Young pig fattening and meat quality due to varying formation intensities in early ontogenesis and two genotypes of the melanocortin receptor 4 (Mc4r) gene

V. Khalak, V. Voloshchuk, B. Gutyj, L. Zasucha, A. Onyshchenko, M. Ilchenko, N. Ofilenko, V. Pokhyl, V. Pundyk, O. Bezaltychna and O. Stadnytska*

Abstract

The aim of this study was to investigate young pig fattening and meat quality due to the varying formation intensities in early ontogenesis and two genotypes based on the melanocortin receptor 4 (Mc4r) gene. To calculate the correlations between traits and the economic efficiency of using animals of experimental groups in industrial complex conditions, the assessment of animals for fattening and meat quality examined the following characteristics: average daily live weight gain during the control fattening period in grams; age of reaching 100 kg live weight in days, chilled carcass length in centimetres; length of the bacon half of the cooled carcass in centimetres; lard thickness at the thoracic vertebrae T6-T7 in millimetres. Further, the biometric processing of research results and calculation of the economic efficiency was performed. Young pigs of the controlled population met the requirements of the 1st class and the elite class for fattening and meat qualities. In examining the interbreed differentiation of large white breed animals, the melanocortin 4 receptor (Mc4r) gene determined that the $Mc4r^{AG}$ genotype outperformed the $Mc4r^{AA}$ genotype for average daily live weight gain, age at live weight of 100 kg, lard thickness at T6-T7, and chilled carcass length by an average of 4.50%. The difference between groups for the Tyler B's index was 11.82 points, and according to the average daily increase in live weight, the disparity between young pigs of interbreed differentiation according to the formation intensity index was 4.69%, the age of reaching 100 kg live weight was 3.10%, and the chilled carcass length was 1.23%. The number of reliable connections between fattening and meat qualities, and the formation intensity and Tyler B indices was 75.0%, indicating their promise for use in selection and breeding work. The maximum increase in additional production was obtained from young pigs of the Mc4r AG genotype (+2.71%) and of group I, in which the formation intensity index ranged from 0.935 to 1.087 points (+2.65%).

Key words: *young pigs; genotype; intensity of formation; ontogenesis; fattening and meat qualities; correlation; economic efficiency*

Viktor KHALAK, Candidate of Agricultural Sciences, Senior Researcher; State Institution "Institute of grain crops of NAAS", Animal Husbandry Laboratory, Dnipro, Ukraine; Vasyl VOLOSHCHUK, Doctor of Agricultural Sciences, Professor, Institute of Pig Breeding and agroindustrial production of NAAS of

Introduction

The production of high-quality pork and optimisation of the conditions of keeping and feeding animals of different sex-age groups relies on the implementation of innovative methods for assessing the breeding value of boars, sows and their offspring, and the selection of high-performance animals based on DNA methods and selection by integrated indicators taking into account the live weight of young pigs in early ontogeny (Xue and Xu, 2008; Tsereniuk, 2014; Voloshchuk et al., 2017; Kramarenko et al., 2018; Oliinychenko, et al., 2018; Balatsky et al., 2018; Kramarenko et al., 2019; Khalak et al., 2019, 2020; Kim et al., 2020; Khalak and Ivanina, 2021; Hryshina et al., 2022).

Krasnoshchok (2017) indicated that using genotypes helps to alter pig body structure proportions. They reported that at the age of four months, animals of the large white breed were inferior to local and hybrid young animals in terms of the half perimeter of the rear, by 14.23% ($P \leq 0.001$); 20.50% ($P \leq 0.001$) and 20.74% ($P \leq 0.001$), respectively. At the age of six months, there was an increase in pigs of the combination great white × (durok × hemshir) and (great white × landrace) × (durok × hemshir), respectively in trunk length by 28.04% ($P \leq 0.001$) and 23.44% ($P \leq 0.01$), in chest girth by 31.1% ($P \leq 0.001$) and 29.03% ($P \leq 0.01$) and in chest width by 50.85% ($P \leq 0.001$) and 34 .42% ($P \leq 0.001$). Accordingly, these pigs have a small exterior, characteristic of the meat type. In pigs of the second research group, the diameter of rear half girth increased by 29.14% ($P \leq 0.001$), chest width by 34.42% ($P \leq 0.001$), and the height at the withers by 32.83% ($P \leq 0.001$). The formation intensity index also affected the pig measurements, where the measurements of girth, depth, and width of the chest at the age of four and six months in large white breed pigs with a high formation intensity were significantly ($P \leq 0.001$) higher than peers of the modal class and the minus-variant class.

