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ACTIVITY OF SERUM ENZYMES OF YOUNG PIGS OF DIFFERENT GENOTYPES BY MELANOCORTIN RECEPTOR GENE (MC4R) AND THEIR RELATIONSHIP WITH FATTENING AND MEAT QUALITIES

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The article is devoted to studying the activity of serum enzymes, fattening, and meat qualities of young pigs of different genotypes by the melanocortin receptor gene MC4R, calculating the level of correlation between traits, and economic efficiency of research results. The experimental part of the research was carried out in the agricultural formations of the Dnipropetrovsk region, the Research Center for Biosafety and Environmental Control of Agricultural Resources of the Dnipro State Agrarian and Economic University, the Genetics Laboratory of the Institute of Pig Breeding and Agricultural Production of the National Academy of Agrarian Sciences of Ukraine and the Laboratory of Animal Husbandry of the State Institution "Institute of Grain Crops of the National Academy of Agrarian Sciences". The work was carried out by the research program of the National Academy of Agrarian Sciences of Ukraine No. 30, " Innovative Technologies of Breeding, Industrial and Organic Production of Pig Products," task "To develop a local system of selection and hybridization of pigs using modern genetic methods (DNA markers)". Laboratory studies and the results of control fattening indicate that the biochemical parameters of blood serum (activity of aspartate aminotransferase, alanine aminotransferase, and alkaline phosphatase) of young pigs of large white breed of the controlled population correspond to the physiological norm of clinically healthy animals, and according to the leading indicators of fattening and meat qualities (age of reaching live weight of 100 kg, days; fat thickness at the level of 6-7 thoracic vertebrae, mm; length of chilled carcass, cm) belongs to class I and class elite. Analysis of the data of control fattening and slaughter shows that young pigs of the second experimental group ($MC4R^{AG}$) are superior to their peers of I ($MC4R^{AA}$) in terms of average daily weight gain, age of live weight100 кг, fat thickness at the level of 6-7 thoracic vertebrae and length of chilled carcass by an average of 4.58%. Several significant associations between interior parameters (aspartate aminotransferase (AST) activity, units/l; alanine aminotransferase (ALT) activity, unit/l), fattening and meat qualities of young pigs of the controlled population is 28.57 %. This indicates the possibility of using interior indicators for early prediction of fattening and meat qualities of young pigs. The maximum increase in additional production was obtained from young pigs of the second experimental group ($MC4R^{AG}$) – +3.24 %, and its cost, which was obtained

from the sale of one head of young pigs of the specified genotype is equal to +261.56 UAH or +6.62 USD.

Keywords: young pigs, genotype, serum biochemical parameters, fattening and meat qualities, correlation, cost of additional products

АКТИВНІСТЬ ФЕРМЕНТІВ СИРОВАТКИ КРОВІ МОЛОДНЯКУ СВИНЕЙ РІЗНИХ ГЕНОТИПІВ ЗА ГЕНОМ РЕЦЕПТОРА МЕЛАНОКОРТИНУ (MC4R) ТА ЇХ ЗВ'ЯЗОК З ВІДГОДІВЕЛЬНИМИ І М'ЯСНИМИ ЯКОСТЯМИ

