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DNA-TYPE RESULTS SWINE FOR MS4R-GENE AND ITS ASSOCIATION WITH PRODUCTIVITY

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Abstract

The peculiarities of growth, development and fattening qualities of young pigs of different genotypes evaluated by the MC4R gene (marker of meat and fattening qualities, their association with productivity were determined). The true difference between animals of different genotypes (GG, AA and AG) is set at live weight at 3 months of age (4.9-5.2 kg), age of achievement live weight 100 kg (GG – Ag, 7.1 days), thickness of the sphinc at 6-7 thoracic vertebrae (GG – AA – 3.7 mm, GG – AG – 2.1 mm), body length and the chest circumference of the shoulder blades at the age of 6 months (AG – GG, 1.3-1.8 cm). According to O. Wangen's index, the GG genotype is an essential advantage in animals. Compared to the peers of the genotype AA and AG, the difference was 44.86-37.73 %.

Key words*: young pigs, growth, development, fattening qualities, DNA-typing, gene, productivity*

INTRODUCTION

Providing the population with a full and sufficient quantity of food was and remains one of the most pressing problems of our time. The experience of advanced states shows that the elimination of the deficit of meat by more than 42.0 % is solved by the pig industry. This is due to the biological characteristics of animals of this species, as well as the creation of optimal conditions for feeding and maintenance for them.

Great importance is the breeding of highly productive breeds and the introduction of innovative methods for assessing the breeding value of pigs of various sex and age groups.

An important issue for increasing the gross production of pork is to solve the problems associated with the reproduction of the herd, increasing the level of fattening and meat qualities of young pigs, obtained using different breeding schemes. Achievement of this goal is impossible without the use of genetic-molecular techniques for the creation of populations of herds of pigs, with a high and stable level of productivity. This is a prerequisite for the economically expedient operation of specialized pork farms.

One of the factors for accelerating the breeding process in the pig breeding industry is the use of marker-associated selection (MAS) [18, 4, 13, 8]. This direction allows the creation of herds of animals with a high reproductive capacity of sows and breeders, fattening and meat qualities of their offspring. Such a practice in animal husbandry has already been launched in a number of foreign countries, as well as in Ukraine.

Domestic and foreign scientists conduct a lot of research on the use of genetic methods in breeding work. Kostenko et al. [10], Yepishko et al. [16] studied the association of the polymorphisms of the EHR, PRLR, FSHβ and RYR1 genes and showed a positive effect of combining the desired genotypes with the reproductive function of sows and buds. In this case, the frequency of occurrence of the genotype ESRVVFSHßBV, which positively affects the reproductive function of the pediatricians, was 12 %.

The problem of the use of the relationship of DNA markers in the selection of pigs was also studied by Bannikova [2], Het'mantseva et al. [5], Domashova [3], Zinov'ieva et al. [17] and others.

The above determines the relevance and vector of our research and meets the requirements of the present to solve the problem of organizing economically feasible production of competitive pork in Ukraine.

MATERIALS AND METHODS

The aim of the work was to study the peculiarities of the growth, development and fattening characteristics of young pigs of different genotypes evaluated by the MC4R gene (marker of meat and fattening qualities) and to establish its association with animal productivity indices. The object of research was sows, puppets, pedigrees and young animals of large white pigs. In this case, genetic, genetic, zootechnical, laboratory, statistical, and economic methods were used. The place of research is the Animal Livestock Laboratory of the Institute of Grain Crops and Genetics of the Institute of Pigbreeding and AIP of the National Academy of Agrarian Sciences, «Druzhba-Kaznacheevka» LTD of the Dnipropetrovsk Region.