Experimental data (Saenko et al., 2019) have shown that genetic markers LEP g.3469 T > C, LEP g.2845 A > T, CTSF g.22 C ≤ A polymorphisms in a subpopulation of pigs of the large white Ukrainian breed selection characterises g. It was found that SNP LEP c. 3469 T > C is associated with indicators of moisture loss in meat during heat treatment, protein content in meat, and the moisture content in pig fat. The meat of animals of the TT genotype was characterised by a 16% higher rate of moisture loss and a 4% higher protein content, and fat by 17%

Ukraine, Poltava, Ukraine; Bogdan GUTYJ*, Doctor of veterinary sciences, Professor (Corresponding author: e-mail: bvh@ukr.net); Stepan Gzhytskyi National University of Veterinary Medicine and Biotechnologies Lviv, Ukraine; Liudmyla ZASUCHA, Candidate of Agricultural Sciences, Doctoral Student, Institute of Pig Breeding and agroindustrial production of NAAS of Ukraine, Poltava, Ukraine; Andrii ONYSHCHENKO, Candidate of Agricultural Sciences, Leading Researcher, Institute of Pig Breeding and agroindustrial production of NAAS of Ukraine, Poltava, Ukraine; Maria ILCHENKO, Candidate of Agricultural Sciences, Leading Researcher, Institute of Pig Breeding and agroindustrial production of NAAS of Ukraine, Poltava, Ukraine; Nataliia OFILENKO, Candidate of Agricultural Sciences, Assistant Professor, Poltava University of Economics and Trade, Poltava, Ukraine; Volodymyr POKHYL, Candidate of Agricultural Sciences, docent, Dnipro State Agrarian and Economic University, Poltava, Ukraine; Vasul PUNDYK, Candidate of Agricultural Sciences, Leading Researcher, Institute of Agriculture of the Carpathian Region of NAAS of Ukraine, Obroshino, Ukraine; Olena BEZALTYCHNA, Candidate of Agricultural Sciences, Leading Researcher, Odessa State Agrarian University, Odessa, Ukraine; Olha STADNYTSKA, Candidate of Agricultural Sciences, Senior Researcher, Institute of Agriculture of the Carpathian Region of NAAS of Ukraine, Obroshino, Ukraine

more moisture than heterozygous animals. Furthermore, the authors proved the association of SNP LEP g.2845 A>T with intramuscular fat content, the moisture-holding capacity of meat, and the moisture content of the lard of large white pigs. The meat of animals of the AA genotype was characterised by a 60% lower intramuscular fat content and a 6% higher moisture retention rate compared to the meat of heterozygous pigs. SNP CTSF g.22 C ≤ G is associated with indicators of intramuscular fat content, calcium, and phosphorus content in the meat of large white pigs of Ukrainian selection, and its moisture-retaining ability. The genetic and associative studies in a subpopulation of pigs of the large white breed of Ukrainian selection testify to the influence of leptin and cathepsin F gene polymorphisms on animal productivity indicators, particularly on specific parameters of carcass structure and the quality of meat and fat. The genetic markers SNPs LEP g.3469 T>C, LEP g.2845 A>T and CTSF g.22 C>G show potential for their use in the marker-associated selection of pigs.