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Стаття присвячена вивченню активності ферментів сироватки крові, відгодівельних та м'ясних якостей молодняку свиней різних генотипів за геном рецептора меланокортину MC4R, розрахунку рівня кореляційних зв'язків між ознаками та економічної ефективності результатів досліджень. Експериментальну частину досліджень проведено в агроформуваннях Дніпропетровської області, Науково-дослідному центрі біобезпеки та екологічного контролю ресурсів АПК Дніпровського державного аграрно-економічного університету, лабораторії генетики Інституту свинарства і АПВ НААН та лабораторії тваринництва Державної установи «Інститут зернових культур НААН». Роботу виконано згідно програми наукових досліджень Національної академії аграрних наук України № 30 «Інноваційні технології племінного, промислового та органічного виробництва продукції свинарства», завдання «Розробити локальну систему селекції та гібридизації свиней із використанням сучасних генетичних методів (ДНК-маркерів)». Лабораторні дослідження та результати контрольної відгодівлі свідчать, що біохімічні показники сироватки крові (активність аспартатамінотрансферази, аланінамінотрансферази та лужної фосфатази) молодняку свиней великої білої породи підконтрольної популяції відповідають фізіологічній нормі клінічно здорових тварин, а за основними показниками відгодівельних і м'ясних якостей (вік досягнення живої маси 100 кг, діб; товщина шпику на рівні 6-7 грудних хребців, мм; довжина охолодженої туші, см) належить до І класу та класу еліта. Аналіз даних контрольної відгодівлі та забою свідчать, що молодняк свиней ІІ піддослідної групи ($MC4R^{AG}$) переважає ровесників І ($MC4R^{AA}$) за середньодобовим приростом живої маси, віком досягнення живої маси 100 кг, товщиною шпику на рівні 6-7 грудних хребців та довжиною охолодженої туші в середньому на 4,58 %. Кількість достовірних зв'язків між показниками інтер'єру (активність аспартатамінотрансферази (АсАТ), од/л; активність аланінамінотрансферази (АлАТ), од/л), відгодівельними і м'ясними якостями молодняку свиней підконтрольної популяції становить 28,57 %. Зазначене свідчить про можливість використання показників інтер'єру для раннього прогнозування відгодівельними і м'ясними якостями молодняку свиней. Максимальну прибавку додаткової продукції одержано

від молодняку свиней II піддослідної групи (MC4R^{AG}) – +3,24 %, а її вартість яку було одержано від реалізації однієї голови молодняку свиней зазначеного генотипу дорівнює +261,56 гривень або +6,62 доларів США.

Ключові слова: молодняк свиней, генотип, біохімічні показники сироватки крові, відгодівельні і м'ясні якості, кореляція, вартість додаткової продукції.

Entry. Topical issues that significantly affect the pace of selection and breeding work in the field of pig breeding include the search for effective methods for assessing the breeding value of animals and selecting highly productive individuals for their further intensive use in breeding reproducers and factories, as well as industrial complexes (Balatsky et al., 2016; Vashchenko, 2019; Albuquerque et al., 2021).

It has been established that such methods for assessing the breeding value of animals and selecting highly productive ones include linear models, DNA markers, and indices of various designs. Thus, Vashchenko P. (2019) notes that linear models for determining the breeding value of pigs by reproductive qualities make it possible at an early stage of ontogeny to determine the most valuable animals for further repair of the herd. The author found that in the herd of pigs of the great white breeds of the factory type "Bagachansky" correlations between the estimates of the breeding value of queens according to the developed models and the productivity of their daughters are significant and 9.9 – 10.5 times more substantial than the links between the productivity of queens and the productivity of their daughters. Long-term research by P. Vashchenko (2019) shows that the BLUP method, which most accurately characterizes their offspring's productivity, is an effective method for assessing boars' breeding value. Thus, the results of the assessment by the method of control fattening of boar offspring and the BLUP method indicate the presence of significant correlations taking into account the length of the body ($r = +0.42 \pm 0.209$, $p \leq 0.05$) and the thickness of the fat ($r = +0.67 \pm 0.170$, $p \leq 0.001$). The relationship between the indicators of boars' productivity and the productivity of their offspring is unreliable and is 1.4-3.5 times lower.

Studies by Verbych I. and Bratkovska G. (Verbych, I. V., & Bratkovska, 2020) show that when comparing productivity indicators with the breeding value indices of large white pigs of the "SE "DG "Pasichna" of the Institute of Feed and Agriculture of Podillya of the National Academy of Agrarian Sciences of Ukraine" of the Khmelnytsky region, a weak correlation was established between the live weight of piglets at the time of their weaning and the breeding value of pigs ($r = 0.21$, $R>0.99$). The coefficient of paired correlation between the indices of fattening and meat qualities of M. D. Berezovsky and the index of B. Tyler is $r = 0.56$ ($P >0.99$).