The estimation of young pigs on the basis of growth, development and fattening qualities was carried out taking into account the following absolute and integrated indicators: absolute (kg), average daily (g) and relative (%) increments of live weight from birth to age reaching a live weight of 100 kg; Body length at the age of 6 months, cm; girth of the breast for shoulder blades at 6 months, cm; age of achievement of live weight 100 kg (days); Eyrosomy Index and Wangen Index (1):

$$ILN = \frac{n}{2.5 - (\frac{x_{max} - x_{min}}{\overline{X}})} \quad (1)$$

where: ILN – index of the leveling of the sow's nest for the live weight of piglets on the date of their birth, points; n – multiplicity of sow, heads; 2.5 – the maximum indicator of live weight of one piglet on the date of birth, kg; x max – live weight of the heaviest piglet in the nest, kg; x min – live weight of the easiest piglet in the nest, kg; $\overline{X}$ – average live weight of piglets in the nest on the date of birth (large sows), kg [6];

$$I = B + (2 \times H) + (35 \times G) \quad (2)$$

where: B – the number of live piglets on the date of the nation (sowing multiplicity), heads; H – number of piglets on the date of receipt, heads; G – middle-dredged growth of livestock mice piglets before weaning, kg [9];

$$\text{Index of eurysomya} = \frac{\text{chest girth behind the shoulder blades}}{\text{length of trunk}} \times 100\ \% \quad (3)$$

$$I = \frac{1}{\sigma_{AD}} \times AD + \frac{1}{\sigma_{TF}} \times TF, \quad (4)$$

where: I – Wangen index, AD – average daily gain of live weight from birth to achieve a living weight of 100 kg, g; TF – thickness of fat at 6-7 thoracic vertebrae, mm; σ AD – phenotypic standard deviation of the average daily gain of live weight, g; σ TF – phenotypic standard deviation of the thickness of the spike, mm [11].

The index of eurysomya was calculated according to the technique of Akimov et al. [1]. Measuring the thickness of the spike was performed using the Renko Lean Meater Digital Backfat Idic, S / N 46080. Measuring the thickness of the wire rod using the Renko Lean Meater Digital Backfat Idic, S / N 46080.

The economic efficiency of research results was calculated according to the formula:

$$E = C \times \frac{C \times P}{100} \times L \times K, \quad (5)$$

where: E – the cost of additional products, UAH; C – the existing purchase price per unit of product in Ukraine (UAH); P – average productivity of animals; P – average increase of basic production (%), expressed as a percentage of 1 head in the application of a new and improved breeding achievement compared with the productivity of animals of basic use; L – constant coefficient of reduction of the result, which is associated

with additional costs for profitable production (0.75); K – number of animals of a new or improved breeding achievement, heads [9].
Results of researches were worked out statistically according to the method of G. Lakin [12].

RESULTS AND DISCUSSIONS

Experimental sows of large white breed are characterized by the following indices of reproductive ability (n=15): multiplicity equal to 11.4±0.76 heads (Cv=25.92 %), high fertility – 1.32±0.029 kg (Cv=8.48 %), the weight of the nest at the farrowing date is 15.1±0.43 kg (Cv=11.10 %), the level of the sow's nest for the live weight of the piglets at the farrowing date is 6.95±0.479 points (Cv=26.70 %), the number of piglets for the date of weaning at the age of 28-32 days – 9.8±0.29 heads (Cv=11.40 %), the weight of the nest for the date of weaning – 95.3±3.56 kg (Cv=14.48 %), average daily increment of live weight of piglets before weaning – 0.241±0.0101 kg (Cv=13.35 %), index L. Lasha in modification of Berezovsky M.D. – 39.61±1.738 points (Cv=13.16 %). The results of research on the reproductive capacity indices of large white breeds of sows in combination with sucking-pigs of a similar genotype of English and Hungarian breeding are produce in Table 1.

Table 1. Indices of reproductive capacity of sows of large white breed (LTD «Druzhba-Kaznacheevka» of Dnipropetrovsk region)