The results of research to date indicate the relevance of this scientific study by domestic and foreign scientists (Pankeev, 2003; Suzuki et al., 2004; Kim et al., 2006; Bordun, 2007; Birta and Burgu, 2012; Topiha and Hryhor'eva, 2013; Rybalko and Floka, 2014; Povod and Hramkova, 2017; Povod et al., 2017; Hramkova, 2017; Hramkova and Povod, 2018).

The purpose of the work is to investigate the fattening and meat qualities of young pigs of different intensity of formation in early ontogenesis and of different genotypes according to the melanocortin receptor 4 (Mc4r) gene, to calculate the level of correlations between traits, as well as the economic efficiency of using animals of experimental groups in industrial conditions of the complex.

Materials and methods

The research was carried out at the agro-forming and processing enterprises of the Dnipropetrovsk region, the genetics laboratory of the Institute of Pig Breeding and Agro-industrial Production of the National Academy of Agrarian Sciences of Ukraine, and the animal husbandry laboratory of the national Institute of Grain Crops of the National Academy of Agrarian Sciences of Ukraine.

The subject of the research was large white breed young pigs of two genotypes for the melanocortin 4 (*Mc4r*) receptor gene ($Mc4r^{AA}$ – *group I*, $Mc4r^{AG}$ – *group II*).

Evaluation of young pigs according to indicators of individual development, fattening, and meat qualities was performed taking the following indicators into account: live weight at the time of birth, at the age of 2 and 4 months (kg), average daily increase in live weight during the period of control fattening (g); the age of reaching 100 kg live weight (days), chilled carcass length (cm); lard thickness at thoracic vertebrae T6-T7 (mm) (Berezovskyi and Khatko, 2005).

The age of reaching 100 kg live weight (1, 2), relative increase in live weight during the growing period from birth to 4 months of age (3), the formation intensity index (Δt) (4), and the Tyler B index (5) were calculated according to the following models:

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

$$D_{100} = \left[(100\,kg - M_0) \div \frac{M_0 - M_{pw}}{D_0 - D_{pw}} \right] + D_0, \quad (1)$$

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

$$D_{100} = D_0 - \left[(M_0 - 100\,kg) \div \frac{M_0 - M_{pw}}{D_0 - D_{pw}} \right] + D_0, \quad (2)$$

where: D_{100} – age of reaching a live weight of 100 kg (days); D_0 – the age at last weighing (days); D_{pw} – age of previous weighing (days); M_0 – live weight at the last weighing (kg); M_{pw} – live weight at pre-weighing (kg) (Instructions on Pig Grading, 2003);

$$K = \frac{W_t - W_0 \times 100}{(W_t + W_0) \times 0.5} \quad (3)$$

where: W_t – live weight at the age of 4 months (kg), W_0 - live weight at the time of birth (kg) (Kravchenko, 1973);

$$\Delta t = \frac{Wв - Wa}{0.5 \times (Wв + Wa)} - \frac{Wc - Wв}{0.5 \times (Wc + Wв)}, \quad (4)$$

where: Wa - live weight at the time of birth (kg), Wв - live weight at the age of 2 months (kg), Wc - live weight at the age of 4 months (kg) (Svechyn, 1985);

$$I=100 + (242 \times K) - (4.13 \times L) \quad (5)$$

where: I – Tyler B index (score), K – average daily gain (kg); L - thickness of the lard at the thoracic vertebrae T6-T7 (mm).

The cost of additional products was calculated taking into account the following indicators: purchase price per product unit following the current prices in Ukraine; average productivity of animals; average premium of primary production (%), expressed as a percentage per head when applying a new and improved breeding system compared to the productivity of primary use animals; constant ratio of reduction of the result, which is associated with additional costs for profitable products (0.75); the number of head of agricultural animals of a new or improved breeding system.

Genotyping of young pigs was performed at the genetics laboratory of the Institute of Pig Breeding and Agro-Industrial Production of the National Academy of Agrarian Sciences of Ukraine (Kim et al., 2000a,b).