Researchers (Balatsky et al., 2016) propose using the genetic marker LEPR SNP NM001024587.1, 1987 C>T in marker selection to predict and improve the meat quality of large white pigs of the Ukrainian breed. The results of the authors' research established that the genotype of animals by the genome LEPR has a significant effect on intramuscular fat content in meat ($\eta 2=14.212\%$, $p<0.05$), total moisture ($\eta 2=7.896\%$, $p<0.05$) and dry matter ($\eta 2=7.577\%$, $p<0.05$); The fat content in the meat of pigs with a heterozygous genotype was significantly lower compared to animals with a homozygous genotype.

RNA sequencing transcriptome analysis shows that AL pigs lived an average of 150.6 days during the trial with a mean daily gain (ADG) of 582 g/day, while BI pigs lived an average of 135.2 days during the trial ($p = 0.273$) and ADG 656 g/d ($p = 0.297$) (Albuquerque et al., 2021). At a weight of 150 kg and compared to BI pigs, AL showed higher levels of total plasma protein (69.8 vs. 64.4 g/L, $p<0.05$), urea (6.9 vs. 5.6 mmol/L, $p<0.05$) and total cholesterol (2.66 vs. 2.23 mmol/L, $p<0.05$). The average

thickness of the bacon was also significantly higher in AL (7.9 vs. p<0.001) compared to BI pigs. For LL muscle, AL pigs had a lower loin proportion (3.63 vs. 5.14%, p<0.05) but a higher total IMF (7.3 vs. 5.7 g/100 g, p<0.01) compared to BI pigs. 4,3 см

The relevance of the chosen direction of research is confirmed by the scientific works of the following scientists: Vylleke et al., 2003; Szyndler-Nкdza et al., 2010; Draguljan et al., 2013; Kostyunina et al., 2015; Herrero-Medrano et al., 2015; Tsereniuk et al., 2016; Balatskyi et al., 2018; Martínez-Montes et al., 2018; Bankovska et al., 2020; Matiiuk et al., 2020; Poklukar et al., 2020; Mykhalko et al., 2022.

Blood analysis using biochemical methods is one of the most informative laboratory diagnostic tools, providing essential information about the functional state of various animal organs and systems. A biochemical blood test makes it possible to detect disorders of the internal organs without interfering with them. The biochemical composition of blood depends on various factors, including the conditions of keeping, feeding, age, and physiological state of animals, as well as on their genotype and lineage.

The aim of the work was to investigate the activity of serum enzymes, fattening, and meat qualities of young pigs of different genotypes by the melanocortin receptor MS4R gene to calculate the level of correlation between traits and the economic efficiency of research results.

Materials and methods. The study was carried out in agricultural formations of the Dnipropetrovsk region, the Research Center for Biosafety and Environmental Control of Agricultural Resources of the Dnipro State Agrarian and Economic University, the Genetics Laboratory of the Institute of Pig Breeding and Agricultural Production of the National Academy of Agrarian Sciences of Ukraine and the Laboratory of Animal Husbandry of the State Institution "Institute of Grain Crops of the National Academy of Agrarian Sciences of Ukraine".The work was carried out by the research program of the National Academy of Agrarian Sciences of Ukraine No. 30 "Innovative technologies for breeding, industrial and organic production of pig products", the task "To develop a local system of selection and hybridization of pigs using modern genetic methods (DNA markers)".

Assessment of young pigs of large white breed (n = 40) for fattening and meat qualities was carried out taking into account the following quantitative characteristics: average daily weight gain, g; age of reaching 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 chilled half carcass, cm, the most significant (front) width of the bacon half of the carcass, cm; smaller (back) width of the bacon half of the carcass, cm. The length of the chilled carcass (cm) was measured with a measuring tape from the edge of the pubic bone fusion to the anterior 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 is at the level of the seventh thoracic vertebra perpendicular to the half of the carcass; the most minor (back) width of the bacon half is at the level of the penultimate lumbar vertebra perpendicular to the half of the carcass (Berezovskyi & Khatko, 2005; Voloshchuk et al., 2017).

