Electrophoresis in 8% polyacrylamide gel restriction MC4R and Leptin (LEP) genes (Pochernyaev, Saenko, Khalak, 2020).

Comprehensive assessment of young pigs of different genotypes for fattening and meat qualities (SI) and the cost of additional products was calculated by the following formulas:

$$CI = 0{,}18 \times X_1 - 4{,}46 \times X_2 \quad (1)$$

where: CI - selection index, points, X_1 - average daily increase in live weight during the period of control fattening, g; X_2 - fat thickness at the level of 6-7 thoracic vertebrae, mm [19] (Bazhov, Komlatsky, 1989);

$$E = Ц \times \frac{C \times П}{100} \times Л \times К \quad (2)$$

where: E - cost of additional products, UAH; Ц - purchase price per unit of output, in accordance with existing prices in force in Ukraine; C - average productivity of animals; П - the average margin of the main product (%), which is expressed as a percentage per 1 head when applying a new and improved selection achievement compared to the productivity of animals of basic use; Л - 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 [20].

The results of the research were processed by the method of variation statistics according to the methods of G.F. Lakin [21].

Research results. Analysis of laboratory studies show that the biochemical parameters of the serum of young pigs of different genotypes by the gene of the melanocortin receptor MC4R correspond to the physiological norm of clinically healthy animals (Table 1).

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

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

Indicators, units of measurement	Biometric indicators	Genotype	
		MC4R^{AA}	*MC4R^{AG}*
		group	
		I	II
Total protein, g/l	$\overline{X} \pm S_{\overline{X}}$	81,25±0,977	85,87±0,895**
	Cv±*Scv*, %	3,40±0,850	2,95±0,737
Urea, mmol/l	$\overline{X} \pm S_{\overline{X}}$	4,77±0,576	5,10±0,275
	Cv±*Scv*, %	34,13±8,532	15,26±3,815

Notes: *** - P≤0,01*

The results of control fattening of young pigs of large white breed (n = 50) indicate that the average daily gain of live weight of animals for the accounting period is 779.9±5.38 g (Cv=4.84 %), the age of reaching live weight of 100 kg – 177.2±0.68 days (Cv=2.82 %), fat thickness at the level of 6-7 thoracic vertebrae - 20.4±0.35 mm (Cv=12.48 %), length of chilled carcass - 96.4±0.33 cm (Cv=1.78 %), the length of the bacon half of the cooled half-carcass is 85.4±0.59 cm (Cv=3.59 %). The CI selection index ranges from 23.29 to 84.77 points.

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

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

Indicators, units of measurement	Biometric indicators	Genotype	
		MC4R^{AA}	*MC4R^{AG}*
		group	
		I	II
Average daily gain of live weight during the period of control fattening, g	*n*	24	26
	$\overline{X} \pm S_{\overline{X}}$	760,8±6,22	796,0±7,08**
	Cv±*Sc$_v$*, %	3,67±0,530	4,54±0,629
Age of reaching live weight 100 kg, days	$\overline{X} \pm S_{\overline{X}}$	178,5±1,08	174,4±1,09**
	Cv±*Sc$_v$*, %	2,72±0,393	3,19±0,442
The thickness of the fat at the level of 6-7 thoracic vertebrae, mm	$\overline{X} \pm S_{\overline{X}}$	21,4±0,55	19,5±0,51*
	Cv±*Sc$_v$*, %	11,59±1,674	13,43±1,862
The length of the cooled carcass, cm	*n*	*9*	*15*
	$\overline{X} \pm S_{\overline{X}}$	95,1±0,35	97,3±0,42
	Cv±*Sc$_v$*, %	1,10±0,259	1,67±0,305
The length of the bacon half of the cooled carcass, cm	$\overline{X} \pm S_{\overline{X}}$	83,3±0,60	86,2±0,57***
	Cv±*Sc$_v$*, %	2,16±0,509	2,56±0,468

Notes ** - P≤0,05, ** - P≤0,01, *** - P≤,001*

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 33.8 g (td=3.49; P <0.01), the age of 100 kg live weight - 3.9 days (td=2.80; P <0.01), fat thickness at the level of 6-7 thoracic vertebrae - 1.8 mm (td=2.60; P <0.05), length of chilled carcass - 2.2 cm td = 4.07; P <0.001), the length of the bacon half of the cooled half-carcass - 2.9 cm (td=3.53; P <0.001).

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

The results of the correlation analysis between the biochemical parameters of blood serum, fattening and meat qualities of young pigs of large white breed of different genotypes by the gene of melanocortin 4 receptor (MC4R^{AA}, MC4R^{AG}) are shown in table 3.

Table 3. Pairwise correlation coefficients between biochemical parameters of blood serum, fattening and meat qualities of young pigs of different genotypes by melanocortin 4 receptor gene (MC4R^{AA}, MC4R^{AG})

Sign		Groupe			
		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

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

It was found that the correlation coefficient between these groups of traits ranges from -0.919 (urea content × average daily increase in live weight during the control period, the group - young pigs of the genotype mc4rag) to +0.977 (total protein content × age of live weight 100 kg, group - young pigs of the genotype MC4R^{AG}).