Biometric processing of the data was performed according to the methods of Kovalenko et al. (2010) using the programmable Data Analysis module in Microsoft Excel. The strength of correlations between traits was determined according to the Chaddock scale (Table 2).

Results and discussion

Young pigs of the large white breed (n=42) were characterised by sufficiently high indicators of growth in

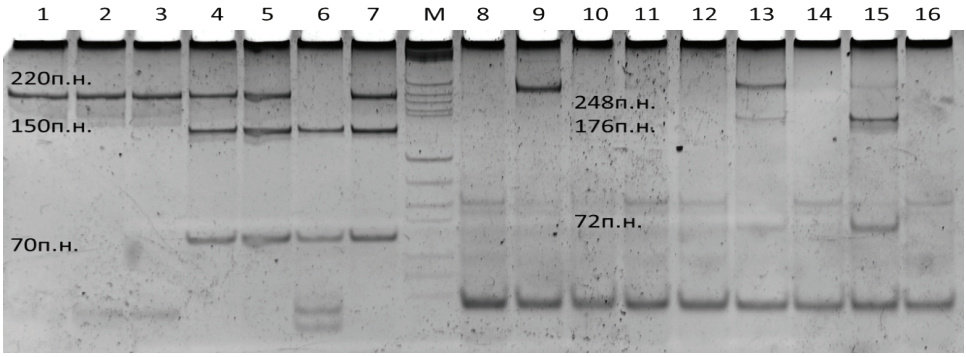

Figure 1. Electrophoresis in 8% polyacrylamide gel of MC4R and Leptin(LEP) gene restrictions. Lane: 1-3 AA genotype, lane: 4, 5, 7 AG genotype, lane: 6 GG genotype, MC4R gene. Lane: 8, 10, 11, 12, 14, 15, 16 TT genotype, lane: 9 AA genotype, lane: 13 AT genotype, Leptin(LEP) gene. M is a molecular weight marker of pBR322 DNA/BsuRI (Khalak and Gutyj, 2022).

early ontogenesis, fattening, and meat qualities. The live weight of animals at the time of birth was 1.50±0.028 kg (Cv, % - coefficient of variation, this biometric indicator characterizes the degree of variability of a quantitative trait) (Cv=12.34%), at the age of 2 and 4 months 18.3±0.22 (Cv=7.98%) and 47.2±0.62 kg (Cv=8.55%), respectively. The average daily increase in the live weight of young pigs during the control fattening period was 780.4±5.91 g (Cv=4.91%), age of reaching a live weight of 100 kg was 177.5±0.80 days (Cv=2.95%)), lard thickness at the thoracic vertebrae T6-T7 was 20.7±0.34 mm (Cv=10.68%), and chilled carcass length was 96.6±0.35 cm (Cv=1.77%). The formation intensity index ranged from 0.573 to 1.087 points, while the Tyler B index ranged from 126.13 to 182.36.

The results of studies of growth indicators in early ontogenesis, fattening, and meat qualities of young pigs of the two genotypes of the melanocortin receptor 4 (Mc4r) gene are shown in Tables 2 and 3. Analysis of the data in Table 1 showed that the difference between the groups in live weight of young pigs at the time of birth was 0.02 kg (td=0.40; $P>0.05$), at 2 and 4 months of age 0.3 (td=0.67; $P>0.05$) and 1.4 kg (td=1.13; $P>0.05$), respectively.

According to the formation intensity index (Δt), the groups differed by 0.038 points (td=0.82; $P>0.05$), and the relative

Table 1. Chaddock scale for grading the strength of the correlation between quantitative traits

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

Table 2. Absolute and integrated indicators of growth of young pigs of experimental groups