The age of reaching a live weight of 100 kg (1, 2) and the multicomponent estimated index of M. D. Berezovsky (3) were calculated according to the following formulas:

If the live weight of the animal is 85-99 kg:

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

If the live weight of the animal is 101-115 kg:

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

where: D_{100} is the age of reaching a live weight of 100 kg, days; D_0 is the age at the last weighing, days; D_{po} – age of pre-weighing, days; M_0 – live weight at the last weighing, kg; M_{no} – live weight at pre-weighing, kg (Instruktsiia , 2003);

$$I = 100 - \frac{K \times B \times C}{A^2} \quad (3)$$

where: K is the age of reaching a live weight of 100 kg, days; A - gross weight gain for the fattening period, kg; B – the number of days of fattening; C – the thickness of the bacon at the level of 6-7 ribs, cm (Vashchenko, 2019).

DNA typing of young pigs by the melanocortin receptor MS4R gene was carried out in the genetics laboratory of the Institute of Pig Breeding and APV of NAAS (Kim et al., 2000; Kim et al., 2004). The bristles of animals of the specified production group were used as a biomaterial.

The activity of aspartate aminotransferase (AST), alanine aminotransferase (ALT), and alkaline phosphatase (ALP) in the serum of young pigs of different genotypes by the melanocortin receptor gene MC4R (n=13) was determined by generally accepted methods (Hryban et al., 2001; Vlizlo et al., 2012).

The cost of additional products was calculated using the following data: the purchase price of a unit of production, according to the existing prices in force in Ukraine (UAH); average animal productivity; average mark-up of primary products (%), 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; constant coefficient of decrease in the result, which is associated with additional costs for profitable products (0.75); the number of livestock of farm animals of a new or improved breeding achievement, heads (Chernenko, 2016).

Biometric processing of research results was done according to generally accepted methods using the programmable "Data Analysis" module in Microsoft Excel. Statistical errors for the arithmetic mean (4), standard deviation (5), coefficient of variation (6), and correlation coefficient (7) were calculated using the following formulas:

$$S_x = \pm \frac{\sigma}{\sqrt{n}} \quad (4) \qquad S_\sigma = \pm \frac{\sigma}{\sqrt{2_n}} \quad (5) \qquad S_{Cv} = \pm \frac{C_v}{\sqrt{2_n}} \quad (6) \qquad S_r = \frac{1 - r^2}{\sqrt{n}} \quad (7)$$

where: n is the sample size; σ is the standard deviation; Cv is the coefficient of variation (Kovalenko et al., 2010, Kramarenko et al., 2019).

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

Table 1

Cheddock Scale for Gradation of the Strength of the Correlation Relationship between Quantitative Traits

Correlation coefficient value	The Strength of the Correlation
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

Research results. The results of laboratory studies indicate that the biochemical parameters of blood serum, namely the activity of aspartate aminotransferase (AST), alanine aminotransferase (ALT), and alkaline phosphatase (ALP) in the serum of young pigs correspond to the physiological norm of clinically healthy animals (Hryban et al., 2001; Vlizlo et al., 2012). Thus, the activity of aspartate aminotransferase (AST) is 59.38±3.761 units/l, alanine aminotransferase (ALT) – 44.38±2.474 units/l, alkaline phosphatase (ALP) – 122.12±8.653 units/l.

It was found that the average daily weight gain of young pigs (n=40) during the period of control fattening is 781.9±6.10 g, the age of reaching live weight is 177.1±0.79 days, the thickness of fat at the level of 6-7 thoracic vertebrae is 20.8±0,35 mm, the length of the chilled carcass is 96.6±0.36 cm, the length of the 100 kg 0,35 mm 0,36 см bacon half of the chilled half-carcass is 85.3±,0,52 cm the estimated index of M. D. Berezovsky is 89.5±0.54 points. Indicators The most significant (front) and most minor (back) widths of the bacon half are 34.2±0.45 and 24.7±0.37 cm, respectively.