Indicators (signs)	Biometric Indicators	Combination	
		GV × GVES	GV × GVUS
Born pigs of all, heads	N	5	10
	$\overline{X} \pm S\overline{x}$	11.0±0.70	12.7±1.30
	Cv,%	14.37	32.58
Including born alive pigs, heads	$\overline{X} \pm S\overline{x}$	10.8±0.58	11.8±1.123
	Cv,%	12.07	30.10
Weight of the nest at birth, kg	$\overline{X} \pm S\overline{x}$	15.1±0.80	15.4±0.54
	Cv,%	11.91	11.34
Femininity, kg	$\overline{X} \pm S\overline{x}$	1.40±0.008	1.34±0.044
	Cv,%	1.27	10.36
Leveling nests for live weight of piglets at birth, points	$\overline{X} \pm S\overline{x}$	7.34±0.401	6.76±0.699
	Cv,%	12.23	32.68
Number of piglets before weaning, heads	$\overline{X} \pm S\overline{x}$	10.2±0.583	9.7±0.33
	Cv,%	12.78	10.92
Mass of the nest at weaning, kg	$\overline{X} \pm S\overline{x}$	94.8±3.67	95.6±5.16
	Cv,%	8.67	17.06
Average daily gain of live weight of piglets before weaning, kg	$\overline{X} \pm S\overline{x}$	0.245±0.004	0.241±0.010
	Cv,%	4.48	13.35
L. Lasha index in modification by M. D. Berezovsky, points	$\overline{X} \pm S\overline{x}$	39.72±1.611	36.61±1.738
	Cv,%	9.06	13.16

Source:Authors' calculations.

The maximum multiplicity indices, the weight of the nest at birth and the weight of the nest at weaning are set in sows of a large white breed of Ukrainian breeding in combination with chicks of a similar genotype of Hungarian breeding.
According to L. Lash's index, in the modification of M.D. Berezovsky, the animals showed a superiority of combinations of Ukrainian breeding moths with breeds of a similar genotype of English breeding.
DNA isolation was carried out using Chelex 100 ion exchange resin Tcserenyuk O.M. [15]. For DNA typing, the PCR-PDRF method was used Stepanov V.I. et al. [14]. PCR was performed using the standard

reaction mixture for the amplification of «Fermentas» (Lithuania) on the Tercik-2 amplifier (DNA technology, Russia) according to the program: denaturation - 94°C 0.5 min, hybridization of primers - 60°C for 0.5 minutes, synthesis - 74° C for 1 min.

For the quantitative analysis of the samples for the melanocortin - 4 receptor gene, an endonuclease TaqI, (MBI Fermentas, Lithuania), using a T ↓ CGA incision, has a restriction temperature of 65 ° C. This process was performed by electrophoresis in a 2.0 % agarose gel.

Visualization was carried out by staining an agarose gel with bromide ethidium with subsequent revision in ultraviolet light on a transilluminator. Photo documentation was performed by a digital camera «Canon».

It was established that the number of animals with genotype AA is 30, GG - 3 heads and AG - 27 heads.

In the study of the peculiarities of growth, development and fattening characteristics of young pigs of different genotypes evaluated by the MC4R gene, it was found that by weight at birth, no significant difference was established between animals (0.05 (td=0.69, P>0.05) – 0.08 kg (td=1.095, P>0.05) (Table 2).