Indicator	Biometric indexes	Genotype	
		Mc4r^{AA}	Mc4r^{AG}
		Group	
		I	*II*
Live weight at the time of birth (kg)	*n*	22	20
	X±Sx	1.50±0.04	1.48±0.04
	σ±Xσ	0.21±0.03	0.16±0.03
	Cv±Scv (%)	14.00±2.11	10.67±1.69
Live weight at 2 months (kg)	*X±Sx*	18.50±0.31	18.20±0.33
	σ±Xσ	1.45±0.22	1.50±0.24
	Cv±Scv (%)	7.83±1.18	8.24±1.30
Live weight at 4 months (kg)	*X±Sx*	46.50±0.81	47.90±0.94
	σ±Xσ	3.83±0.58	4.22±0.67
	Cv±Scv (%)	8.23±1.24	8.81±1.39
Relative increase in live weight during the growing period from birth to 4 months of age (%)	*X±Sx*	187.47±0.31	187.78±0.39
Intensity of formation index (Δt)	*X±Sx*	0.84±0.03	0.80±0.03
	σ±Xσ	0.16±0.02	0.14±0.02
	Cv±Scv, %	18.49±2.79	18.00±2.85

Table 3. Feeding and meat qualities of young pigs of two genotypes of the melanocortin 4 (Mc4r) receptor gene

Indicator	Biometric indexes	Genotype	
		Mc4r^{AA}	Mc4r^{AG}
		Group	
		I	*II*
Average daily gain of live weight during the control fattening period (kg)	*n*	22	20
	X±Sx	760.70±7.67	802.20±6.31
	σ±Xσ	35.93±5.42	28.23±4.47
	Cv±Scv, %	4.72±0.71	3.51±0.56
Age of reaching 100 kg live weight (days)	*X±Sx*	178.80±1.18	174.20±1.02
	σ±Xσ	5.55±0.84	4.56±0.72
	Cv±Scv, %	3.10±0.47	2.61±0.41
Lard thickness at the thoracic vertebrae T6-T7 (mm)	*X±Sx*	21.60±0.52	19.80±0.32
	σ±Xσ	2.44±0.37	1.47±0.23
	Cv±Scv, %	11.29±1.70	7.42±1.17
Tyler B index	*X±Sx*	143.59±2.73	155.41±1.65
	σ±Xσ	12.82±1.93	7.36±1.16
	Cv±Scv, %	8.92±1.35	4.73±0.75

Cooled carcass length (cm)	*n*	10	14
	X±Sx	95.50±0.34	97.40±0.44
	σ±Xσ	1.08±0.24	1.65±0.31
	Cv±Scv, %	1.13±0.25	1.69±0.32

Table 4. Feeding and meat qualities of young pigs of different interbreed differentiation according to the formation intensity index

Indicator	Biometric indexes	Gradations of the formation intensity index		
		0.935-1.087	0.728-0.912	0.573-0.707
		Subgroup		
		I	*II*	*III*
Average daily gain of live weight during the period of control fattening (kg)	*n*	14	13	15
	X±Sx	801.70±10.17	776.40±10.37	764.10±8.21
	σ±Xσ	38.06±7.19	37.40±7.35	31.82±5.7
	Cv±Scv, %	4.74±0.90	4.81±0.94	4.16±0.76
Age of reaching 100 kg live weight (days)	*X±Sx*	174.80±1.11	177.00±1.48	180.40±1.25
	σ±Xσ	4.15±0.78	5.34±1.05	4.86±0.89
	Cv±Scv, %	2.37±0.45	3.01±0.59	2.69±0.49
Lard thickness at the thoracic vertebrae T6-T7 (mm)	*X±Sx*	20.80±0.39	20.90±0.67	20.50±0.69
	σ±Xσ	1.46±0.28	2.43±0.48	2.69±0.49
	Cv±Scv, %	7.01±1.33	11.62±2.28	13.12±2.40
Tyler B index	*X±Sx*	151.08±1.16	148.56±3.92	147.05±1.53
	σ±Xσ	6.07±1.15	14.13±2.78	7.74±1.41
	Cv±Scv, %	4.01±0.76	9.51±1.87	5.26±0.96
Cooled carcass length (cm)	*n*	7	7	10
	X±Sx	95.80±0.45	96,80±0.50	97.00±0.68
	σ±Xσ	1.21±0.32	1.34±0.36	2.16±0.48
	Cv±Scv, %	1.26±0.34	1.38±0.37	2.22±0.50

increase in live weight during the rearing period from birth to 4 months of age was 0.31% (td =0.63; $P>0.05$).