The coefficient of variability of biochemical parameters of blood serum, fattening, and meat qualities of young pigs ranges from 1.81 to 25.55 % (Table 2).

Table 2

Indicators of variability of interior traits (n=13), fattening and meat qualities (n=40) of young pigs of large white breed

Indicators, units of measurement	Biometric indicators	
	$\sigma \pm S\sigma$	$Cv \pm Sc_v$, %
Aspartate aminotransferase (AST) activity, U/L	13.56±2.664	22.84±4.487
Alanine aminotransferase (ALT) activity, units/l	8.92±1.752	20.10±3.48
Alkaline phosphatase (ALP) activity, U/L	31.20±6.129	25.55±5.019
Average daily weight gain, g	38.64±4.322	4.94±0,116
Age of reaching live weight 100 kg, days	5.02±0.561	2.84±0.317
The thickness of the bacon at the level of 6-7 thoracic vertebrae, mm	2.25±0.251	10.81±1.209
Length of chilled carcass, cm	1.75±0.195	1.81±0.202
Length of bacon half of chilled half carcass, cm	2.51±0.280	2.95±0.329
The largest (front) width of the bacon half of the chilled carcass, cm	2.33±0.260	6.83±0.763
Smallest (back) width of the bacon half of the chilled carcass, cm	1.88±0.210	7.63±0.853
Evaluation index of M. D. Berezovsky, point	3.54±0.395	3.96±0.442

The results of the study of biochemical parameters of blood serum, fattening, and meat qualities of young pigs of different interbreed differentiation by the melanocortin receptor gene MC4R are given in Tables 3 and 4.

The results of the study of biochemical parameters of blood serum, fattening, and meat qualities of young pigs of different interbreed differentiation by the melanocortin receptor gene MC4R indicate that the difference between the groups in aspartate aminotransferase activity (AST) is 5.98 units/l (td=0.81; p>0.05), alanine aminotransferase activity (ALT) – 6.72 units/l (td=1.44; p>0.05), alkaline phosphatase activity (ALP) – 3.70 units/l (td=0.20; p>0.05) (Table 3).

Table 3

Biochemical parameters of blood serum of young pigs of different intrabreed differentiation by the melanocortin receptor gene MC4R

Indicator (feature), units of measurement	Biometric indicators	Genotype	
		MS4R^{AA}	***MS4R^{AG}***
		group	
		I	II
Aspartate aminotransferase (AST) activity, U/L	*n*	*7*	*6*
	X±Sx	62.14±6.185	56.16±4.020
	σ±Xσ	16.36±4.374	9.84±0.289
	Cv±Sc$_v$, %	26.32±7.037	17.52±5.063
Alanine aminotransferase (ALT) activity, units/l	*X±Sx*	41.28±3.649	48.00±2.886
	σ±Xσ	9.65±2.580	7.07±2.043
	Cv±Sc$_v$, %	23.37±6.248	14.72±4.254
Alkaline phosphatase (ALP) activity, U/L	*X±Sx*	120.41±12.341	124.11±13.217
	σ±Xσ	32.65±8.729	32.37±9.355
	Cv±Sc$_v$, %	27.11±7.248	26.08±7.537

It was found that the maximum indicator of the average daily weight gain (808.1±5.37 g) and the minimum value of the age of reaching live weight (174.9±0.78 days) are characterized by the animals of the second experimental group. The difference between the animals of the II 100 (*MC4R^{AG}*) and I (*MC4R^{AA}*) experimental groups is (td=5.06; p<0.001) and 3.9 days (td=2.76; p<0.05), respectively 47,4 g. (Table 4).