Table 2. Meat and fattening qualities of young animals

Indicators	Biometric Indicators	Genotype		
		AA	GG	AG
Live weight at birth, kg	n	30	3	27
	$\overline{X} \pm S\overline{x}$	1.51±0.028	1.56±0.067	1.48±0.031
	Cv,%	10.49	7.37	11.07
Weight at removal, kg Washing	$\overline{X} \pm S\overline{x}$	9.4±0.23	8.9±0.63	9.9±0.26
	Cv,%	13.61	12.11	13.67
Live weight at 90 days of age, kg	$\overline{X} \pm S\overline{x}$	35.9±1.01	31.0±1.52	36.2±2.34
	Cv,%	15.28	8.53	33.67
Live weight at the age of 6 months, kg	$\overline{X} \pm S\overline{x}$	104.7±0.65	103.3±2.02	103.0±0.64
	Cv,%	3.44	3.42	3.26
Absolute growth of live weight from birth to achieve a live weight of 100 kg,	$\overline{X} \pm S\overline{x}$	102.5±0.65	101.7±2.08	101.5±0.65
	Cv,%	3.48	3.54	3.34
Average daily gain of live weight from birth to achievement live weight 100 kg.	$\overline{X} \pm S\overline{x}$	0.576±0.0040	0.582±0.0086	0.559±0.046
	Cv,%	3.82	2.54	4.29
Overall growth of live weight from birth to achieve a live weight of 100 kg, %	$\overline{X}$	194.2	193.9	194.1
Age of achievement of live weight of 100 kg, days	$\overline{X} \pm S\overline{x}$	171.2±1.19	169.0±2.38	176.1±1.45
	Cv,%	3.80	2.44	4.29
House density of 6-7 thoracic vertebrae, mm	$\overline{X} \pm S\overline{x}$	23.7±0.40	20.0±0.57	22.1±0.45
	Cv,%	9.28	5.00	10.78
Length of the body in 6 months, cm	$\overline{X} \pm S\overline{x}$	115.7±0.32	114.9±0.47	116.2±0.37
	Cv,%	1.52	0.87	1.69
Heat of breast with shoulder blades at 6 months, cm	$\overline{X} \pm S\overline{x}$	108.3±0.42	107.6±0.34	109.4±0.61
	Cv,%	2.16	0.54	2.93
Index of eyrosomya, points	$\overline{X} \pm S\overline{x}$	93.60±61	93.62±0.55	94.14±0.41
	Cv,%	1.72	1.02	2.32
Index of O.Vagen, points	$\overline{X} \pm S\overline{x}$	36.96±0.237	59.36±1.139	32.73±0.304
	Cv,%	3.51	3.32	4.82

Source: The table is filled based on [7].

At 90 days of age, the difference between animals in the genotype AA, AG and peers GG was 4.9 (td=2.70, P<0.01) and 5.2 kg (td=1.86, P>0.05) respectively. It was established that during the period of control feeding of animals, the genotype GG was characterized by maximum daily average increments of live weight (0.582±0.0086 kg) and the minimum value of the sign «age of reaching a living weight of 100 kg, days» (169.0±2.38 days). Compared to those of other genotypes (AA and AG), the difference according to these indices was 0.006 (td=0.63, P>0.05) – 0.023 kg (td=0.50, P>0.05), 2.2 (td=0.83, P>0.05) – 7.1 days (td=2.62, P<0.05).

The absolute and relative growth of live weight from birth to reaching a live weight of 100 kg varied from 101.5 (AG) to 102.5 kg (AA) and from 193.9 (GG) to 194.2 % (AA) .

In the thickness of the spike at the level of 6-7 thoracic vertebra, the difference in favor of young pigs with genotype GG was 3.7 (td=5.78, P<0.001) – 2.1 mm (td=3.08, P<0.01)

The length of the body, the circumference of the breast of the shoulder blade and the index of the eyrosomy of the genotype AG dominated the peers of other genotypes (GG and AA) by 1.3 (td=2.21, P<0.05) – 0.5 cm (td=1.04 , P>0.05), 1.8 (td=2.61, P<0.05) – 1.1 cm (td=1.50, P>0.05) and 0.52 (td=0.76, P>0.05) – 0.54 points (td=0.72, P>0.05).

The maximum index of O. Wangen's index was found in animals of the genotype GG, which is 44.86 (td=22.76, P<0.001) and 37.73 % (td=32.52, P<0.001) more than that of genotypes of the same age (AG and AA).

CONCLUSIONS

Polymorphism by the MC4R gene indicates the potential and effectiveness of marker breeding of the large white breed pigs of the LTD «Druzhba-Kaznacheevka» of the Dnipropetrovsk region.

The true difference between animals of different genotypes (GG, AA and AG) is based on live weight at 3 months of age (4.9-5.2 kg), age of achievement of live weight of 100 kg (GG -Ag, at 7.1 days), thickness of the sphincus at the level of 6-7 thoracic vertebrae (GG - AA - by 3.7 mm, GG - AG - by 2.1 mm), body length and chest circumference at the age of 6 months (AG - GG, 1.3-1.8 cm). According to O. Wangen's index, the GG genotype is an essential advantage in animals. Compared to the peers of the genotype AA and AG, the difference was 44.86-37.73 %.

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