The analysis of the results of the control feeding of young pigs shows that the young pigs of group II (*Mc4r* ^{AG}) prevailed over group I (*Mc4r* ^{AA}) in terms of the average daily increase in live weight by 41.5 g (td=4.19; $P<0.001$), and the age of reaching live weight of 100 kg by 4.6 days (td=2.96; $P<0.01$) (Table 3).

Young pigs of group II (*Mc4r* ^{AG}) in comparison to group I (*Mc4r* ^{AA}) were characterised by a smaller index of fat thickness at T6-T7 (by 1.8 mm; td=4.18; $P<0.001$), and the difference between the groups in the chilled carcass length was 1.9 cm (td=3.45; $P<0.001$). According to the Tyler B index, the young pigs of group II outperformed group I by 11.82 points (td=3.70; $P<0.01$).

The interbreed differentiation of young pigs according to the formation intensity

Table 5. The level of correlations between fattening and meat quality, the formation intensity index, a complex index of fattening and meat qualities (Tyler B index), and relative live weight gain during the rearing period from birth to 4 months of age

Indicator		Biometric indexes		Correlation strength
x	y	r±Sr	tr	
Average daily gain of live weight during the control fattening period (kg)	1	0.459±0.122***	3.76	Moderate
	2	0.605±0.098***	6.18	Noticeable
	3	-0.181±0.149	1.21	Weak
Age of reaching 100 kg live weight (days)	1	-0.443±0.124***	3.57	Moderate
	2	-0.681±0.083***	8.23	Noticeable
	3	-0.051±0.154	0.21	–
Lard thickness at the thoracic vertebrae T6-T7 (mm)	1	0.033±0.154	0.21	–
	2	-0.934±0.020***	47.42	Very high
	3	-0.146±0.151	0.97	Weak
Cooled carcass length (cm)	1	-0.249±0.145	1.72	Weak
	2	0.323±0.138*	2.34	Moderate
	3	0.331±0.137*	2.41	Moderate

Note: *1 – formation intensity index (Δt) (score); 2 – complex index of fattening and meat qualities (Tyler B index) (score); 3 – relative increase in live weight during the rearing period from birth to 4 months of age (%) * – P <0.05; *** – P<0.001.*

Table 6. Economic efficiency of research results

Group	Average daily gain of live weight during the period of control fattening (kg)	Increase in additional products (%)	Cost of additional products (hryvnias / USD per head)*
General sample	**780.40±5.91**	**–**	**–**
Interbreed differentiation by genotype			
I	760.70±7.67	-2.52	-178.71 / -4.50
II	802.20±6.31	+2.71	+187.24 / +4.71
Interbreed differentiation according to the Tyler B index			
III	764.10±8.21	-2.08	-148.82 / -3.74
II	776.40±10.37	-0.51	-35.80 / -0.90
I	801.70±10.17	+2.65	+183.72 / +4.62

Note: ** – the selling price of young pigs at the time of the study was 67.80 hryvnias or 1.71 USD per 1 kg of live weight*

index showed that the difference between groups (I-III) in the average daily gain in live weight was 37.6 g (td=2.87; $P<0.01$) and the age of reaching live weight of 100 kg was 5.6 days (td=3.35; $P<0.01$) (Table 4).

The analysis of the data shows that the young pigs of subgroup III in comparison to subgroup I were characterised by a lower Tyler B index (by 4.03 points; td=2.12; $P<0.05$), and the difference between the groups for chilled carcass length was 1.2 cm (td=1.5; $P>0.05$). No significant difference was found in fat thickness at T6-T7 in animals with different formation intensities in early ontogenesis.