In terms of the thickness of bacon at the level of 6-7 thoracic vertebrae, young pigs of the second experimental group outnumbered their peers I by 1.8 mm (td=2.85; p<0.01), the length of the chilled carcass – (td=3.33; p<0.01), the length of the bacon half of the chilled half-carcass 1,9 см – (td=2.95; p<0.01), the estimated index of M. D. Berezovsky – 2.8 points (td=2.71; p<0.01) 2,6 cm. Studies show that the maximum values "the largest (front) width of the bacon half of the chilled carcass, cm" and "the smallest (back) width of the bacon half of the chilled carcass, cm" are also characterized by young pigs of the second experimental group. Compared to the peers of the first experimental group, the difference in these indicators is 2,2 cm (td=2.71; p<0.01) and 1.3 cm (td=1.88; p>0.05), respectively.

Table 4

Fattening and meat qualities of young pigs of different intrabreed differentiation by the melanocortin receptor gene MC4R

Indicator, units of measurement	Biometric indicators	Genotype	
		MS4R^{AA}	***MS4R^{AG}***
		group	
		I	**II**
Average daily weight gain, g	*n*	*22*	*18*
	X±Sx	760.7±7.66	808.1±5.37
	σ±Xσ	35.93±5.419	22.82±3.803
	Cv±Sc$_v$, %	4.72±0.711	2.82±0.470
Age of reaching live weight 100 kg, days	*X±Sx*	178.8±1.18	174.9±0.78
	σ±Xσ	5.55±0.837	3.32±0.553
	Cv±Sc$_v$, %	3.10±0.467	1.89±0.315
The thickness of the bacon at the level of 6-7 thoracic vertebrae, mm	*X±Sx*	21.6±0.52	19.8±0.36
	σ±Xσ	2.44±0.368	1.54±0.256
	Cv±Sc$_v$, %	11.29±1.702	7.77±1.295
Length of chilled carcass, cm	*n*	*10*	*13*
	X±Sx	95.5±0.34	97.4±0.47
	σ±Xσ	1.08±0.241	1.71±0.335
	Cv±Sc$_v$, %	1.13±0.252	1.75±0.343
Length of bacon half of chilled half carcass, cm	*X±Sx*	83.8±0.61	86.4±0.64
	σ±Xσ	1.93±0.431	2.33±0.457
	Cv±Sc$_v$, %	2.30±0.514	2.69±0.528
The largest (front) width of the bacon half of the chilled carcass, cm	*X±Sx*	33.1±0.63	35.3±0.52
	σ±Xσ	2.30±0.514	1.88±0.369
	Cv±Sc$_v$, %	6.94±1.552	5.32±1.045
Smallest (back) width of the bacon half of the chilled carcass, cm	*X±Sx*	24.0±0.38	25.3±0.59
	σ±Xσ	1.38±0.308	2.14±0.420
	Cv±Sc$_v$, %	5.75±1.286	8.45±1.660
Evaluation index of M. D. Berezovsky, point	*n*	*22*	*18*
	X±Sx	88.5±0.71	91.3±0.75
	σ±Xσ	3.83±0.577	2.73±0.455
	Cv±Sc$_v$, %	4.32±0.651	2.99±0.498

The coefficient of variability (Cv,%) of absolute indicators of fattening and meat qualities in young pigs of different interbreed differentiation according to the MS4R gene ranges from 1.13 (length of chilled carcass in animals of the experimental group I – *MC4R^{AA})* to 11.29 % (fat thickness at the level of 6-7 thoracic vertebrae in animals of the experimental group I – *MC4R^{AA}*).

The calculation of the pair correlation coefficient between the biochemical parameters of blood serum, fattening, and meat qualities of young pigs of large white breed shows that this biometric indicator varies from -0.344±0.1421 to +0.402±0.1411 (Table 5).