Significant correlations were also established between the following pairs of traits: total protein content × length of chilled carcass (r = –0.817, group - young pigs of the MC4R^{AG} genotype), urea content × age of live weight 100 kg (tr = +0.885 - +0.830, group - young pigs of the MS4R^{AA} genotype, MC4R^{AG}), urea content × length of chilled carcass (r = –0.723, group - young pigs of the MC4R^{AG} genotype), total protein content × age of live weight 100 kg (r = –0.726, group - young pigs of genotype MC4R^{AA}), total protein content × length of bacon half of chilled half carcass (r = –0,824, group - young pigs of the MC4RAA genotype), urea content × average daily gain of live weight during the period of control fattening (tr = +0.793, group - young pigs of the MC4R^{AA} genotype).

The number of significant correlations between the biochemical parameters of blood serum, fattening and meat qualities of young pigs of large white genotype MS4R^{AA} is 40.00 %, MC4R^{AG} - 50.00 %. This indicates the possibility of using interior indicators for early prediction of fattening and meat qualities in young pigs of large white breed.

The results of the calculation of economic efficiency of

research results are shown in table 4.

Table 4. Economic efficiency of research results

Group	n	The average daily gain of live weight during the period of fattening from 30 to 100 kg, g	Addition of additional products, %	Cost of additional products, UAH / head.*
Total sample	50	779,9±5,38	-	-
I	15	760,8±6,22	-2,44	-114,43
II	15	796,0±7,08	+2,02	+94,73

***Notes:* * -** the selling price of young pigs on the date of the research was UAH 45.3. per 1 kg of live weight

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 head is +94.73 UAH.

Conclusions

1. Biochemical parameters of blood serum of young pigs of large white breed correspond to the physiological norm of clinically healthy animals, and in terms of fattening and meat qualities, according to the current Instruction on grading pigs, they belong to class I and elite class.

2. It was found that animals of the $MC4R^{AG}$ genotype outperform their peers of the $MC4R^{AA}$ genotype at the age of reaching a live weight of 100 kg, fat thickness at the level of 6-7 thoracic vertebrae and the length of the chilled carcass by an average of 4.47 %. The coefficient of variation of the main quantitative traits in animals of the experimental groups varies from 1.10 to 13.43 %.

3.The number of reliable correlations between biochemical parameters of blood serum, fattening and meat qualities of young pigs of large white breed genotype $MS4R^{AA}$ is 40.00 %, $MC4R^{AG}$ - 50.00 %, which indicates the possibility of using interior indicators for early prediction of fattening and meat qualities in young pigs of large white breed.

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Показники білково обміну та їх зв'язок з відгодівельними і м'ясними якостями у молодняку свиней різних генотипів.

В статті наведено результати досліджень деяких біохімічних показників сироватки крові, а також відгодівельних і м'ясних якостей молодняку свиней великої білої породи різних генотипів за геном рецептора меланокортину MC4R. Дослідження проведено в СТОВ «Дружба-Казначеївка» Дніпропетровської області, м'ясокомбінаті «Джаз», науково-дослідному центрі біобезпеки і екологічного контролю ресурсів АПК Дніпровського державного аграрно-економічного університету, лабораторії генетики Інституту свинарства і агропромислового виробництва НААН та лабораторії тваринництва Державної установи Інститут зернових культур НААН. Оцінку молодняку свиней великої білої породи за відгодівельними і м'ясними якостями проводили з урахуванням наступних показників: середньодобовий приріст живої маси за період контрольної відгодівлі, г; вік досягнення живої маси 100 кг, діб; товщина шпику на рівні 6-7 грудних хребців, мм, довжина охолодженої туші, см.; довжина беконної половини охолодженої півтуші, см. (Березовський, Хатько, 2005). ДНК-типування тварин проводили в лабораторії генетики Інституту свинарства і АПВ НААН (Kim, Lee, Shin та ін., 2006). Вміст загального білку (г/л) і рівень сечовини (ммоль/л) у сироватці крові 5-місячних тварин досліджували за загальноприйнятими методиками (Влізло та ін., 2012). Біометричні показники розраховували за методиками Лакіна (1990). Встановлено, що біохімічні показники сироватки крові молодняку свиней піддослідних груп відповідають фізіологічній нормі клінічно здорових тварин, а молодняк свиней генотипу $MC4R^{AG}$ достовірно переважають ровесників генотипу $MC4R^{AA}$ за віком досягнення живої маси 100 кг, товщиною шпику на рівні 6-7 грудних хребців та довжиною охолодженої туші в середньому на 4,47 %. Кількість достовірних кореляційних зв'язків між біохімічними показниками сироватки крові, відгодівельними і м'ясними якостями молодняку свиней великої білої породи генотипу $MC4R^{AA}$ становить 40,00 %, $MC4R^{AG}$ – 50,00 %. Зазначене свідчить про можливість використання показників інтер'єру для раннього прогнозування відгодівельних і м'ясних якостей у молодняку свиней великої білої породи. Максимальну прибавку додаткової продукції одержано від молодняку свиней великої білої породи генотипу $MC4R^{AG}$ за геном рецептора меланокортину. Вона становить +2,02 %.

Ключові слова*: свині, порода, генотип, ген, відгодівельні та м'ясні якості, індекс, мінливість, кореляція, економічна ефективність.*

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