The coefficient of variability (Cv,%) of fattening and meat qualities in young pigs of different genotypes and formation intensity index values ranged from 1.13% (chilled carcass length (cm) in animals of the $Mc4r^{AA}$ genotype) to 14.00% (live weight at birth (kg) in animals of the $Mc4r^{AA}$ genotype).

The results of the calculation of the pairwise correlation coefficient between fattening and meat quality and the formation intensity index, a complex index of fattening and meat qualities (Tyler B index), and relative live weight gain during the rearing period from birth to 4 months of age, are shown in Table 5.

Calculation of the pairwise correlation coefficient between fattening and meat qualities, the formation intensity index, a complex index of fattening and meat qualities (Tyler B index), and relative live weight gain during the rearing period from birth to 4 months of age showed that this biometric indicator varied from -0.934 to +0.605.

Reliable pairwise correlation coefficients between traits in young pigs of the large white breed were established between the following pairs of traits: average daily gain in live weight during the period of control fattening × formation intensity index (Δt) (r=0.459); average daily gain in live weight during the period of control fattening × complex index of fattening and meat qualities (Tyler B index) (r=0.605); age of reaching live weight 100 kg × formation intensity index (Δt) (r=-0.443); age of reaching live weight 100 kg × complex index of fattening and meat qualities (Tyler B index) (r=-0.681); lard thickness at T6-T7 × the complex index of fattening and meat qualities (Tyler B index) (r=-0.934); chilled carcass length × the complex index of fattening and meat qualities (Tyler B index) (r=0.323); chilled carcass length × relative live weight gain during the growing period from birth to 4 months of age (r=0.331).

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 $Mc4r^{AG}$ genotype (+2.71%) and animals of subgroup I, in which the formation intensity index ranged from 0.935 to 1.087 points (+2. 65%) (Table 6).

The value of additional products obtained from young pigs of the specified groups was +187.24 and +183.72 hryvnias or +4.71 and +4.62 US dollars.

Conclusions

The study results showed that the leading indicators of growth, fattening, and meat qualities of young pigs of the controlled population meet the requirements of the 1st class and the elite class.

Taking into account the interbreed differentiation of large white breed animals, it was established that young pigs of the $Mc4r^{AG}$ genotype outperformed peers of the $Mc4r^{AA}$ genotype in the average daily live weight gain, age at achieving a live weight of 100 kg, lard thickness at the level

of T6-T7, and chilled carcass length by an average of 4.50%. According to Tyler B index, the difference between the groups is 11.82 points (td=3.70; $P<0.01$).

According to the average daily increase in live weight, the interbreed difference between young pigs based on the formation intensity index was 4.69%, the age of reaching 100 kg live weight was 3.10%, and the chilled carcass length was 1.23%.

The number of reliable connections between fattening and meat qualities, and the formation intensity and Tyler B indices was 75.0%, indicating their promise for use in selection and breeding work.

The maximum increase in additional production was obtained from young pigs of the Mc4r ^{AG} genotype (+2.71%) and animals of subgroup I with a formation intensity index ranging from 0.935 to 1.087 points (+2.65%).

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Hranidbena i mesna svojstva mladih svinja različitog intenziteta formiranja u ranoj ontogenezi i unutarpasminske diferencijacije prema genu za melanokortin 4 (Mc4r) receptor