Table 5

The level of correlation between the biochemical parameters of blood serum, fattening and meat qualities of young pigs of large white breed

Sign		Biometric indicators		The Strength of the correlation
X	***into***	**r±Sr**	**tr**	
Aspartate aminotransferase (AcBP) activity, U/L	1	-0.049±0.1578	0.31	-
	2	+0.212±0.1511	1.40	*Weak*
	3	-0.316±0.1424*	2.22	*Moderate*
	4	+0.073±0.1574	0.46	-
	5	+0.197±0.1521	1.30	*Weak*
	6	-0.058±0.577	0.37	-
	7	+0.179±0.1532	1.17	*Weak*
Alanine aminotransferase (ALT) activity, units/l	1	+0.281±0.1457	1.93	*Weak*
	2	-0.344±0.1395*	2.47	*Moderate*
	3	+0.091±0.1569	0.58	-
	4	+0.293±0.1446*	2.03	*Weak*
	5	+0.402±0.1327**	3.03	*Moderate*
	6	+0.169±0.1537	1.10	*Weak*
	7	+0.097±0.1567	0.62	-
Alkaline phosphatase (ALP) activity, U/L	1	+0.128±0.1556	0.82	*Weak*
	2	-0.001±0.1582	0.01	-
	3	-0.101±0.1566	0.64	*Weak*
	4	-0.111±0.1563	0.71	*Weak*
	5	+0.194±0.1523	1.27	*Weak*
	6	-0.285±0.1454	1.96	*Weak*
	7	-0.146±0.1549	0.94	*Weak*

*Note: x – biochemical parameters of blood serum; y – fattening and meat qualities of young pigs (total sample); 1 - average daily weight gain, g; 2 - age of reaching live weight 100 kg, days; 3 - the thickness of the bacon at the level of 6-7 thoracic vertebrae, mm; 4 - length of chilled 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*

Significant 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, tr = 2.22), alanine aminotransferase activity (ALT) × age of reaching a live weight of 100 kg (r = -0.344, tr = 2.47), alanine aminotransferase activity (ALT) × length of chilled carcass (r = + 0.293, tr = 2.03), alanine aminotransferase (ALT) activity × the length of the bacon half of the chilled half-carcass (r= +0.402, tr=3.03).

The calculation of the economic efficiency of the research results shows that the maximum increase in additional production was obtained from young pigs of the second experimental groups - +3.24 % (Table 6).

The cost of additional products obtained from one head of young pigs of this group is + 261.56 or + 6.62 US dollars.

Table 6

Cost-effectiveness of research results

Group	n	Average daily live weight gain, g	± to the population average	Cost of additional products, UAH / USD / Goal
Total Sample	40	781.9±6.10	-	-
I	22	760.7±7.66	-2.71	-223.65 / -5.66
II	18	808.1±5.37	+3.24	+261.56 / +6.62

*Note: * - the selling price of young pigs at the time of the study was UAH 78.80 or USD 1.99 per 1 kg of live weight.*

Discussion. Enzymes are involved in all biochemical processes of the body, and metabolic disorders caused by various harmful factors lead to changes in the concentration of the corresponding enzymes in biological fluids. Alanine aminotransferase and aspartate aminotransferase are the most important representatives of the group of enzymes (intracellular enzymes) involved in the synthesis and breakdown of amino acids; interconnection of carbohydrate, lipid, and amino acid metabolism pathways; synthesis of some specific compounds, including urea and γ-aminobutyric acid.

That is why we investigated the activity of aminotransferases in the serum of young pigs of different genotypes according to the melanocortin receptor gene (MC4R) and determined their relationship with fattening and meat qualities. Reliable links have been established between the indicators of the interior and the fattening and meat qualities of young pigs of the controlled population.

It was found that animals of the $MC4R^{AG}$ genotype outnumbered their peers of the $MC4R^{AA}$ genotype in terms of fattening and meat qualities by an average of 4.29%. The pairwise correlation coefficients between interior, fattening, and meat qualities in animals of different genotypes ranged from -0.917 to +0.577, indicating their use's effectiveness for early prediction of these groups of traits (Khalak et al., 2021).