Viktor KHALAK, Candidate of Agricultural Sciences, Senior Researcher, State Institution «Institute of grain crops of NAAS», Animal Husbandry Laboratory, Dnipro, Ukraine; Vasyl VOLOSHCHUK, Doctor of Agricultural Sciences, Professor, Institute of Pig Breeding and agroindustrial production of NAAS of Ukraine, Poltava, Ukraine; Bogdan GUTYJ, Doctor of veterinary sciences, Professor, Stepan Gzhytskyi National University of Veterinary Medicine and Biotechnologies Lviv, Ukraine; Liudmyla ZASUCHA, candidate of Agricultural Sciences, Doctoral Student, Institute of Pig Breeding and agroindustrial production of NAAS of Ukraine, Poltava, Ukraine; Andrii ONYSHCHENKO, Candidate of Agricultural Sciences, Leading Researcher, Institute of Pig Breeding and agroindustrial production of NAAS of Ukraine, Poltava, Ukraine; Maria ILCHENKO, Candidate of Agricultural Sciences, Leading Researcher, Institute of Pig Breeding and agroindustrial production of NAAS of Ukraine, Poltava, Ukraine; Nataliia OFILENKO, Candidate of Agricultural Sciences, Assistant Professor, Poltava University of Economics and Trade, Poltava, Ukraine; Volodymyr POKHYL, candidate of Agricultural Sciences, docent, Dnipro State Agrarian and Economic University, Poltava, Ukraine; Vasul PUNDYK, Candidate of Agricultural Sciences, Leading Researcher, Institute of Agriculture of the Carpathian Region of NAAS of Ukraine, Obroshino, Ukraine; Olena BEZALTYCHNA, Candidate of Agricultural Sciences, Leading Researcher, Odessa State Agrarian University, Odessa, Ukraine; Olha STADNYTSKA, Candidate of Agricultural Sciences, Senior Researcher, Institute of Agriculture of the Carpathian Region of NAAS of Ukraine, Obroshino, Ukraine

Cilj je ovog rada bio istražiti tovne i mesne kvalitete mladih svinja različitog intenziteta formiranja u ranoj ontogenezi i različitih genotipova prema genu za melanokortin receptor 4 (Mc4r); izračunati razinu korelacije između svojstava, kao i ekonomsku učinkovitost korištenja životinja pokusnih skupina u uvjetima industrijskog kompleksa. Ocjenjivanje životinja za tov i kvaliteta mesa provedeni su uzimajući u obzir sljedeće značajnosti: prosječni dnevni prirast žive vage u razdoblju kontrolnog tova, g; dob dostizanja 100 kg žive vage, broj dana, duljina ohlađenog trupa u cm; duljina polovice slanine ohlađenog trupa u cm; debljina slanine na razini 6-7 torakalnih kralješaka u mm. Biometrijska obrada rezultata istraživanja i izračun ekonomske učinkovitosti rezultata istraživanja provedeni su prema općeprihvaćenim metodama. Utvrđeno je da mlade svinje kontrolirane populacije u tovu i kvaliteti mesa zadovoljavaju uvjete I. klase i elitnog razreda. Uzimajući u obzir unutarpasminsku diferencijaciju velikih bijelih pasmina, genom za melanokortin 4 receptor (Mc4r) utvrđeno je sljedeće: mlade svinje genotipa Mc4r^{AG} nadmašuju vršnjake genotipa Mc4r^{AA} po prosječnom dnevnom prirastu žive vage, dobi u kojoj je živa vaga 100 kg, debljini sala na razini 6-7 torakalnih kralješaka i duljini ohlađenog trupa za prosjek od 4,50 %. Razlika između skupina prema indeksu Tylera B. iznosi 11,82 boda (td=3,70; P<0,01). Prema prosječnom dnevnom prirastu žive mase, razlika između mladih svinja različite unutarpasminske diferencijacije prema indeksu "intenzitet formiranja" je 4,69 %, dob dostizanja 100 kg žive vage je 3,10 %, a duljina ohlađenog trupa iznosi 1,23 %. Broj pouzdanih veza između tovnih i mesnih kvaliteta, kao i indeksa „intenzitet formiranja" i Tyler B. iznosi 75,0 %, što ukazuje na njihovu primjenu u selekcijsko-oplodnom radu. Najveće povećanje dodatnog uzgoja ostvareno je kod mladih svinja genotipa Mc4r^{AG} (+2,71 %) i životinja I. skupine, kod kojih se indeks "intenziteta formiranja" kreće od 0,935 do 1,087 bodova (+2,65 %).

Ključne riječi: *mlade svinje, genotip, intenzitet formiranja, ontogeneza, tovne i mesne kvalitete, korelacija, ekonomska učinkovitost*