The authors (Kirovych et al., 2023) recommend that in order to increase the reproductive capacity of pigs of the pietrain breed, the selection of replacement gilts should be carried out, taking into account polymorphism for the RYR-1 and MC4R genes. When forming parental pairs in order to obtain a high level of productivity for reproductive traits (multiple births of more than 8.00 heads), boars can be carriers of the homozygous genotype GG^{nn} according to the genes MC4R and RYR1, which in turn contributes to the production of offspring with an increased level of meat productivity.

The efficiency of pork meat production, along with reproductive and fattening characteristics, largely depends on the level of slaughter and meat quality. This issue is particularly important when using specialized meat breeds of foreign selection to improve the meat qualities of pig breeds of domestic selection when breeding new interbreed types and lines or obtaining hybrid commercial young animals.

When studying the influence of carriers of different alleles of the MC4R gene on the manifestation of live weight, fattening, and meat traits in young pigs of hybrid origin F2 (1/4 BB + 1/4UM + 1/2 PTP), Garmatyuk K.V. noted the positive effect of the $MC4R^{G}$ allele and the $MC4R^{GG}$ genotype on animal productivity. The lowest age to achieve live weight is typical for carriers of the $MC4R^{GG}$ genotype – 164.0 days, which outnumbered carriers of the $MC4R^{AA}$ genotype by 4.5 days or by 2.7% ($p<0.01$) (Harmatiuk, 2019).

The results of the study by P. Vashchenko (2019) indicate that the results of DNA typing of the Myrhorod pig breed according to the *MC4R* gene should be used as

a fixed factor in determining the breeding value by the BLUP method on the grounds of "age of reaching weight 100 kg" and "fat thickness". The author notes that the correlation between the estimates obtained from models with and without the use of data on the genotype of pigs by the MC4R gene, According to the trait, the age of reaching a mass of 100 kg is 0.76±0.109 (*p<0.001);* based on "fat thickness" – 0.71±0.119 (*p<0.001).* When breeding to reduce the thickness of bacon, it is necessary to control the uniformity of its deposition since it has been found that its relative evenness deteriorates with a decrease in the thickness of bacon. Pigs with a lower fat thickness (a large white breed of Hungarian breed) are characterized by a lower coefficient of evenness, inferior to UVB-1 animals by 86.9 % (*p<0.001).*

Further directions of our work include studies of the physicochemical properties and chemical composition of the longest back muscle and subcutaneous fat of young pigs of different breeds and genotypes according to the melanocortin receptor gene MC4R.

Conclusions:

1. It was found that the biochemical parameters of blood serum (activity of aspartate aminotransferase, alanine aminotransferase, and alkaline phosphatase) of young pigs of large white breed of the controlled population correspond to the physiological norm of clinically healthy animals and according to the leading indicators of fattening and meat qualities (age of reaching live weight 100 kg, days; fat thickness at the level of 6-7 thoracic vertebrae, mm; length of chilled carcass, cm) belongs to class I and class elite.

2. Taking into account the interbreed differentiation of young pigs according to the MS4R gene, it was found that young pigs of the second experimental group ($MC4R^{AG}$***)*** are superior to their peers of I ($MC4R^{AA}$)

in terms of average daily weight gain, the age of reaching a live weight of 100 kg, the thickness of fat at the level of 6-7 thoracic vertebrae, and the length of the chilled carcass by an average of 4.58%.

3. The number of reliable associations between interior indicators (activity of AST, ALT), fattening, and meat qualities of young pigs of the controlled population is 28.57 %. This indicates the possibility of using these interior indicators for early prediction of fattening and meat qualities of young pigs.

5. The maximum increase in additional production was obtained from young pigs of the second experimental group ***(*$MC4R^{AG}$***)*** – +3.24 %, and its cost, which was obtained from the sale of one head of young pigs of the specified genotype, is + 261.56 UAH or + 6.62 US dollars.

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